Environmental
Programs

# Introduction to Fugitive Emissions Monitoring

**Self-Instructional Manual**
*APTI Course SI: 380*
*First Edition*

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# Course Description

This course provides introductory level information relating to the source and control of fugitive VOC (Volatile Organic Compounds) and VHAP (Volatile Hazardous Air Pollutant) emissions through the application of a leak detection and repair (LDAR) program.

The most important aspects of this course are the introduction and definitions/descriptions of basic terms, processes, and equipment related fugitive VOC and VHAP emissions

## Objectives

The course is made up of seven lessons that meet the following course objectives: (Throughout the remainder of the course, all references to fugitive emissions will assume emissions of VOC and VHAP types only.)

1. Identify the regulations related to fugitive emissions
2. Identify the sources capable issuing fugitive emissions
3. Identify the equipment capable of issuing fugitive emissions
4. Describe the components of the LDAR (leak detection and repair) program
5. Identify the test equipment used to detect fugitive emissions
6. Identify the performance specifications for Federal Reference Method 21

# Lesson 1

## Introduction

This lesson introduces the subject of fugitive emission detection and control. The material presented in this lesson will be amplified with more detailed discussions in the following lessons.

**Objectives**

Upon completion of this lesson, the student should be able to:

1. Identify the source categories that are regulated for fugitive VOC emissions
2. Identify the equipment regulated under fugitive emission standards
3. Describe the components and process steps of a leak detection and repair (LDAR) program

## Sources of Air Pollution

In discussions of air pollution sources, four terms are routinely used:

- mobile sources
- stationary sources
- point sources
- area sources

Mobile sources are generally related to transportation. Mobile sources are not included within the general parameters for fugitive emissions and, therefore, will be given no further consideration in this course.

Stationary sources define emission sources that are fixed and include all forms and types of manufacturing, chemical and petroleum processing, power generation, and small business facilities.

A stationary point source refers to any place within a facility from which emissions are possible. For a given facility, a stack may be one point source. An emission leak within a process is also considered a point source. An automobile or a truck would represent a point source or mobile source.

Area source refers to any one of several sources contributing to the air pollution of a given geographic area. Area sources may be stationary, mobile, or a combination of stationary and mobile.

## What Are Fugitive Emissions?

The term, fugitive emission, as used in air quality control, generally refers to any emission escaping from regulated processes (sources) other than via the designed release point (smoke stack, etc.). The point source for a fugitive emission is simply called "a leak." These leaks and emissions are most often associated with the equipment necessary for the movement of process fluids and gasses.

The term "fugitive" is used because these emissions are neither calculated in the source design, captured by the emission control equipment/systems, nor are they detected through normal equipment monitoring processes. Since these emissions bypass control equipment, they are also referred to as "uncontrolled emissions."

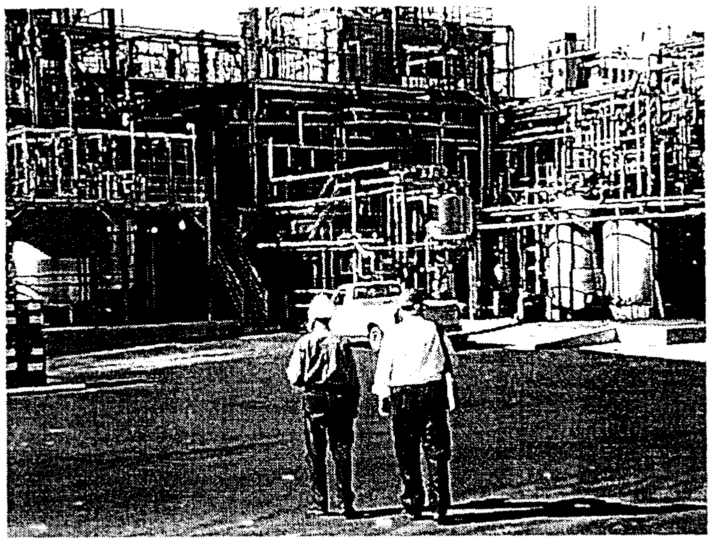


Figure 1-1 Chemical Processing Plant

Figure 1-1 is a picture of a chemical processing plant. From the picture you can readily see that there are miles of pipes. These pipes have numerous connections to process equipment, and each connection (and possibly each piece of equipment, point source) represents a possible source for a fugitive VOC leak.

## *What Equipment is Regulated?*

The equipment regulated under fugitive emission standards are:

- pumps
- valves
- compressors
- pressure relief devices
- sampling connections
- open ended valves and lines
- flanges (connectors)
- product accumulator vessels
- agitators

Each of these pieces of regulated equipment will be described in more detail in following lessons.

## *What Source Categories Are Regulated?*

Basically, any fugitive emission from within a facility governed by New Source Performance Standards (NSPS), National Emission Standards for Hazardous Pollutants (NESHAP), Hazardous Organic NESHAP (HON), and Maximum Achievable Control Technology (MACT) rules is subject to regulation. These sources include SOCMI, petroleum refineries, benzene, and vinyl chloride facilities.

## *The Need For Regulation*

The question may arise: "Since fugitive emissions are leaks, it would follow that they represent only a small source of emissions, therefore why must they be regulated?"

While any single leak is certainly inconsequential, an accumulation of many leaks from any source or group of sources constitutes a major release of pollutants into the air.

Figure 1-2 provides a glimpse of estimated emissions from three types of sources. It doesn't take much inspection to see that in each case, a very large percentage of emission reduction is possible by eliminating, or reducing, uncontrolled emissions.

| **Source** | **Total Emissions** | **Uncontrolled** | **Controlled** | **% Reduction Possible** |
|---|---|---|---|---|
| Refineries | 73,700 tpy | 53,900 tpy | 19,800 tpy | 73 |
| SOCMIs | 132,000 tpy | 91,500 tpy | 40,700 tpy | 69 |
| Benzene | 11,450 tpy | 8,700 tpy | 2,750 tpy | 75 |
| **Total** | **217,350 tpy** | **154,100 tpy** | **63,250 tpy** | **71** |

Figure 1-2 Uncontrolled Emissions Impact

# Agency Leak Detection and Repair Program (Process Steps)

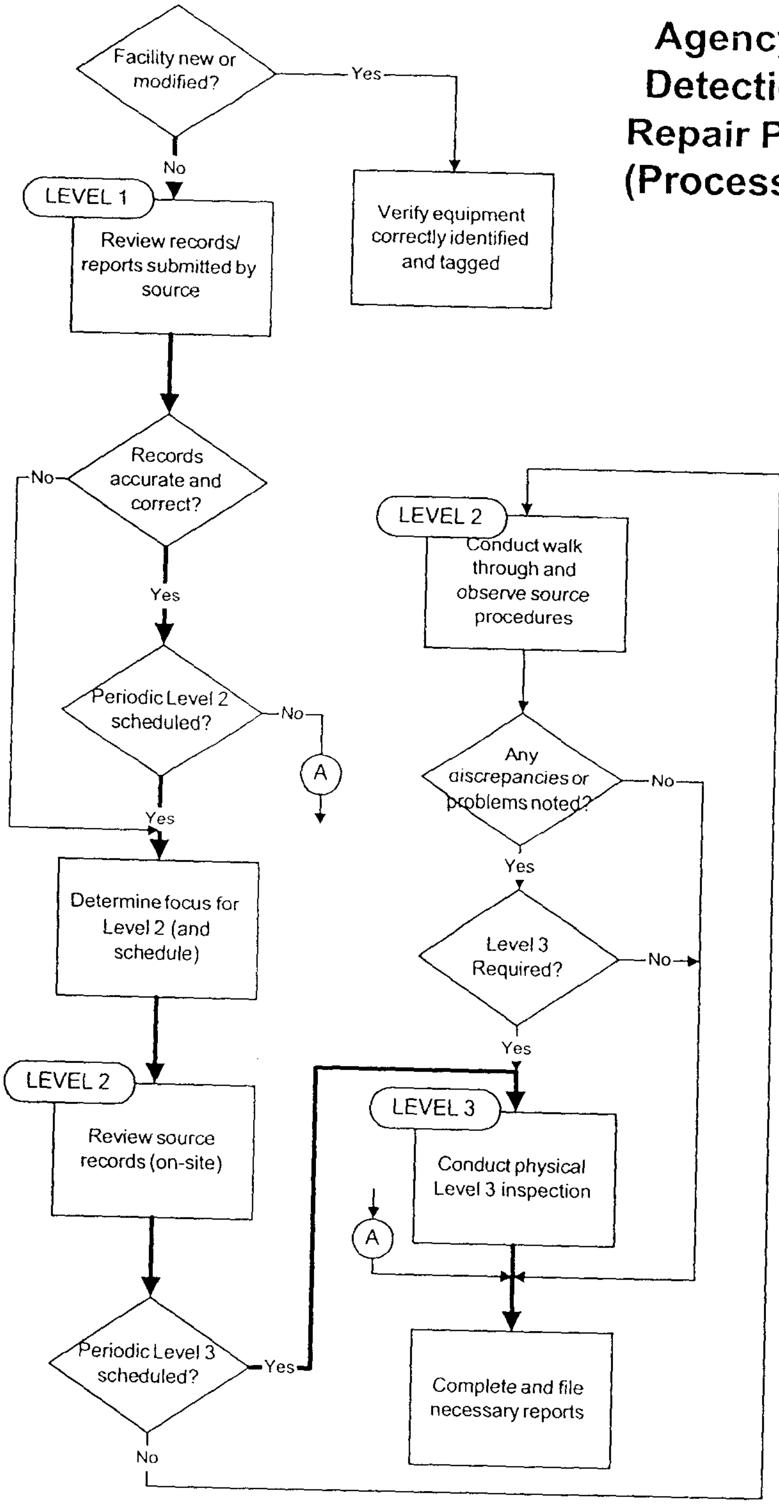



Figure 1-3 LDAR Flow

The regulations governing fugitive emissions will be described in the next lesson.

## How Are Fugitive Emissions Detected and Controlled?

The answer to this question is the basis for this self-study course and Course 380 – *Inspection Techniques for Fugitive VOC Emission Sources*. Implementation of an agency leak detection and repair (LDAR) program provides the framework for locating, documenting, and verifying leak (fugitive emissions) repairs in affected facilities. It should be noted here that the term "agency" refers to the regulating authority (state and/or local).

The agency LDAR program is implemented at three levels (Figure 1-3) as follows:

1. Level 1: Pre-inspection record review at the agency office.
2. Level 2: Onsite inspection of source records and a facility walk through and observation
3. Level 3: Onsite inspection with the inspector conducting the monitoring and testing

The agency program should include a checklist designed to optimize agency time and talents when performing a source inspection. If all records and reports are in order as determined by a Level 1 review, then no further review of the source is required at this time. However, if the Level 1 review indicated deficiencies, then the inspector goes to the site and performs a Level 2 review, including comparison of Level 1 records with on-site records and a "walk-through" of the facility. If, then, deficiencies are discovered, the inspector performs a Level 3 inspection to verify compliance with the fugitive VOC leak regulations. At this point the source may be required to strengthen its QIP and LDAR programs.

Before going further, it is important to understand that the source is responsible for compliance with all applicable regulations. Therefore, the normal periodic monitoring and testing of all regulated equipment is generally conducted by the source or by an outside consultant hired by the source. Since many source facilities capable of generating fugitive emissions have literally thousands of possible emission points, the agency inspector cannot be expected to personally inspect every point source at every facility.

### The LDAR Inspection Program

As a preface for the material to be presented in the remainder of the course, let's follow an agency inspector on an ideal inspection. Figure 1-3 provides an overview of the main components of an agency LDAR program and it provides a road map for the Internet slide presentation that follows.

Return to your Internet home page and select "Slide Show. You will view an audio/slide presentation providing an overview of an agency LDAR program

The script/text for the on-line slide presentation is provided in Appendix A

## Lesson 1 - Self-Test

1. Fugitive emissions are generally identified with which of the following sources:
   a. Mobile source
   b. Stationary source
   c. Both a and b
2. (True/False) Emissions from a stack, if not within specifications/limits, are classified as fugitive emissions.
   a. True
   b. False
3. Fugitive emissions are governed under which of the following regulations?
   a. HON
   b. MACT
   c. NESHAP
   d. NSPS
   e. All of the above
4. (True/False) Fugitive (uncontrolled) emissions need to be regulated since they represent more than twice the emissions from controlled sources.
   a. True
   b. False
5. Which level(s) of an LDAR inspection are conducted at the agency location?
   a. Level 1
   b. Level 2
   c. Level 3
   d. Level 1 and 2
   e. Level 2 and 3
6. Which level(s) of an LDAR inspection are conducted at the source location?
   a. Level 1
   b. Level 2
   c. Level 3
   d. Level 1 and 2
   e. Level 2 and 3
7. A walk-through inspection is conducted as part of a Level ___ inspection.
   a. Level 1
   b. Level 2
   c. Level 3
   d. Level 1 and 2
   e. Level 2 and 3

# Lesson 1 - Self-Test Answers

1. b
2. b
3. e
4. a
5. a
6. e
7. b

# Lesson 2

## Regulations Affecting Fugitive Emission Monitoring

Ground level ozone is a pervasive pollution problem throughout the United States. Ozone is formed readily in the atmosphere by the reaction of volatile organic compounds, or VOCs, oxides of nitrogen (NOx), heat and ultraviolet light, which are most abundant in the summer. NOx is emitted from motor vehicles, power plants, other sources of combustion and natural sources including lightning and biological processes in the soil. VOCs are emitted from a variety of sources including motor vehicles, chemical plants, refineries, factories, consumer and commercial products, other industries and natural (biogenic) sources.

The purpose of this lesson is to provide an "overview" of the regulations affecting fugitive VOC emissions into the atmosphere in order to minimize the ground-level concentrations of ozone

### Objectives

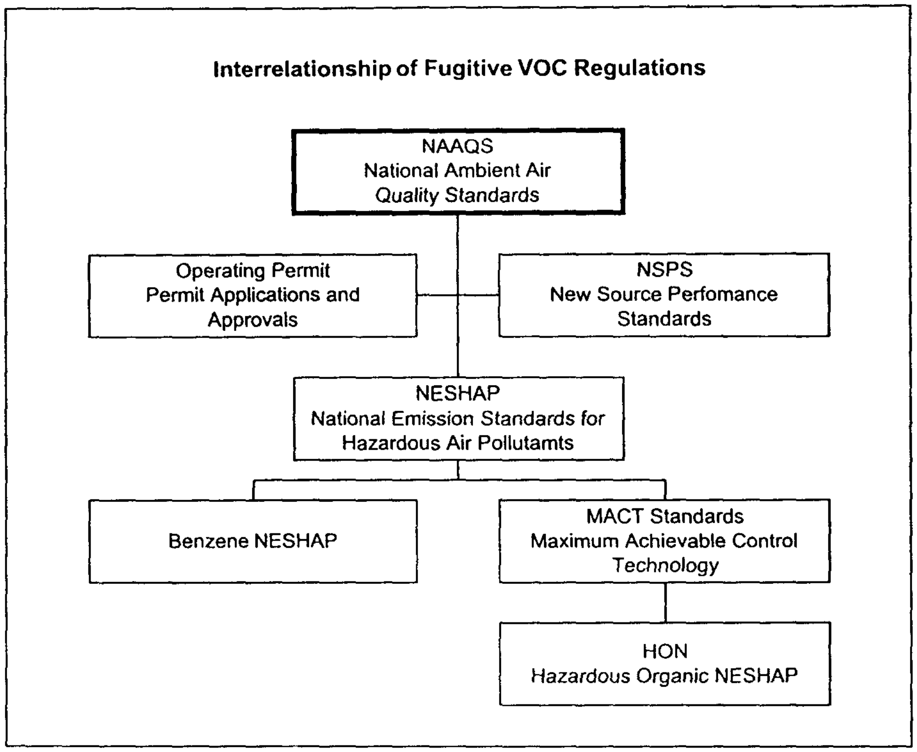
Upon completion of this lesson, the student should be able to:

1. Identify major programs and regulations related to fugitive emission monitoring
2. Identify regulations pertaining to the fugitive emissions
3. Define or describe the function/purpose of LDAR and QIP

## Fugitive VOC regulations

The control of fugitive VOC emissions from equipment leaks are found in various EPA regulations. A majority of them are found in the New Source Performance Standards (NSPS), the National Emission Standards for Hazardous Air Pollutants (NESHAPs) and the Hazardous Organic NESHAP (HON). Under these regulations, various industries are affected and must control their fugitive VOC emissions.

The following chart shows the interrelationship of the fugitive VOC regulations.




The NAAQS have been in effect for over 30 years and apply to six criteria pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide ($NO_2$), Sulfur Dioxide ($SO_2$) ozone ($O_3$), and particulate matter ($PM_{2.5}$). To meet the NAAQS standards throughout the United States, EPA established the NSPS program to regulate the emissions of pollutants from new sources. The NSPS program was implemented to prevent new pollution problems from developing and to enhance air quality as the Nation's industrial base is replaced. Existing sources are regulated through State Implementation Plans (SIPs) that incorporate all federal programs.

All regulations, working together are intended to minimize the emissions of VOCs from equipment leaks in regulated processes. As an example, the HON regulations were established to control fugitive emissions from the Synthetic Organic Chemical Manufacturing Industry (SOCMI) industry account for more than 35 % of the total VOC emissions within that industry.

## Philosophical timeline

The development of the regulations from the early 1970's until the present has changed "philosophically." The early NSPS standards were performance base-standards, where the best available control technology (BACT) was applied to control both criteria and non-criteria pollutants. As the air toxic problem increased in the US during the middle to late 1970s, the EPA required sources to install better pollution control devices at their facilities through the NESHAP regulations. The objective was to control HAP emissions to a "zero risk level of protection" for the population. However, the NESHAP program has regulated few HAPs due to the extensive laboratory testing that required to prove that the chemical was carcinogenic. To date, there are only seven (7) NESHAPs that are regulated at selected regulated facilities. They are asbestos, mercury, beryllium, vinyl chloride, benzene, radionuclides, and arsenic.

- Asbestos — March 31, 1971
- Mercury — March 31, 1971
- Beryllium — March 31, 1971
- Vinyl Chloride — Dec. 24, 1975
- Benzene — June 8, 1977
- Radionuclides — Dec. 27, 1979
- Arsenic — June 5, 1980

## A short history of the passage of the CAAA of 1990

The lack of the ability to control HAP emissions from industrial sources, continued violations of the NAAQS, increased emissions from automobiles, and the growing concerns with long-range transport of $SO_2/NO_x$ and acid rain, resulted in Congress passing the Clean Air Act Amendments of 1990 (CAAA of 1990).

There were eleven titles associated with the CAAA of 1990. The two titles that affect the control of fugitive VOCs are: Title I, Nonattainment and Title III, Hazardous Air Pollutants (HAPs).

**Titles of the CAAA of 1990**

| | |
|---|---|
| Title I | Nonattainment |
| Title II | Mobile Sources/Clean Fuels |
| Title III | Hazardous Air Pollutants |
| Title IV | Acid Rain |
| Title V | Permits |
| Title VI | Ozone Depletion/Global Warming |
| Titles VII-XI | Miscellaneous, Research, Enforcement |

Under Title I, the control of fugitive VOCs will help in reaching and maintaining the NAAQS for ozone. As of September 1998, 130 areas are still designated nonattainment for all criteria pollutants. Of that, 38 areas are nonattainment for ozone based upon the pre-existing ozone 8-hour standard of 0.12 ppm. [Nonattainment designations based on the revised 8-hour ozone standard of 0.085 ppm will not be designated until late 2000.]

With reference to Title III, the CAAA of 1990 list 188 HAPs which are known to cause or suspected of causing cancer or other serious human health effects or ecosystem damage. HAPs are emitted from literally thousands of sources including large stationary industrial facilities (i.e., power plants), medium industrial chemical facilities of the SOCMI, and small area sources like the neighborhood dry cleaners.

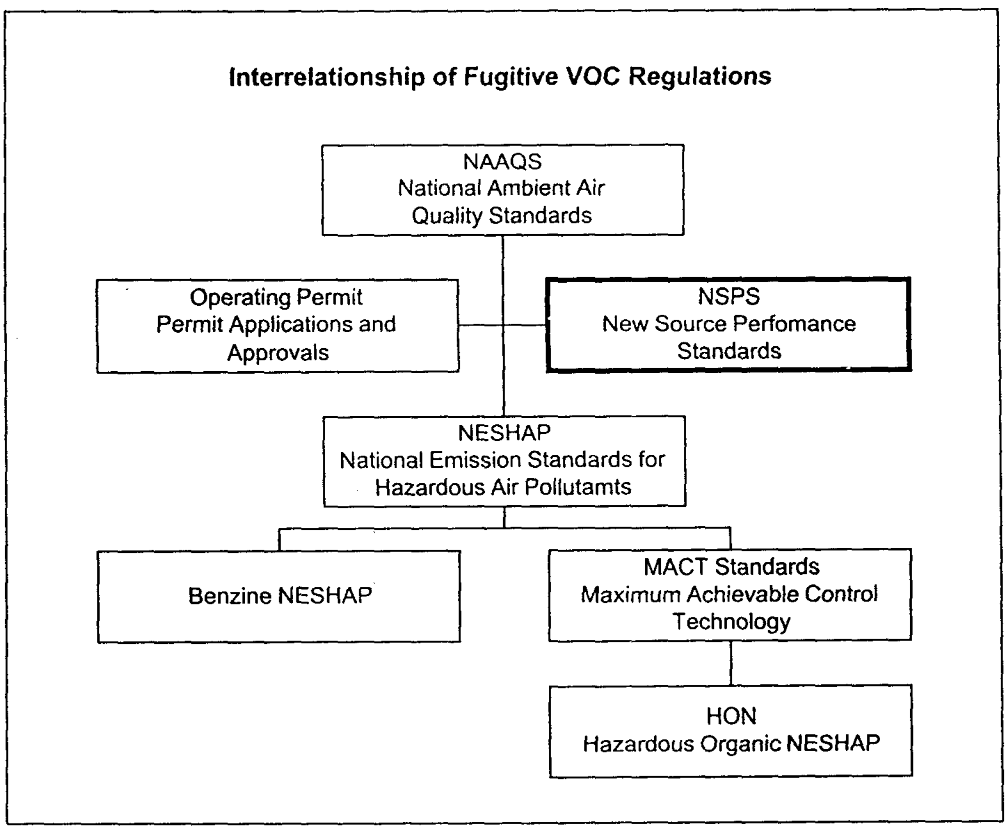
## The effects of Title I and Title III

The key feature associated with Title I is: a new round of updating the SIPs and federal implementation plans (FIPs) to outline how the nonattainment areas are to achieve the NAAQS for ozone. This means tighter emission controls for VOCs, both fugitive and point source, at existing and new facilities.

Under Title III, the EPA has provided a list of designated substances to be regulated by applying MACT to the affected facility. In addition, the Agency can require additional controls to be applied to minimize exposure from the 188 HAPs to a risk level of 1 in 1,000,000 of getting cancer ($10^{-6}$ risk).

The control of fugitive VOCs from affected facilities are implemented through two major regulations as documented in the Code of Federal Regulations (CFR), the NSPS and NESHAP programs.

Let's see how the control of VOC emissions are implemented within the regulatory framework of the Environmental Protection Agency (EPA).



Under Title 40 (The Environment), Part 60 (New Source Performance Standards), EPA has regulated fugitive VOC emissions from process equipment in the following subparts:

| | |
|---|---|
| Subpart VV: | SOCMI |
| Subpart GGG: | Petroleum Refineries |
| Subpart KKK: | Onshore Natural Gas Processing |
| Subpart DDD: | Polymer Manufacturing Industry |

## • *Subpart VV: Synthetic Organic Chemicals Manufacturing Industry (SOCMI)*

Subpart VV defines the leak detection and repair (LDAR) program that is the "backbone" for all regulations containing requirements for controlling fugitive VOC emissions.

Among the items included in Subpart VV are:

1. Standards for process equipment in "light liquid service."
2. Requirements for first attempt to repair equipment when a leak is detected (within 5 days) and maximum days to repair (15 days)
3. Exemptions for pumps with barrier fluids.
4. Stated maximum percent (3%) allowed for "difficult-to-monitor" valves
5. Alternative standards (skip periods) allowed for well controlled fugitive emissions if they represent < 2.0 %.
6. Guidance on implementing Method 21 test procedures
7. Stated recordkeeping and reporting requirements associated with site specific LDAR program
8. List of specific chemical VOCs regulated under Subpart VV

## • *Subpart GGG: Petroleum refineries*

Petroleum refineries are defined in the equipment leak standard applicable to them as; "...any facility engaged in producing gasoline, kerosene, distillate fuel oils, residual oils, lubricants, or other products through the distillation, cracking, or reforming of unfinished petroleum derivatives."

Subpart GGG addresses compressors and the group of all the equipment within a process unit that is in "light liquid service for fugitive VOC emissions " if the chemical makeup of the processing fluid "evaporates to greater than 10 % at 150 C." All components (i.e., valves, flanges, pumps, compressors, pressure relief valves, sampling connectors, and agitators) which are in contact with the process fluid meeting the definition of "light liquid service" is regulated for fugitive emissions under this regulation.

- ***Subpart KKK: Onshore natural gas processing***

  Subpart KKK for Onshore Natural Gas Processing also contains leak detection requirements. Natural gas processing plants are defined as "...processing (sites) engaged in the extraction of natural gas liquids from field gas, fractionation of mixed natural gas liquids to natural gas products or both."

  Subpart KKK specifically includes any compressor station, dehydration units, sweetening units, or liquefied natural gas unit if it is located at an onshore natural gas processing plant.

  The definition of "in VOC service " is the same as that found under the petroleum refinery subpart.

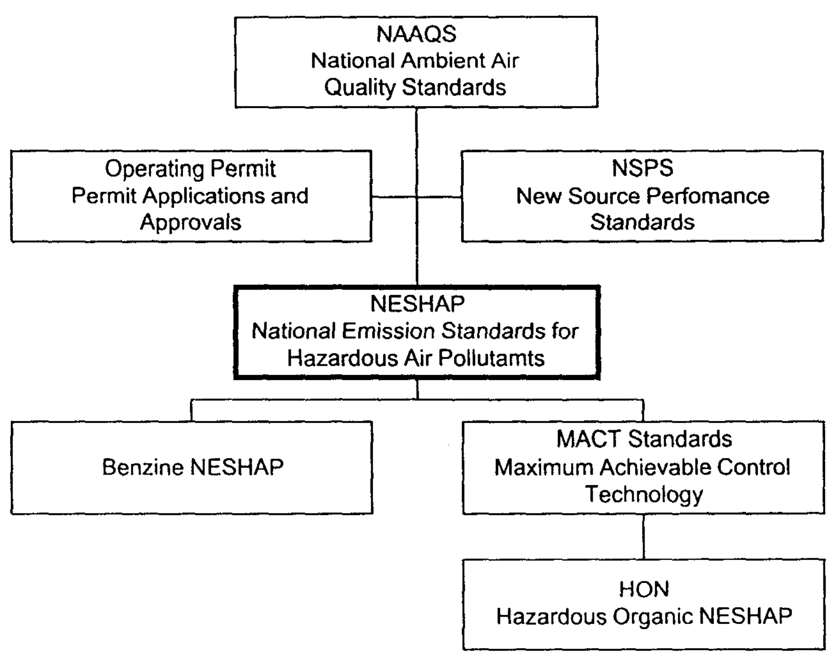
- ***Subpart DDD: Polymer manufacturing plants***

  Similar to the other subparts, Subpart DDD defines *"...in light liquid service"* and applies to those polymer manufacturing plants that produce polypropylene, polyethylene, polystyrene, and copolymers. The percent evaporated is greater than 10% at 150 C. In addition, the same valves and flanges are regulated under this subpart as they have been in previous subparts.

## *Equipment leaks regulations under NESHAP (40CFR 61)*

As previously noted, the control of fugitive VOCs is implemented through two major regulations, the NSPS and NESHAP programs.

**Interrelationship of Fugitive VOC Regulations**



Let's now look at the regulations found under the NESHAP program that addresses equipment leaks of fugitive VOCs.

Those subparts that contain fugitive VOC equipment leak standards, under 40CFR61, are:

Subpart F: Vinyl Chloride

Subpart J: Benzene

Subpart V: Fugitive Emissions Sources (VHAP Equipment Leaks)

Remember, NESHAP regulations were developed to control pollutants that are hazardous because they are carcinogens or cause other serious diseases.

## • *Subpart F: Vinyl Chloride (40CFR61)*

Subpart F of 40CFR61, the vinyl chloride standards, affects plants that produce ethylene dichloride, vinyl chloride, and one or more polymers containing any fraction of polymerized vinyl chloride.

The primary effect of Subpart F implementation was to require a specific monitoring schedule, leak definition, and repair provisions for valves and flanges in vinyl chloride service.

As with other regulations, there are several exemptions. They include:

1. Research and development facilities using < 50 gallons and not regulated
2. Equipment in vacuum service and not regulated
3. Less stringent recordkeeping and reporting requirements if number of leaking valves are < 2% of the total population

## • *Subpart J: Benzene (40CFR61)*

The standard for fugitive emissions for equipment in benzene service (10% by weight benzene) applies to pumps, compressors, pressure relief devices, sampling connection systems, open-ended valves or lines, valves, and flanges and other connectors. This standard applies to individual pieces of equipment that is in benzene service.

Exemptions include:

1. Plant design < 1,100 tons/yr
2. No equipment in benzene service in the process
3. Coke by-product plants
4. Equipment in vacuum service

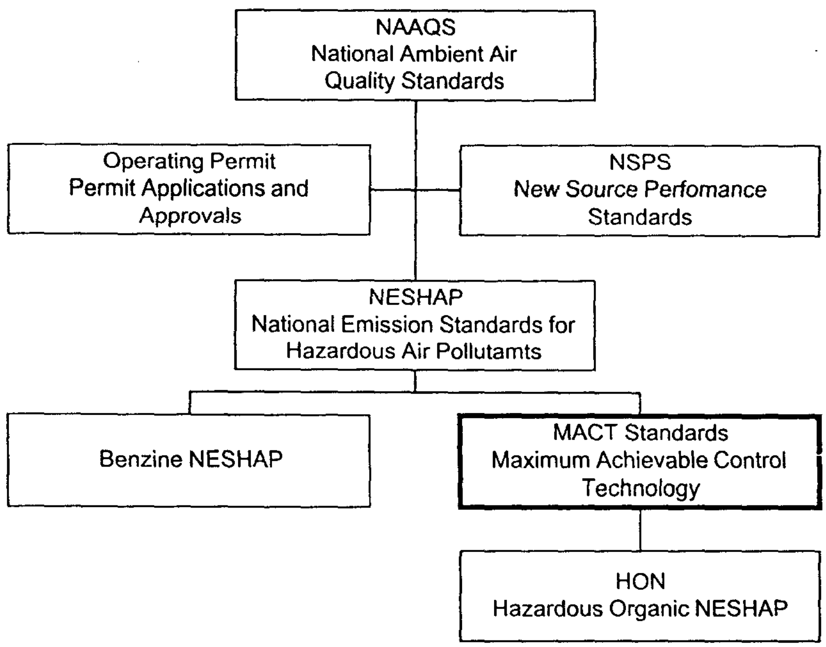
### *Subpart V: Fugitive Emission Sources (40CFR61)*

Covers all equipment that is in contact with the process fluid that is at least 10% by weight a VOC or VHAP

Standard addresses LDAR program requirements similar to those found in Subpart VV of 40CFR60, NSPS.

Now let's look at the MACT standards under the NESHAP program.

**Interrelationship of Fugitive VOC Regulations**



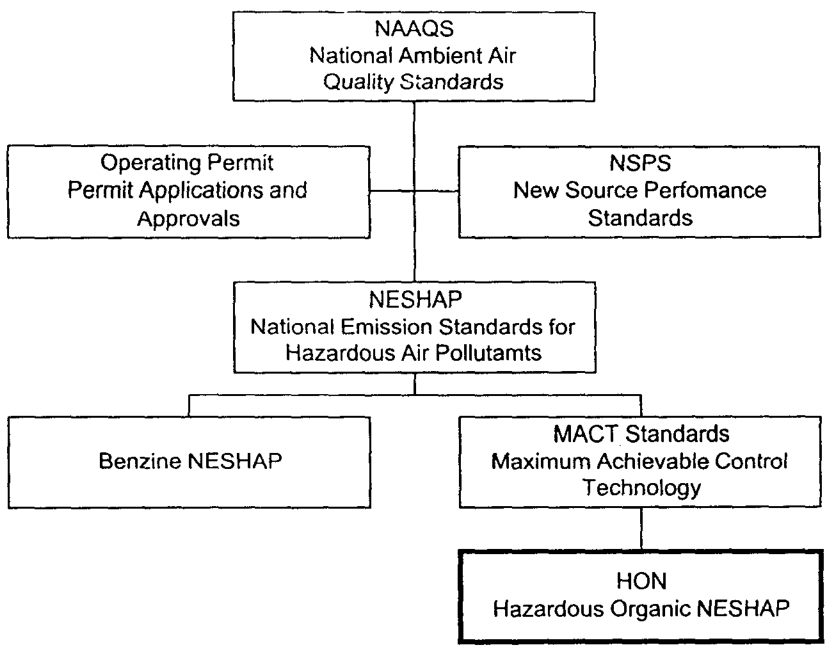

The MACT regulations (Maximum Available Control Technology), as the name implies, requires the use of modern/current technology in control equipment to achieve the maximum HAPs emission reduction possible.

The CAAA of 1990 established a 10-year schedule for MACT standard promulgation for more than 173 source categories. Under this schedule, EPA is to promulgate certain MACT standards in the first 2 years of the program (2-year bin), about 25 percent in the first 4 years (4-year bin), an additional 25 percent not later than the 7$^{th}$ year (7-year bin) and the remaining 50 percent not later than the tenth year (10-year bin) of the program.

- 2 Year Bin: Dry Cleaners (Subpart M) HON (Subpart M)
- 4 Year Bin: Aerospace (Subpart GG) Marine Vessels (Subpart Y)
- 7 Year Bin: Lead Smelting (Subpart X) Shipbuilding (Subpart XX)
- 10 Year Bin: Industrial Boilers Stationary Turbines

Finally, let's look at the regulations under the NESHAP program form the Hazardous Organic NESHAP (HON) regulations.

**Interrelationship of Fugitive VOC Regulations**




The HON regulations can be found in 40CFR63 in Subparts F, G, H, and I, and address four (4) major categories involved with the SOCMI program. They are:

- ***Subpart F (40CFR63)***

  Subpart F contains provisions for determining applicability of the HON, definitions, and general procedures for testing, compliance, reporting, and recordkeeping.

- ***Subpart G (40CFR63)***

  Subpart G defines the specific control, monitoring, reporting, and recordkeeping requirements for SOCMI process vents, transfer operations, storage vessels, and wastewater streams.

- ***Subpart H (40CFR63)***

  Subpart H defines fugitive VOC equipment leaks and emissions from SOCMI

- ***Subpart I (40CFR63)***

  Subpart I provides the definition for non-SOCMI processes subject to the negotiated regulation.

The HON regulates emissions of 111 of the 188 listed organic HAPs as identified in the CAAA of 1990. In addition, the HON also lists 21 specific compounds that are polycyclic organic matter.

At a minimum, the provisions of Subparts F, G, and H apply to chemical manufacturing process units that:

1. Manufacture as a primary product one or more of the chemicals listed in Table 1 of Subpart F; and
2. Use as a reactant or manufacture as a product, by-product, or co-product, one or more of the organic hazardous air pollutants listed in Table 2 of Subpart F.

There are several exemptions associated with the SOCMI regulations. They are:

1. If production capacity for those chemicals listed in Table 1 of Subpart F is less than 1,100 tons/year, then the requirements under the HON do not apply
2. If chemical process uses only heavy liquid in production, the HON requirements do not apply.
3. Beverage alcohol production facilities are not regulated.
4. Equipment that is not in "VOC service" is not regulated
5. Equipment that is in vacuum service is not regulated

### Equipment covered by HON

If the process is in contact with VOCs/VHAPs that are at least 5% of the composite gas stream, the following equipment is subject to the HON rule:

- Pumps
- Valves
- Connectors/flanges
- Compressors
- Agitators
- Closed vent systems and control devices

## Regulation considerations

Remembering that the HON regulation covers 453 organic chemical manufacturing processes and 385 facilities that produce any of the chemicals listed in Table 1 of Subpart F, EPA rule makers were faced with the question, "Can a simple set of rules apply to all SOCMI industrial facilities?" The answer is obviously "No," the rules must be flexible. The rule must achieve lower fugitive emission levels from regulated facilities and equipment and yet be consistent with MACT requirements

Therefore, EPA formed a committee of interested parties (EPA, regulated community, environmental groups, state and local agencies, and a facilitator) so that the concerned parties could negotiate directly to resolve issues and gain a consensus for publication of a final rule. This type of rule making is referred to as "Regulation Negotiation (Reg Neg)."

Prior to Reg Neg, EPA would set the emission standard and it was the source's responsibility to meet that standard or face the penalty.

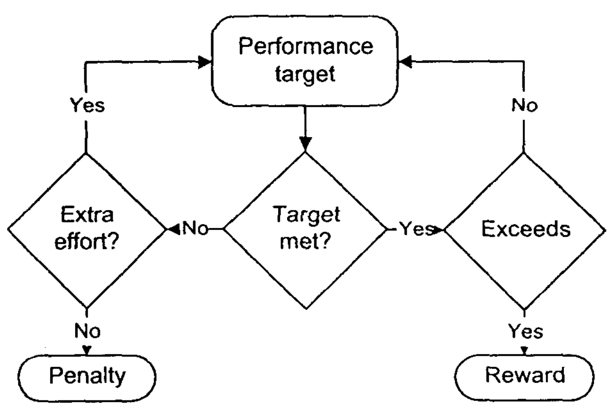



Figure 2-1 Reg Neg Enforcement

Figure 2-1 illustrates the enforcement path for Reg Neg rules. Under "Reg Neg," a source may receive rewards if they exceed emission reduction targets. The traditional penalty is still in place if targets are not met. When targets are not met, the source must implement a stricter monitoring program and develop a Quality Improvement Plan (QIP) which documents how the source is to bring the system back within compliance. If a QIP is developed and executed, the penalty may be avoided.

## *Quality Improvement Program (QIP)*

The QIP enables plants failing to meet base performance levels to eventually achieve the desired levels without incurring penalties or being in noncompliance. Overall, this achieves emission reduction (by replacement of existing components with superior technology) without lengthy enforcement action.

The QIP program involves the source gathering background information, determining superior technologies to replace the poor performing equipment, and replacing the equipment with the superior equipment until the base performance is achieved. However, sources do not like to be forced into a QIP program because it requires by law to replace components with superior technology and the fact that it is the Agency dictating the program.

## *Leak detection and repair program*

An important element of the final HON rule, developed under Reg Neg, was the requirement that a leak detection and repair (LDAR) program be established at a regulated facility. LDAR is the backbone of the fugitive emission monitoring and enforcement activities. LDAR will be discussed in more detail in following lessons.

## Lesson 2 – Self-Test

1. Which of the following standards is the oldest?
   a. HON
   b. MACT
   c. NAAQS
   d. NESHAP
   e. NSPS
2. To date, how many NESHAPs are regulated?
   a. None
   b. 7
   c. 26
   d. 34
   e. >50
3. The hazardous air pollutant definitions appear in _____ of the CAAA
   a. Title I
   b. Title II
   c. Title III
   d. Title IV
   e. Title V
4. The MACT standard is found in ________ of the CAAA
   a. Title I
   b. Title II
   c. Title III
   d. Title IV
   e. Title V
5. SOCMI regulations appear in Part ___ of 40CFR60
   a. VV
   b. GGG
   c. KKK
   d. DDD
6. Fugitive emission source equipment/components are defined in Part ___ of 40CFR61
   a. C
   b. F
   c. J
   d. N
   e. V

7. (True/False)RegNeg provides an avenue for a source to avoid penalties if extra effort is made to meet targets.
   a. True
   b. False

## Lesson 2 – Self-Test Answers

1. c
2. b
3. c
4. c
5. a
6. e
7. a

# Lesson 3

## Fugitive VOC Emission Properties

The ambient air contains hundreds, if not thousands, of air pollutants that may be detrimental to health. The regulations that regulate the emission of air pollutants are very specific concerning the type and quantity of pollutant allowed to be emitted. Regulations even specify the type of control equipment required to minimize the emissions.

Therefore, an inspector needs to know the nature and type of emissions that are regulated in order to do the job correctly.

### Objectives

Upon completion of this lesson, the student should be able to:

1. Define/describe the terms associated with fugitive VOC emission activities
2. Identify the different classifications of air pollutants
3. Identify typical compounds that are regulated under the fugitive VOC emissions regulations

## Classification of Air Pollutants

The two basic physical forms of air pollutants are particulate matter and gases. Particulate matter includes small solid or liquid particles such as dust, smoke, mists, and fly ash. Gases include substances such as carbon monoxide, sulfur dioxide, and volatile organic compounds (VOCs). Both particulate matter and gases contain combination of organic and inorganic constituents.

Pollutants are classified as either primary pollutants or secondary pollutants. A *primary pollutant* is one that is emitted into the atmosphere directly from the source of the pollutant and retains the same chemical form after release. An example of a primary pollutant is the emissions of sulfur dioxide from a fossil-fueled-fired steam generator.

A *secondary pollutant* is one that undergoes a chemical change once it reaches the atmosphere. The reaction in the atmosphere of organic vapors with sunlight and oxides of nitrogen to form ozone is an example of a secondary pollutant.

EPA further identified air pollutants as *criteria pollutants* and *non-criteria pollutants.* Criteria pollutants are the six pollutants identified under NAAQS ( $CO$, $O_3$, $SO_2$, particulate matter,

$NO_2$, and Pb). Non-criteria pollutants are all pollutants other than specified as criteria under NAAQS.

### Regulated Pollutants

The 1970 Clean Air Act established NAAQS and sampling methodologies for criteria pollutants. In addition, the Act established emission limits and monitoring methodology for non-criteria pollutants through the NESHAP program. In 1983, the SOCMI regulations identified an additional set of non-criteria pollutants for emission control.

As part of the CAAA of 1990, EPA published two more lists of non-criteria pollutants to be reviewed. Title I contains a list of non-criteria VOCs that were believed to take part in the complex atmospheric chemistry in the formation of ozone, while Title III contains a list of non-criteria VOCs that are defined as Hazardous Air Pollutants (HAPs).

The 1994 Hazardous Organic NESHAPS (HON) rule adds two more HAP lists of regulated pollutants (Subpart F, Tables 1 and 2) that must be reviewed in determining the applicability of the HON regulations.

### VOC Categories

Based on vapor pressure, EPA has classified VOCs in four categories:

- Very Volatile: >380 mm Hg
- Volatile: 0.1 - 380 mm Hg
- Semi-volatile: 10E-1 to 10E-7 mm Hg
- Non-volatiles: <10E-7 mm Hg

The temperature of the process stream can affect the category under which a VOC will fall.

## Regulatory Definitions

Within the regulations there are terms and definitions important to monitoring fugitive emissions. In the following text, some of the frequently used terms are briefly defined.

- *Volatile organic compounds (VOCs)*, as defined under NSPS/SOCMI regulations, are any reactive organic compound that participates in atmospheric photochemical reactions.
- *Volatile hazardous air pollutant (VHAP)* applies to benzene and vinyl chloride service.
- *Service* is a modifying term used, as you will see in the following definitions, to indicate that the gas or fluid is associated with subject process or product.
- *In VOC service* refers to equipment containing or contacting a process fluid that is at least 10 % VOC (reactive organic) by weight. This NSPS regulation applies only to those compounds in VOV service.
- *In gas/vapor service* refers to equipment that contains process fluid in the gaseous or vapor state at operating conditions.
- *Hazardous Air Pollutants (HAPs)* are those constituents listed in Title III of the CAAA of 1990.

It is important to note that the definitions are general. The actual values used in determining whether a gas or fluid is in a given "service" may vary according to the regulation under which it is being applied.

# *Lesson 3 - Self-Test*

1. A pollutant that changes properties once released into the atmosphere is a _____.
   a. Criteria pollutant
   b. Non-criteria pollutant
   c. Primary pollutant
   **d. Secondary pollutant**
   e. VOC
2. The six pollutants identified in NAAQS are identified as _______________s
   a. Criteria pollutant
   b. Non-criteria pollutant
   c. Primary pollutant
   d. Secondary pollutant
   e. VOC
3. (True/False) VOCs are classified as a primary pollutant.
   a. True
   b. False
4. (True/False) All regulated pollutants are identified in one composite list in the regulations.
   a. True
   b. False

## Lesson 3 - Self-Test Answers

1. d.
2. a.
3. b.
4. b.

# Lesson 4

## Fugitive Emission Sources

The focus of this lesson is to identify the source of fugitive emissions both by industry type and by the equipment used in these industries.

### Objectives

Upon completion of this lesson, the student should be able to:

1. Identify the facilities/industries most prone/susceptible to emitting fugitive emissions
2. Identify equipment defined in the regulations as sources for fugitive emissions
3. For each piece of equipment identify the point(s) where fugitive emissions originate

Petroleum refineries and synthetic organic chemical manufacturing industries (SOCMI) have miles of piping and numerous components through which process gases, liquids, and vapors are transported (flow). The process transport components (valves, fittings, pumps, compressors, pressure relief devices, diaphragms, etc.) in these facilities can leak gases or liquids into the environment. The leaks of light or volatile organic compounds (VOCs) are a concern with respect to their effect on air quality. Fugitive emissions are estimated to be responsible for over 50 percent of the total VOC emissions from refineries and SOCMI sources.

## Major leaking components

NSPS, NESHAP, and HON regulations identify the components in the process transport function that are to be inspected for fugitive emissions (leaks). Those components are:

- Flanges/connectors
- Valves
- Pumps
- Compressors
- Pressure relief devices
- agitators

The thermal stresses, vibrations, effects of corrosion (both within the system and from outside atmospheric conditions), and mechanical wear that the components are subjected to account for the development of leaks and the unwanted emissions. In the remainder of this lesson the components will be briefly described and, where possible, the leak points will be identified and illustrated.

## Flanges and connectors

There are many ways of joining piping sections and process transport equipment together, but three common methods are welds, flanges, and threaded fittings.

1. Many piping connections are welded when disassembly of connections will be unnecessary. Proper welds are practically leak proof connections, but they may fail or corrode.
2. Bolted flanges (Figure 4-1) are a common type of connector used for pipes, valves, and process equipment where disassembly for maintenance may be required. Flanged connections are usually used for piping carrying flammable or other hazardous materials because they are stronger and leak less than screwed fittings. Flanged connections are bolted together with a gasket material, usually made of Teflon, graphite, or polymer material, between the flanges. Leaks can occur between the flanges due to thermal stresses, faulty gaskets or improper tightening of bolts. In practice, flanges are rarely found to leak and are relatively small sources of emissions.
3. Threaded fittings are used for joining small diameter piping (under two inches in diameter). Threaded connections are prone to leaking when they are disassembled regularly. Threaded connections can also break more easily, especially when stepped on or subjected to some other heavy load.

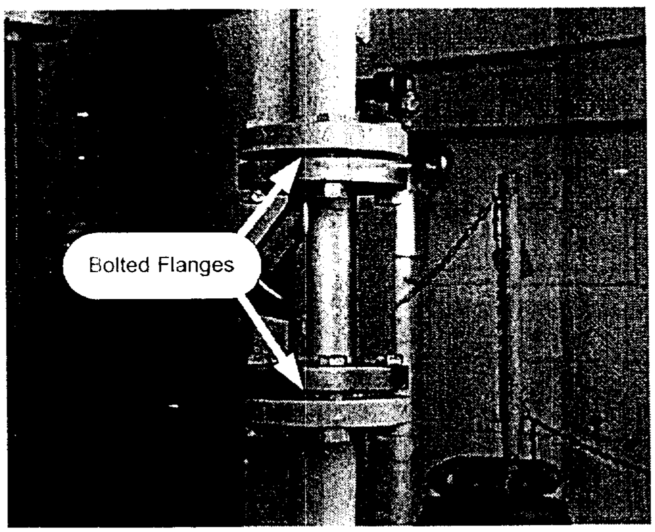



Figure 4-1 Bolted flanges

## Valves

Valves are used to control flow rate, turn a flow on or off, switch flows along different routes of piping, or control the direction of flow of gases or liquids. Many valve designs exist and are employed in refineries and SOCMI facilities. However, regardless of the valve design, the leak points in a valve are basically the same for all designs.

Process valves make up more than 90 % of the process components that must be checked for leaks. Of the total fugitive VOC emissions from a refinery process, valves account for more than 35 % of those emissions and of those valves approximately 85 % of fugitive VOC emissions are from valves controlling gas streams.

Parts of a valve include the body, disc or gate, stem, bonnet, packing or seal, and the handle as illustrated in Figure 2-1. The disc or gate of the valve directly contacts the flow and permits or restricts the flow of the fluid or gas. The stem transfers the action of the handle to the disc or gate to control the flow. The body of a valve houses the valve components and forms the passage route for the gas or liquid. The packing or seal surrounds the stem and provides a barrier between the process liquids and gasses and the outside atmosphere. The bonnet houses the packing or seal and supports the stem. The handle provides for manual operation of the valve. Some valves may be operated by electrical or hydraulic mechanisms rather than by a handle. The parts of a typical valve are illustrated in figure 4-2.

The bonnet may be bolted, breechlocked, or screwed to the body. Bolted bonnets are the most common and are sealed to the body using a gasket.

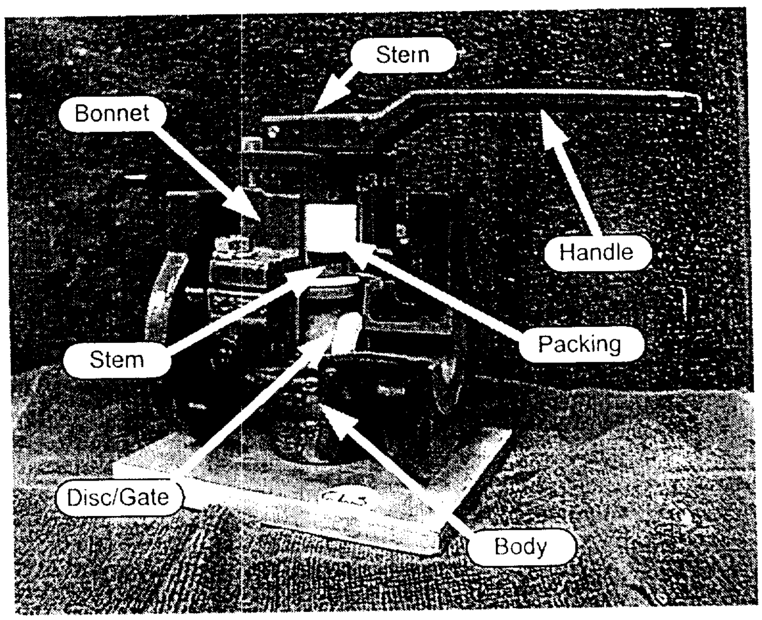



Figure 4-2 Typical valve

Leaks can develop in valves from thermal stresses, vibrations, corrosion, valve stem distortion, packing material failure, and wear. These effects can lead to the misalignment and distortion of sealing surfaces. Potential areas of fugitive VOC emissions from valves include:

- Valve stem at the exit from the housing. Valve stems are packed with laminated graphite, hydrocarbon plastics, and synthetic materials that fail over time and provides a passageway for the emissions.
- Bonnet/housing gasket. Due to extensive wear and operation, the gasket material can become worn and provide a possible area for leaking VOC emissions.
- Valve flange/ connector to intake and output pipe.

Figure 4-3 identifies three common leak points on a valve.

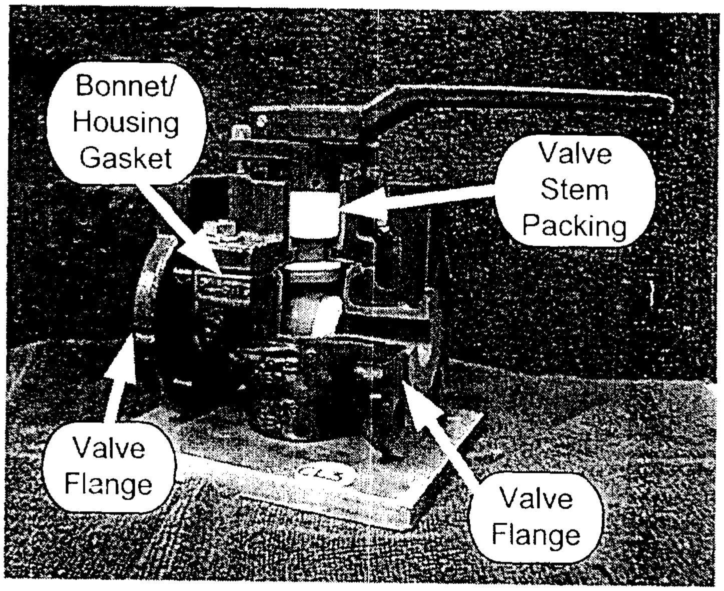



Figure 4-3 Valve leak points

## Pumps

Pumps are mechanical devices that impart energy to a fluid, and are used to provide the power to transport a liquid from one location to another. Two of the more common types of pumps found in the petroleum and SOCMI industries are:

- Centrifugal pumps
- Positive displacement pumps.

Centrifugal pumps have a rotating impeller that provides kinetic energy and static pressure to the fluid.

A positive displacement pump operates on the same principle as a tire pump and the shaft motion is in and out, driving a piston in the pump cylinder/housing.

Regardless of the type of pump, the fluid being moved inside a pump must be isolated from the atmosphere. Isolation is achieved in two basic manners:

1. Using a seal at the interface between the pump and the shaft. Leaks may occur at the point of contact between the shaft and the "seal/stationary casting
2. Using a magnetic coupling between the pump and the drive source (centrifugal pumps). In this case, the motor shaft and the pump shaft are two separate shafts coupled magnetically and no seal is required.

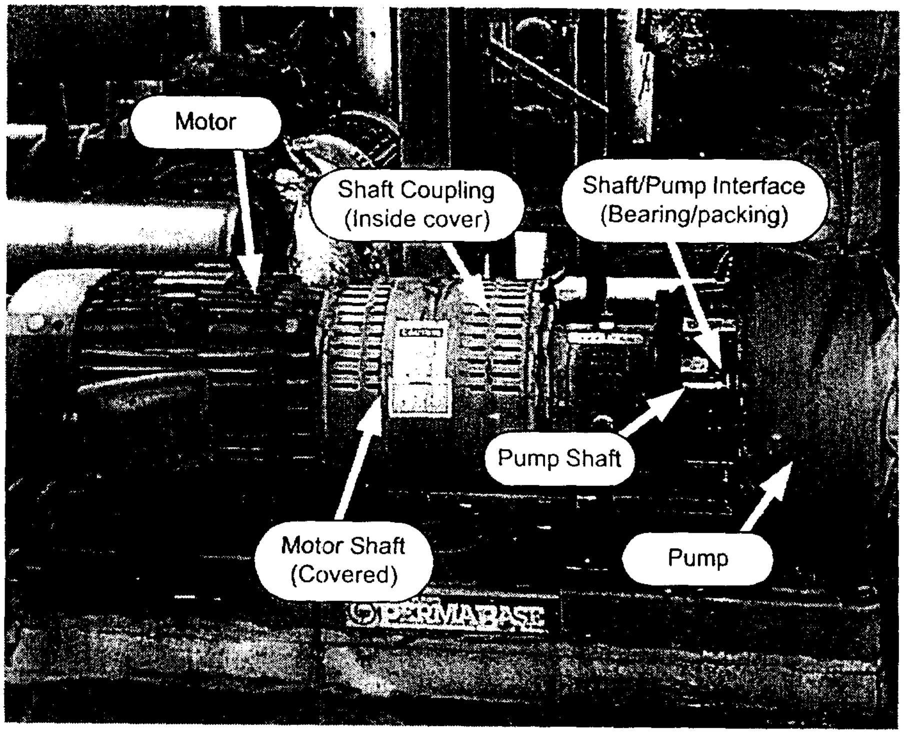



Figure 4-4 Centrifugal pump assembly

In the illustration (Figure 4-4), the motor, motor shaft, and shaft coupling are of no concern when looking for leaks. The interface of the pump shaft and the bearing or packing are the focal point for leaks.

In addition to the shaft/bearing interface, the pump, like the valve, has a body constructed of at least two pieces and held together with bolts. Although not as subject to leaking, the body has the potential. It is interesting to note in figure 4-4 that the pump housing is insulated to minimize fugitive VOCs, making it very difficult to monitor the pump housing joints.

## Compressors

Compressors are used to compress and transport gases. From a "leak" standpoint, a compressor is the same as a pump. Mechanically, they are similar to pumps in that they are generally either reciprocating or centrifugal. Once again, the major source of emissions is the shaft and the compressor housing.

## Pressure Relief Devices

Pressure relief devices [also called pressure relief valves (PRVs) or pressure vacuum valves (PV valves)] are valves that are made to release pressure from a vessel or relieve a vacuum on a vessel. They prevent damage to equipment and are safety feature on most vessels in a refinery.

Engineering codes require the use of pressure relieving devices or systems in applications where the process pressure may exceed the maximum allowable working pressure of the vessel. Typically, relief valves are spring-loaded and designed to open when the system pressure exceeds a set pressure, allowing the release of vapor or liquids into the atmosphere. When the normal pressure is re-attained, the valve reseats and a seal is again formed. Sometimes pressure relief devices will not close properly after they release pressure, so they become a source of fugitive VOC emissions.

The only potential area of leaks with a PRV is the "sealing seat" of the valve which is enclosed in a pipe system (or horn) to allow release of pressure. Monitoring for fugitive VOC emissions would occur at the seating of the valve.

Possible causes of leaks in a PRV:

- "Simmering or popping:" A condition that occurs when the system pressure comes close to the set pressure of the valve
- Improper reseating of the valve after a relieving operation
- Corrosion or degradation of the valve seat.

Pressure relief valves that vent to a flair header or are equipped with upstream rupture disks need not be screened.

## Agitators

Agitators are used to stir or blend chemicals. Like pumps and compressors, agitators may leak organic chemicals at the point where the shaft penetrates the casing. Consequently, seals are required to minimize fugitive emissions. The shaft of the agitator may either be horizontal or vertical.

In figure 4-5, the size of a typical agitator vessel can be observed. Leak points on the vessel are the connections for the process fluid/gasses entering and leaving the vessel and the interface with the shaft and the vessel.

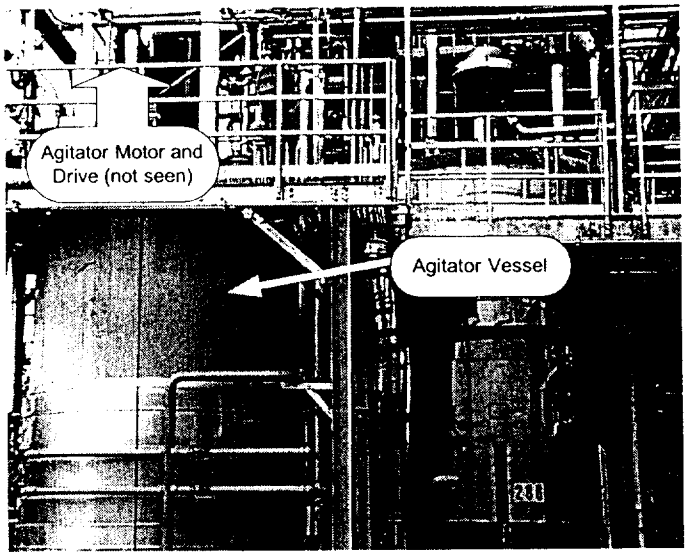



Figure 4-5 Agitator vessel

From a platform at the top of the agitator, the shaft is seen at the interface point with the vessel. The possible fugitive emission point is clearly visible, and is being monitored in this illustration (Figure 4-6).

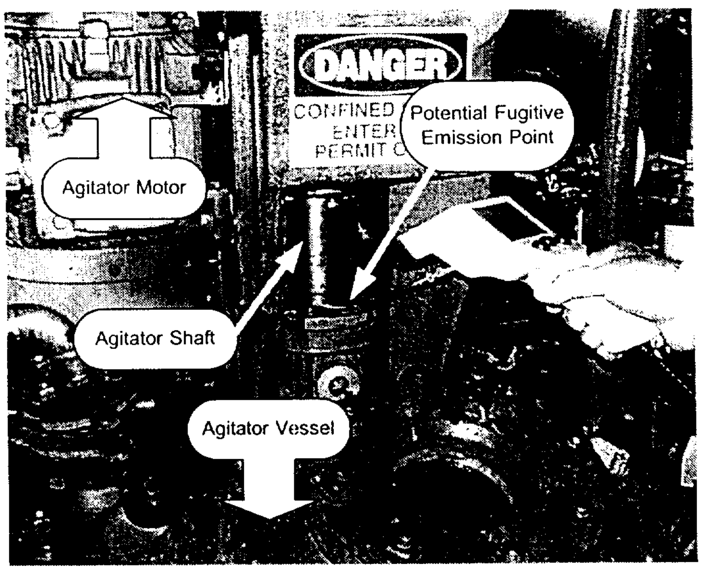



Figure 4-6 Agitator shaft

This lesson has introduced the major components subject to fugitive emission monitoring. Now we know what is to be monitored. The next lessons will introduce how monitoring is to be implemented.

# Lesson 4 Self-Test

1. Which of the following components of a valve would not be susceptible to leaking?
   a. Body/flange
   b. Bonnet
   c. Disk/gate
   d. Packing
   e. Stem
2. Of the three connection methods listed below, which is the most common in refinery and SOCMI facilities?
   a. Bolted flange
   b. Threaded fitting
   c. Weld
3. Which of the following pump components should be examined for leaks?
   a. impeller
   b. Motor shaft
   c. Pump casing
   d. Pump shaft
   e. Shaft coupling
4. (True/False) The components and leak points on a compressor are essentially the same as those for a pump.
   a. True
   b. False
5. Which of the following pressure relief valve conditions is not a fugitive leak?
   a. Corrosion of the valve seat
   b. Excessive/extreme pressure in the system on which the valve is installed
   c. Improper reseating of the valve
   d. Simmering or popping
6. (True/False) The most likely point for a leak on an agitator is at the bearing (interface) of the agitator shaft with the vessel.
   a. True
   b. False

## Lesson 4 Self-Test Answers

1. c
2. a
3. d
4. a
5. b
6. a

# Lesson 5

## Federal Reference Method 21

The various fugitive emission regulations (NSPS, NESHAP, HON, & SIPs) require the use of Federal Reference Method 21 (FRM 21) for determining whether a component leak meets the leak definition found within the individual regulations. It is therefore important to become familiar with FRM 21.

There are a number of analyzers available for the inspector to use in evaluating equipment leaks. However, not all of these monitors meet the specifications of FRM 21.

### Objectives

Upon completion of this lesson, the student should be able to:

1. Identify the basic requirements of Federal Reference Method 21
2. Identify the specifications that apply to analyzing equipment under FRM 21

Federal Reference Method 21 can be found in 40 CFR 60, Appendix A. 40 CFR 60 covers the New Source Performance Standards (NSPS) and Appendix A contains the Federal Reference Methods that must be used in determining emission compliance with in the limits specified in the NSPS.

FRM 21 specifies that a hand-held instrument is to be used in determining VOC leaks from process equipment. FRM 21 does not recommend specific analyzers or manufacturers, but it does define analyzer performance specifications

## Portable VOC Analyzers

Portable VOC analyzers take two basic forms:.

1. A single hand-held units (Figure 5-1) containing all the instrumentation in one unit. The sample is extracted, conditioned, analyzed, and reported within one assembly.
2. The multi-component unit (Figure 5-2) that separates the inlet from the analytical section of the system by way of an umbilical cord. This approach allows greater flexibility in reaching "hard-to-monitor" regulated equipment.

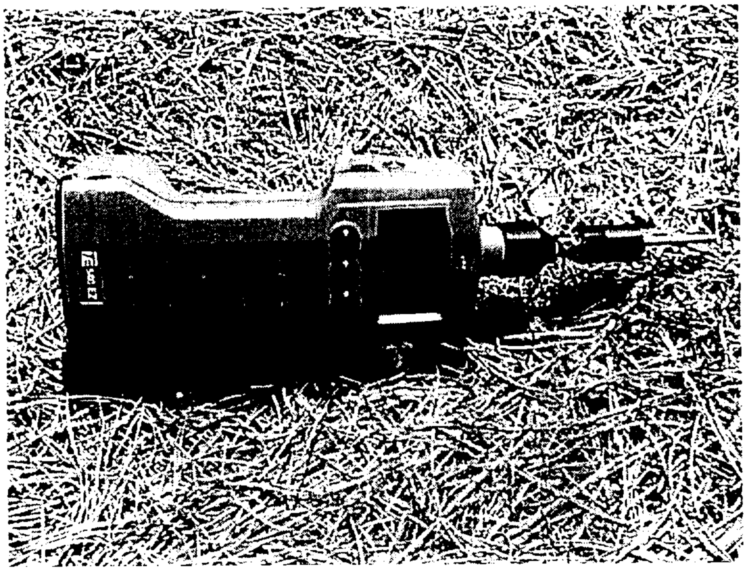


Figure 5-1 Single component hand-held analyzer


Figure 5-2 Multi-component hand-held analyzer

Each analyzer comprises two functional units, the probe mechanism and the analytical assembly. In addition each analyzer will contain a power supply (battery) and support gas(es). In the case of the multi-component analyzer, there will be an umbilical connector between the probe and the analysis unit.

The objective of the probe assembly is to extract a representative fugitive VOC sample from the leaking component and move it to the detector for analysis. To minimize dilution of the gas stream as it is being pulled into the system FRM 21 specifies that the probe opening cannot be greater then 1/4 "outside diameter. Optional components of the probe/interface assembly include bar code reader, meter/readout, and particulate filter.

The analytical assembly normally contains the detector, electronics processing boards, pump, flow control devices, high pressure gas cylinders, power supply, and service panel.

FRM 21 does not specify a particular manufacturer's instrument to be used in determining VOC leaks from process equipment. Rather, FRM 21 requires that portable VOC detection equipment must meet specific instrumentation specifications and certain performance criteria.

The following FRM 21 instrument specifications will be discussed in the following pages::

1. VOC monitor response to the process chemical being tested
2. Measurement range must include the "leak definition"
3. Scale resolution
4. Response time
5. Intrinsically safe
6. Probe dimensions specifications
7. Response factor requirements
8. Accuracy requirements

## 1. Monitor Response

The portable VOC analyzer must be able to respond to compounds being processed and regulated. Two of the most commonly used detectors used in fugitive VOC monitoring are:

1. Flame ionization detector (FID)
2. Photoionization detector (PID)

By far the most widely used detector in portable "total hydrocarbon" analyzers is the flame ionization detector (FID), wherein the gas sample is introduced into a hydrogen/air flame, the VOCs are burned, ionized, and detected. The technique is specific for organic compounds and gives relatively uniform response for the various compounds.

The photoionization detector (PID) is the second most popular detector for VOC analyzers. The PID analyzer also ionizes the VOCs in the gas stream, instead of burning the gas stream it uses high intensity ultraviolet light (UV). Since the ionization potential of a particular compound must be less than the ionization of the UV light energy in order to be detected, this means that the PID is not as "universal" a detector as the FID

## 2. Measurement Range

The portable fugitive VOC analyzer must have a measurement range that encompasses the leak definition. This means that the instrument must be able to detect fugitive VOCs as high as 10,000 ppm and as low as 500 ppm, depending upon the leak definition specified in the regulations.

## 3. Scale Resolution

The third instrumentation specification specified that the scale reading on the analyzer must be readable to within +/- 2.5 % of the specified leak definition concentration when performing a "no detectable emission" survey. For a leak definition of 500 ppm, this means that the scale reading must be readable to 12. 5 ppm and for a 10,000 ppm leak definition, the scale must be readable to 250 ppm.

## 4. Response time

Response time (RT) instrument specification is defined as 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 and displayed on the instrument readout meter. In operation, zero gas is introduced into the instrument and a stable reading is obtained. Then, quickly switch to the calibration gas and measure the time from switching to the time when 90 % of the final stable reading is attained. Perform this activity two additional times to obtain an average of 3 readings for the average response time. Method 21 specifies that that average must be < 30 seconds.

## 5. Safety

The instrument must be intrinsically safe. This is a very important requirement because many of the organic emissions we are attempting to detect as fugitive emissions are explosive.

## 6. Probe Dimensions

To minimize biases from dilution, the maximum outside diameter (OD) of the sample probe can be no greater than ¼". Larger probe OD has the ability to pull surrounding air into the probe, thus diluting the sample and producing a bias in the sampling system. The specification also states that the pump in the instrument must be able to draw a sample gas at a rate of 0.10 to 3.0 L/min into the 1/4 " OD probe opening. The flow rate range was selected after field studies indicated that this range limited the biases of the sampling technique due to sample extraction.

## 7. Response Factor (RF)

This instrument specification requires that the RF be less than 10 for the specific VOC being tested. This specification requires the user to use an instrument that responds within a certain level of reliability and accuracy to the VOC being monitored. The specification requires the user to determine the RF for each of the VOCs being monitored.

A response factor of 1.0 means that the instrument readout is identical to the actual concentration of the chemical in the gas sample. As the RF increases, the instrument readout is proportionally less than the actual concentration. A high RF means that the instrument does not detect the compound very well. A low RF means that the instrument is very sensitive to the compound of interest.

### 8. Accuracy

Similar to the response time test, the instrument specification associated with calibration precision (accuracy) requires a calibration gas to be introduced into the analyzer three time and the average response of the analyzer must be within 10 % of the certified calibration gas value recorded on the calibration gas cylinder. This specification assures that the user is using a well characterized instrument in determining fugitive VOC leaks from process equipment..

## Performance Criteria

Method 21 requires the following checks for each leak detection analyzer to ensure that the analyzer meets Method 21 performance criteria:

- The response factor must be determined for each compound that is to be measured before placing the analyzer into service
- A response time test must be performed prior to placing the analyzer into service and whenever there is a change to the sample pump or flow system of the analyzer.
- A calibration precision test must be completed prior to placing the analyzer into service and every 3 months thereafter (or at the next use, whichever is later)

The performance criteria specifications require that a calibration precision test be performed before the analyzer is "placed in service" and at a minimum every 3-months.

The calibration precision test is performed by 3 analyses of: zero gas being introduced, then the certified calibration gas being introduced into the analyzer to determe the analyzer's response to the calibration gas. The acceptance criteria is +/- 10 % of the certified calibration gas concentration as recorded on the gas cylinder or on the certification papers.

Calibration test must be performed prior to placing the monitor "in service" and should be done at the inspector's dedicated facility for maintaining monitors. The basic components for performing calibration checks on the analyzer are:

- NIST traceable gas cylinders;
- Tedlar bags;
- Appropriate tubing; and
- Field portable VOC analyzer.

Detailed procedures are described in the regulations and with the manuals that accompany the analyzers.

## Selecting an Analyzer

There are no specific rules for selecting an analyzer since many factors entering into the selection are agency/site specific. However, the list below provides ssome items to consider when selecting an analyzer:

1. Size of the regulated facility and number of components to be monitored as part of the site specific leak detection and repair (LDAR) program
2. Specific needs for the portable fugitive VOC analyzer to meet inorder to minimize time and labor associated with screening procedures in the LDAR program (i.e., bar code scanning needs, audible alarm level capability, data logger capability etc.)
3. Size, weight and bulk of instrumentation; and
4. Ease of instrument data logger interface with plant data management software
5. Enhanced speciation capability for future VOC emission inventory
6. Durability of analyzer, power supply system, and data logger under unique conditions (for example, cold weather impacts
7. Ease of operation, calibration, and "on-the-job" repairs
8. Manufacturer technical support.

This concludes the introduction to Federal Reference Method 21 and hand-held analyzers

# Lesson 5 – Self-Test

1. Documentation to Federal Reference Method 21 is found in:
    a. 40CFR60 Appendix A
    b. 40CFR60 Appendix B
    c. 40CFR63 Appendix A
    d. 40CFR63 Appendix B
    e. All of the above
2. (True/False) The single component analyzer is generally preferred over the multi-component analyzer.
    a. True
    b. False
3. The analyzer should be able to detect VOC concentrations as high as 10,000 ppm and as low as:
    a. 600 ppm
    b. 500 ppm
    c. 400 ppm
    d. 300 ppm
    e. Less than 300 ppm
4. The maximum outside diameter of the probe must be:
    a. More than ¼"
    b. Exactly ¼"
    c. No greater than ¼"
    d. Less than ¼"
5. Which of the following response factors indicate a very sensitive analyzer?
    a. 1.0
    b. 5.0
    c. 10.0
    d. 15.0
    e. 20.0
6. A calibration precision test must be performed when an analyzer:
    a. Before it is first put into service
    b. Each time it is used
    c. At least every three months
    d. Every three months or the next time it is used, whichever comes later
    e. a and d above

# Lesson 5 – Self-Test Answers

1. a
2. b
3. b
4. c
5. a
6. e

# Lesson 6

## Leak Detection and Repair Program

In Lesson 1, using the slide show, we established the basic structure and functions of the three level agency LDAR program. In this lesson we will cover basically the same ground, but will look at some aspects of the program in a little more detail and in some cases from a different perspective. You may wish to run the slide show again before proceeding with the lesson.

The information provided in lessons 2-5 identified information and basic skills the inspector must have in order to be effective in the agency LDAR program.

### Objectives

Upon completion of this lesson, the student should be able to:

1. Describe the difference between an agency LDAR program and the facilities LDAR program
2. For a Level 1 inspection, identify basic procedures/issues/concerns
3. For a Level 2 inspection, identify basic procedures/issues/concerns
4. For a Level 3 inspection, identify basic procedures/issues/concerns

## LDAR and LDAR

Until now, the LDAR program has been approached from the standpoint of the agency. However, each refinery or SOCMI facility has an LDAR program even though the facility may not call it an LDAR program. For our purposes, we will refer to the LDAR program associated with refineries and SOCMI facilities as the "site LDAR program."

Simply stated, the site LDAR program consists of the activities that the site initiates to stay in compliance with fugitive emission standards. Thus, the purpose of the agency LDAR program is to monitor and verify the effectiveness of the site's LDAR program.

To effectively evaluate the source LDAR program, he must be able to:

1. Determine which State/Local and Federal equipment leak regulations are applicable
2. Understand the overall approach of using both equipment standards and leak detection and repair standards
3. Determine if a source is complying with all the requirements of component identification, component marking, equipment design, monitoring, repair, recordkeeping, and reporting as part of a source LDAR program
4. Understand the analyzer performance specifications required by Federal Reference Method 21
5. Evaluate source personnel's calibration procedures and records
6. Evaluate field monitoring procedures used by source personnel to detect leaks from regulated components

To assist you with understanding the responsibilities of the inspector in performing a Level 1, 2, or 3 review of a facility's LDAR program, Appendix B contains a sample agency LDAR program, Field Notebook Checklist. It is provided as a guide to be used by an inspector when reviewing a source's LDAR program.

## Level 1

We know from lesson 1 that the level 1 agency inspection is conducted at the agency and involves reviewing the site records. The number of reports required of the source will vary according to the specific regulations that apply to that given source.

### Scope

It is necessary for the inspector to determine at an early time, what the scope of the inspection is to be. Factored into this determination are such considerations as:

- Is the inspection a regular/periodic inspection?
- Are there known or indicated signs of failure to meet compliance?
- Have there been major modifications to the site?
- In short, why is THIS inspection being performed?

Depending upon the answer to the questions above, the focus and emphasis of the record review may be dictated. Aside from the technical material that should be found in the reports, the inspector should also note or verify the existence of:

- A statement of compliance
- Outline of identification of components and applicable regulations
- Written SOP (standard operating procedures) for equipment to be used in source LDAR program
- Identification of responsible officer(s) and chain-of-authority
- Identification of data acquisition methods
- Establishment of a source quality improvement program (QIP)
- An established program for maintaining source records and reports
- Authorized signatures, where appropriate, on the LDAR documents

## Record Review

Remember that the various regulations specify what reports and records are required, what information must be included, and when reports are to be submitted. The record review should certify compliance with recordkeeping and report submission requirements.

Among the reports and documents the inspector should review are:

1. Regulations
2. Source permit
3. Notification of construction/reconstruction report
4. Initial Semi-annual report
5. Follow-up semi-annual reports
6. Additional compliance reports
7. Previous inspection reports.

It cannot be over emphasized that an inspection notebook is essential and the notebook is (or will become) a legal document. If any aspects of the document review are incomplete or if questions arise from the review, they should be noted in the inspection notebook resolved as appropriate.

When reviewing reports, the inspector may have problems in identifying specific violations or in substantiating noncompliance. From a regulatory point of view, the repeated existence of any of the following report conditions may serve to flag a source as being out of compliance.

1. Failure to submit report
2. Late submittals
3. Missing or incomplete report content
4. Self-reported violations

## Inspection Plan

A well-developed inspection plan will result in a more efficient inspection process. The determination of the scope of the inspection, discussed earlier, is the first step in developing an inspection plan. The next steps in developing a plan are influenced by the results of the record review.

Based upon the Level 1 review, and assuming a Level 2 and/or 3 inspection is indicated, the inspection plan should include:

- Identifying the scope of the Level 2 inspection
  - on-site records review only
  - on-site records review and walk-through inspection
  - verification of correct equipment labeling
  - on-site interviews (if so, identify personnel)
- Notify appropriate site personnel of the inspection plans
- Scheduling the inspection
- Inspection to cover whole facility or just parts (if parts, what parts)
- Identify equipment needed and assure equipment is available and ready for use
- Identify records, notebooks, supplies to be carried
- If a Level 3 is being implemented then determine if the inspection will be random monitoring inspection or a targeted monitoring inspection for a specific area.

Your inspection plan is important to the facility you are to visit because allowances must be made for:

- Operational/process schedules at the permitted facility
- Construction activities at the process area which might minimize your fugitive leak inspection activities
- Process specific health and safety issues at the process during your visit (i.e., large scale welding, fugitive emissions etc)
- Personnel scheduling and availability to meet your needs.

Informing the source of the inspection plan does not preclude a possible "unannounced" visit.

# *Level 2*

One of the most important goals for an inspector to attain is that of doing your job while creating the least possible disruption possible to the facility personnel and operations. The creation of an inspection plan during the level 1 inspection is a major step in achieving that goal because the inspector arrives on site knowing what needs to be done and knowing that the site personnel know what is expected. Following proper sign- in and sign-out procedures at the facility furthers attainment of the goal.

## *Opening Interview/meeting*

The main objective of the opening interview is to confirm or inform the facility official(s) of the scope/objective of the inspection, the authority under which it will be conducted, and the procedures that are to be followed.

If this is a first time inspection, then a health and safety briefing is usually required by the facility prior to entering the production areas. This will alert the inspection team of the hazards associated with the facility and any special precautions and safety activities that should be followed in the event of an emergency. If this is a follow-on inspection, then a briefing of health and safety issues for that day is appropriate.

## Record Review

For a first time inspection, a thorough review must be performed. Following inspections may be simple spot check of different portions of the records. All inspections should be sure to cover items that have come into question and/or known problem areas.

A check of consistency and validity is important. Comparisons should be drawn between earlier reports and the information in the latest reports. It is desirable to do this comparison with the facility representative so any questions can be answered during the comparison.

An on-going task is to verify that all processes and equipment covered under the regulations are listed and identified in records maintained by the facility.

The on-site records should agree with the most recent semi-annual report that you reviewed under the Level 1 review.

One of the more important aspects of the level 2 inspection is the review of the history of equipment that has leaked. It is important to follow-up on the repair of leaks and the inspection of high-risk (prone to leak) equipment

Once a leak has been reported, the inspector should check the records to verify that it was repaired within the specified time period or that it was reported as "delay-of-repair" and indication of when the repair will be scheduled in the future. The records should also indicated a reasoning for delay in repair and status of when that piece of equipment is going to be repaired and re-certified.

When reviewing equipment leak records, it is important to keep in mind the primary purpose of the record review is to verify the information in the reports and documentation of other elements of program performance such as performance of monitoring, adherence to repair schedules, documentation of visual inspections etc

The record review is to also confirm the performance of repairs and follow-up monitoring on all reported leaks. The source is in non-compliance if it:

- Fails to record leaks and dates of repairs
- Fails to record the reason for delaying repairs
- Fails to report leaks on the semi-annual report.

As specified in the HON requirements, all pumps must be visually inspected for leaks once per week. The inspector should review those records to verify that they are indeed being inspected and documented.

### Walk-Through

A part of the Level 2 inspection is a facility walk-through. In this part of the inspection, the inspector is primarily an observer. The inspector, through observations, makes a judgement call as to the competency of the personnel handling the fugitive emission monitoring and of the effectiveness of the site LDAR program.

During the walk-through the inspector should watch for:

- Proper tagging of equipment
- Visible emissions/leaks
- Hissing sounds
- Unusual smells
- Proper use of monitoring equipment
- Proper calibration of monitoring equipment
- Proper logging by site personnel of all measurements

Since many sites use the services of outside vendors to perform monitoring activities, it will be necessary to arrange for vendor personnel to be present for the walk-through. Also, it may be necessary to visit the vendor's location to observe calibration procedures for the fugitive VOC monitoring equipment.

## Level 3

Although often more time consuming than a Level 1 or Level 2 inspection, the Level 3 inspection requires less description than the other two. Generally, the Level 3 inspection includes all of the components of the Level 1 and 2 with the addition of the Agency inspector bringing his own portable VOC analyzer and performing leak checks of various components in the process. A level 3 inspection is normally conducted annually or if deficiencies have been discovered during the Level 1 and 2 inspections.

As a general rule of thumb, 200 to 300 are usually a sufficient number to constitute a representative sample of valves and can be inspected within a half day of direct monitoring. Very large process areas (i.e., more than 1,000 valves) may require a larger sample.

Often, a facility will have an established "start-to-finish" route to be used by its own monitoring personnel or subcontractors. Taking a representative number of components (several from each category of pumps, valves, connectors, agitators etc.) on that route would be acceptable as a fair representation of the process.

The secret of an effective level 3 inspection is pre-planning. Through planning, the important areas and equipment at the facility can be monitored.

## Closing Conference

We will discuss the closing conference here. However, a closing conference should also follow a level 2 inspection.

The closing conference is held with facility personnel at the conclusion of any on-site inspection. The conference should be brief and should be used to answer any question that may have arisen during the inspection.

The inspector should inform the facilities personnel when the report should be available, but should not attempt to evaluate the inspection findings.

## Reports

Upon completion of the closing conference, the inspector should begin preparing the inspection report while all the events of the inspection are still fresh in his or her mind. The inspector should use information from the notebook to prepare the report. The notebook should contain notes and data entered during:

- the review of the facilities initial report and semi-annual reports (Level 1)
- information gathered from the on-site record review and the walk-through of the facility (Level 2),
- the evaluation of fugitive VOC emissions with a portable VOC analyzer (Level 3).

The report organizes and correlates all evidence gathered during the inspection into a concise and useable format. It serves to record the procedures used in gathering data and gives factual observations and evaluations drawn in determining facility compliance. The inspector's report will also serves as part of the evidence for any enforcement proceeding or compliance-related follow-up activities.

The report should contain (at a minimum):

- Review of inspection data
- Summary of findings/compliance status for regulated equipment
- Evaluation of observed program
- Discussion
- Declaration of confidential business information
- Additional information needs

## Summary

Once the inspector has performed an inspection of the facility through the Level 3 evaluation, the inspector should be able to answer the following questions:

- Are in-plant records being properly kept and reports being properly submitted?
- When detected leaks are not repaired in the required time frame, are the delays justifiable?
- Can the plant's personnel demonstrate, in general terms, the capability to carry out the work practice standards and source specific LDAR program required by the regulations?
- Is all equipment that should be subject to the standard being treated as such?
- Does the facility meet the applicable regulations through the implementation of the LDAR program?

We have now learned that there is a systematic approach to evaluating a source compliance status. This approach includes a methodological evaluation of records, equipment, and source LDAR program.

# Lesson 6 – Self-Test

1. (True/False) The agency specifies an LDAR program for the facility that matches the agency LDAR program.
   a. True
   b. False
2. A record review is accomplished for
   a. L1 inspection
   b. L2 inspection
   c. L3 inspection
   d. a & b above
   e. b & c above
3. (True/False) Missing or incomplete reports may signal a facility that is out of compliance
   a. True
   b. False
4. Which of the following is NOT a function of the L2 walk-through?
   a. Observing use of monitoring equipment
   b. Observing visible emissions/leaks
   c. Scheduling the L3 inspection
   d. Verifying equipment is properly tagged
5. A closing conference should be held after
   a. L1 inspection
   b. L2 inspection
   c. L3 inspection
   d. a & b above
   e. b & c above
6. Assuming a facility of less than 1000 valves. How many valves would constitute a representative sample?
   a. 100-200
   b. 200-300
   c. 300-400
   d. 400-500
   e. >500
7. (True/False) The level 1 inspection is performed on-site at the facility
   a. True
   b. False

8. (True/False) The walk-through inspection is part of the level 2 inspection
    a. True
    b. False
9. (True/False) The inspection notebook is a legal document
    a. True
    b. False

# Lesson 6 – Self-Test Answers

1. b
2. d
3. a
4. d
5. e
6. b
7. b
8. a
9. a

# Lesson 7

## Recordkeeping & Reporting

A very important aspect in monitoring and verifying compliance is proper completion and filing of appropriate reports and records. This lesson will touch on the records needed to support a leak detection and repair program

### Objectives

Upon completion of this lesson, the student should be able to:

1. Identify recordkeeping requirements mandated by regulations
2. Understand the importance of reviewing records to determine a source's compliance status

The required review of records and reports are elements for the demonstration of the compliance efforts of a facility. It is important that an inspector be extremely familiar with the reporting and recordkeeping requirements of the regulations. The evaluation of these reports and examination of on-site records are vital portions of compliance determination. The object of this lesson is to summarize the reporting and recordkeeping requirements of NSPS and HON/NESHAP equipment leak regulations.

## Fugitive Leak Requirements

Sources falling under fugitive emission regulations must maintain the following records:

- A list of identification (ID) numbers for all equipment subject to the requirements.
- A list of ID numbers for equipment designated for "no detectable emissions."
- A list of ID numbers for pressure relief devices in gas/vapor service.
- A record of the determination of process streams in gas/vapor service.
- A list of ID numbers for equipment in vacuum service.
- A list of ID numbers for "unsafe-to-monitor" valves, an explanation of why unsafe, and alternative monitoring plan for the "unsafe-to-monitor" valves.
  A list of ID numbers for "difficult-to-monitor" valves, an explanation of why "difficult-to-monitor," and monitoring plan for the "difficult-to-monitor" valves.
- A list of ID numbers for equipment complying with "skip period," a schedule of monitoring and a record of the percent of valves found leaking during each monitoring period.

- A record of the determination of process streams in gas/vapor service
- A record of the determination of the percentage of benzene content in process streams
- A list of ID numbers for pumps in light liquid service that require weekly visual checks.

Recordkeeping (Closed-vent Systems and Control Devices)

- Detailed schematics, design specifications, and piping and instrumentation diagrams
- Dates and descriptions of any changes in the design specifications
- A description of the parameter(s) monitored
- Periods when the closed-vent systems and control devices are not operated as designed
- Dates of startups and shutdowns

## Recordkeeping Requirements for Leaks

When leaks are detected, the following records must be maintained:

- Record of each leak for 2 years
- Equipment ID number
- Instrument used in identifying the leak
- Operator ID number
- Date of leak
- Maximum instrument reading
- Date of each repair attempt
- Explanation of repair attempt
- Documentation of repairs not performed within 15 days
- Documentation of reason for delay of repair

## NSPS Reporting Requirements

There are two types of NSPS reports. The first is the notification of construction or reconstruction. The second type of NSPS report is the semi-annual report.

In addition to the construction report, there are certain conditions for a source that require a report be made.

- Written notification of the date of construction or reconstruction within 30 days after work begins
- Notification of anticipated date of initial startup (30-60 days)
- Notification of actual date of startup (within 15 after)
- Notification of any physical or operational changes to the existing facility that may increase the emission rate (within 60 days)

The initial report contains two major sections. The first is a written assertion that state the company will implement the standards, testing, recordkeeping, and reporting requirements contained in the applicable regulations.

The second part is information regarding the equipment subject to regulations. This includes:

1. Identification numbers and process unit identification for each source
2. Description of the type of affected equipment
3. % by weight of volatile HAPs in the fluid in the equipment
4. State of the fluid at the affected equipment
5. Description of method of compliance

Six months after the initial report, and every six months thereafter, (continuing six-month reports), the facility must submit semi-annual reports. The semi-annual reports must contain:

1. Process unit identification
2. Number of affected components (valves, pumps, etc.) that were found leaking
3. Explanation of delay in repairs
4. Dates of all process shutdowns
5. Revisions to initial report
6. 90 day notification to enter "skip" period or % leakers program
7. Performance test

If a performance test was performed during the 6 months, then the results of the test must also be reported in the semi-annual report. Such performance test include:

1. Verification of a alternative skip period
2. Verification of an alternative standard based on allowable percentage of valves leaking
3. Verification of equipment classified as "no detectable emissions" rather that a leak detection and repair standard

This lesson is primarily an information lesson and there are no self-test items.

End of course

# Appendix A

## LDAR Slide Show Script

Following is the script used with the LDAR slide show

### LDAR Inspection Program Script

To see an example of an LDAR program inspection, let's tag along with an inspector as he performs his duties. As we join the inspector, there are a few things we will need to assume:

1. The source has all necessary permits.
2. The source has taken all prudent measures to achieve and maintain compliance with all permit conditions.
3. The source employs an outside contractor to inspect and monitor all "leak" points.
4. All reports are submitted on time and are complete

The inspection to be performed for today's example will follow the steps indicated by the bold lines on the flowchart, Figure 1-3 in your manual. You will note that the inspection is conducted at three levels and that there are various conditions that will affect the inspection path followed.

We join the inspector at his desk as he begins the Level 1 inspection process which involves preparation for the on-site inspection. The inspector reviews records and reports submitted by the source as well as previous inspection reports. By reviewing these records, the inspector conducts an "on-paper" performance evaluation of affected components and in doing so he begins to determine the source's level of compliance.

Although not required, it is highly recommended that the agency develop a checklist for the three levels of inspection. A checklist will aid newer personnel with completing the process, and help all inspectors eliminate mistakes or omissions in the process. Additionally, the checklist provides a good tracking vehicle.

Since the conduct and results of the inspection process have legal implications, it is important for the inspector to keep detailed records of each inspection in an inspection notebook for each source. The notebook and the "checklist" will provide the basis for the inspection report.

Include all facts, along with tangible evidence such as: pertinent observations, photographs, copies of documents, descriptions of procedures, unusual conditions, and statements from facility personnel.

A Level 1check should include reminders to review:

- Regulations
- Source permit
- Notification of construction report (NSPS)
- Initial Semi-annual report
- Follow-up semi-annual reports
- Additional compliance reports
- Previous inspection reports.

If any aspects of the document review are incomplete, it should be noted in the inspection notebook.

The records review should include an evaluation of the source specific LDAR information. The areas of data review should include:

- the number or percentage of component leakers
- leakers not repaired within 15 days
- components identified as "no detectable emissions"
- components identified as "difficult or unsafe-to monitor"

Make summary comments of the data review in the inspection notebook. It is very important to enter notes describing items of importance or concern that should be addressed in the Level 2 inspection.

The inspector should have access to up-to-date schematics, blue prints, or flow charts of the regulated process areas at the facility. These documents are required for understanding and verifying that all equipment is properly tagged and classified. A major problem confronting inspectors is determining whether equipment exists in the facility that is subject to the standard, but is not listed in the records.

Finally, the inspector must make arrangements for conducting the site inspection. Unless this is an unannounced inspection the source would have been contacted several days in advance of the actual inspection.

The inspector scheduled a periodic level 3 inspection. Therefore, he will need to take test equipment to the site and test equipment must be properly calibrated.

Depending upon the agency, the calibration may be done by lab technicians, or the inspector may have to do his own calibration. Either way, calibration records must be maintained and included with the inspection report. It would be good to also keep a copy in the inspection notebook.

Armed with the test equipment, checklists, notebooks, and other necessary records, the inspector is off to meet the contact at the source location.

Important items on the checklist include: health and safety gear. Inspectors should bring their own hard hat, safety shoes, ear plugs, and respirator with appropriate cartridges and any other safety equipment the site conditions may require.

This completes the basic elements of the Level 1 agency inspection process

A level 2 phase of an agency LDAR program is conducted at the source location. The Level 2 inspection determines the adequacy of the source's equipment leak detection and repair program. It also assesses the source's effectiveness in implementing their leak-check program.

The inspector now addresses a level 2 checklist that includes:

- checking in
- a preinspection meeting
- an opening conference
- records review
- LDAR program review
- a walk-through inspection
- closing conference

Upon arrival at the facility, the inspector notes any strong odors or visible emissions and begins his visit by checking-in at the front gate or at the receptionist area in the administrative building. He identifies himself, states his business, and asks that his contact be notified.

He then signs the facility register and, if necessary, registers or logs any equipment he is bringing into the facility. In the case of cameras or recording devices, it is best to obtain permission from the facility representative before arriving at the facility.

After signing-in, the inspector initiates the level 2 review with a pre-inspection meeting at the facility with the appropriate facility representatives. They discuss the purpose of the inspection, the authority under which it will be conducted, the procedures to be followed, scheduling of personnel, and identifying what records need to be available and reviewed during the visit. Unless the inspection is an unannounced inspection, many of the pre-inspection meeting activities can be accomplished prior to the inspector arriving on site.

If this is the inspector's first visit, site personnel should instruct the inspector in safety procedures, such as: where to meet in an emergency, where first aid stations are located, and how to obtain help in an emergency.

When reviewing the source's on-site records pay particular attention to any items, detected in the Level 1 review, that were of importance or concern

The review focus, as mentioned before, should be guided by the inspector's prior review of the reports and should use the records to (1) confirm the accuracy and content of the semi-annual reports; and (2) verify that the recordkeeping requirements of the applicable standards are complied with.

Use the Level 2 checklist to assure all important points of the inspection are covered..

Some of the items that should appear on the checklist include:

- verifying all ID numbers for subject processes and equipment
- a list of no detectable emissions
- a list of "unsafe-to-monitor, "difficult-to-monitor," and "unsafe-to-repair" equipment;
- records of weekly "visual" inspection of pumps
- a list of all leakers, and
- test equipment calibration logs

This list of LDAR program items and the steps identified in our presentation are very basic. They provide only a general overview of the LDAR inspection process.

Before proceeding into the process area, the inspector should review plant safety procedures and confirm that his safety equipment is applicable for the job.

We have already completed half of the Level 2 process. The second half of a Level 2 inspection consists of accompanying source personnel on a "walk-through" inspection. If a Level 3 inspection has been scheduled, as it has in our case, the walk-through inspection probably would not be performed.

In the walk through, make a visual inspection of critical equipment and process areas. Observe source personnel performing leak detection activities. Note any irregularities in your inspection notebook.

In addition, during the walkthrough, the agency inspector should:

- compare equipment ID tags to the process flow charts or "blue prints"
- verify proper equipment identification as part of a regulated process
- observe the technique used by the plant personnel or private contractor in performing leak detection measurements, and
- use the observations to determine the competency of the personnel performing the monitoring.

A Level 3 inspection includes most of the components of a Level 2 inspection, but is broader in scope. In a Level 3 inspection, the inspector performs the monitoring and testing functions himself. Whereas, in a Level 2 inspection he observes source personnel performing the tests. For this reason, the Level 3 inspection is the most time consuming and intense of the inspection program. As with other levels of inspection, the task is less prone to mistakes and oversight when the inspector uses a checklist.

Even a small facility has a significant number of valves, pumps, and flanges. It is not practical to inspect every piece of equipment during any given inspection visit. Therefore, using a checklist and planning the scope of the inspection is a very important step. It helps set up an efficient and representative inspection.

When the inspection has been completed, the inspector should meet with source personnel to answer any immediate questions. Since the inspector has not had time to evaluate the inspection results, no attempt should be made to provide an analysis. The source personnel should be informed when they may expect the inspection report to be available.

It is the inspector's responsibility to establish and maintain a working relationship with the facility. The inspector can offer or suggest available resources and technical guidelines. He can refer questions and concerns to other agency personnel. Or he can discuss problems and possible solutions in a way that will reflect favorably on the inspector and the Agency.

Now comes the part of the inspection most people like doing the least, THE REPORT.

Write the inspection report as soon as possible after the inspection. Most agencies have a format established for the reports. Having a report checklist will help assure that all elements and findings are included. Remember that the report is a legal document. It must be accurate and timely and provide complete coverage of all significant inspection activities.

There is one last item that has no formal checklist. Remember that air quality requires the cooperation of both the source and the agency. Most sources have the desire to meet air quality regulations. They also have a mandate to perform for their stockholders. A good agency inspector will work with the source to achieve results that meet the agency's requirements to assure cleaner air and to meet the source's mandate to be profitable.

This short presentation has introduced the three level inspection of the agency LDAR program

Level 1: Pre-inspection records review and verification in agency office

Level 2: On-site inspection for determination of adequacy of LDAR program and its success

Level 3: On-site inspection with the addition of monitoring and testing conducted by the inspector

The agency LDAR program will be expanded upon in following lessons and follow-on courses.

# Appendix B

## AGENCY LDAR PROGRAM
## FIELD INSPECTION NOTEBOOK

AGENCY LDAR PROGRAM
FIELD INSPECTION NOTEBOOK

# 1.0 LEVEL I CHECKLIST

## 1.1 SOURCE IDENTIFICATION

Company Name ______________________________

Mailing Address ______________________________

______________________________

______________________________

______________________________

Location of Facility

______________________________

______________________________

______________________________

______________________________

Personnel

| | Name | Title | Phone |
|---|---|---|---|
| •Facility Manager | | | |
| •Environmental Manager | | | |
| •Facility Contact | | | |
| •Confidentiality Statement Required | | | |

## 1.2 PREPARATION FOR INSPECTION

### 1.2.1 Applicability of Federal Equipment Leak Regulations

- Which Federal Equipment Leak Regulations applies to the affected facility:

**New Source Performance Standards**

40CFR60, Subpart VV- SOCMI Equipment
40CFR60, Subpart GGG- Petroleum Refineries
40CFR60, Subpart KKK- Onshore Natural Gas Processing Plants
40CFR60, Subpart DDD- Polymer Manufacturing Industry

**National Emission Standards for Hazardous Air Pollutants (NESHAP)**

40CFR61, Subpart J- Benzene Equipment Leak
40CFR61, Subpart F- Vinyl Chloride
40CFR63, Subpart H- Leak Organic Hazardous Air Pollutant (HAP) Equipment Leak NESHAP
40CFR63, Subpart I- Organic HAP Equipment Leak NESHAP for Certain Processes

**Resource Conservation and Recovery Act (RCRA)**

40CFR264, Subpart BB- Air Emission Standards for Equipment Leaks for TSDFs
40CFR265, Subpart BB- Air Emission Standards for Equipment Leaks for Interim Program TSDFs

### 1.2.2 Notification of Construction/Reconstruction Report Repair

Initial notification of construction or reconstruction within 30 days of commencement?__________
Notification of initial startup?__________
Notification of actual startup?__________
Notification of physical/operational changes to facility?__________
Notification of compliance status?__________
Brief description of the facility's operation and design capacity__________
Identification of process unit(s) which fall under regulatory requirements__________
Primary emission control (e.g. flare, scrubber, incinerator etc)__________
Statement that requirements of standard are being implemented__________
List of all subject equipment including:
-Type of equipment (e.g., valves, pumps, flanges etc.)__________
-Identification number of regulated equipment__________
-Process unit where equipment is located__________
-Percent by weight for regulated pollutant at the equipment__________
-Process fluid state at the equipment (gas/vapor, liquid, two phase fluid)__________

-Method of compliance with the standard [e.g., monthly leak detection and repair program (LDAR), pump equipped with dual mechanical seals]________________
Brief description of source LDAR program________________
Schedule for submitting semiannual reports________________
Engineering diagram of regulated processes within the facility________________

## 1.2.3 Semi-annual Report

Obtain copy of source permit and compare to applicable regulations______________
Obtain copy of previous semi-annual report________________
-Report submitted on time?________________
-Report signed by facility representative?________________
-Process unit identified?________________

-Report contains information associated with:
- -Total components monitored?________________
- -Number (by type) of components leaked?________________
- -Number of components for which leaks were not properly repaired?___________
- -Identification of "non-repairable" leaking components?________________
- -Summary of leaks not repaired within 15 days?________________
  - -Tag number________________
  - -Date detected________________
  - -Part________________
  - -Delay of repair reason________________
  - -Why unit shutdown technically not feasible________________

-Compare "no detectable emissions" equipment number with previous reports________
-% of total components (by type) found leaking?________________
-Check % leaking in records to reported results________________
-Check listed repairs and equipment identification along with retest requirements_____
-Identification of construction or replacement of equipment________________
-Review all performance test conducted during the reporting period on all equipment designed to meet the "skip period" and "no detectable emissions"________________

[NOTE: Remember to bring a copy of at least one semiannual report on the inspection so that the semiannual report data can be spot checked against in-plant records data.]

Does the source maintain a document listing:
-A list of ID numbers for "difficult-to-monitor" components?________________
-A list of ID numbers for "unsafe-to-monitor" components?________________
-A list of ID numbers for "skip periods" components?________________
-A list of ID numbers for "no detectable emissions" components?________________

### 1.2.4 Review of Source Leak Detection and Repair Program (LDAR)

-Source specific leak detection and repair program (LDAR) submitted and maintained in source files for review and update?________________________________

-Clear statement by the regulated facility associated with the establishment of the LDAR program at the facility along with reference to applicable regulations?_____________

-LDAR document signed by Plant Manager, Environmental Manager, and Maintenance and Production Manager (if applicable)?____________________________________

-Outline of applicable regulations and identifications of components regulated under those requirements?___________________________________________________

-Identification of responsibility and chain-of-authority for source LDAR program?______

-Identification of equipment to be used in the source LDAR program, along with written procedures (SOPs) for operation, maintenance, and calibration of equipment in accordance with Federal Reference Method 21 specifications?_______________________________

-Identification of plant procedures and proper record keeping requirements within the source specific LDAR program, including identification of responsibilities for tagging leaking components, repairing leaking components, acquiring proper Work Orders, retesting of components once leaks are repaired, updating maintenance records and schedules based upon number of leaking components, and notification of source personnel of all activities involved with the repair of a leaking components.

-Identification of data acquisition methods used in the LDAR program, example calculation of "percent leaking components," and discussion on how semiannual reports will be prepared and verified.

- Identification of a source Quality Improvement Program (QIP)?____________________

### 1.2.5 Source Notification

-Has the appropriate representative of the source been notified of the time and date of auditor's intended visit? Yes _____ No _____

By phone ______________________________________________________

By letter ______________________________________________________

Name of Representative Contacted________________________________________

Date contacted ___________________________________________________

Record of notification filed ______________________________________________

### 1.2.6 Prepare Pre-inspection Plan

-Develop inspection plan containing inspection objectives:

Onsite records review only?

Onsite records review and walk-through inspection?

Onsite records review, walk-through, and equipment leak evaluation?

-Gather inspection materials (i.e., source files, notebook, pen, paper, camera etc.)_______

-Acquire safety protection equipment (i.e., hard hat, safety shoes, ear plugs etc.)_______

-For a Level 3 evaluation, acquire and calibrate fugitive VOC equipment and verify proper operation_______________

If a Level 3 evaluation, what type?

Random monitoring (to cover any/or some of the HON/NSPS/NESHAP applicable areas)?

Targeted monitoring (To cover a specific applicable area of the process)? Specific Area_______________

-Obtain inspection checklist, site map and process drawings of regulated facility________

## 2.0 LEVEL II CHECKLIST

## 2.1 ARRIVING AT THE FACILITY

### 2.1.1 Walking to the Facility

-When arriving at the facility, notice any visible emission from the process.

- Visible emissions?__________Yes_____________No
- Where?_______________

-Are there any strong odors around the facility?

- Yes______________________No_______________

Describe_______________

_______________

### 2.1.2 Sign-in At the Facility Logbook

-Always sign-in at the facility reception area. Show plant personnel your credentials and equipment which you are bringing onto the property.

-Register any cameras, sampling equipment at the reception area to verify that you are not violating company policy.

-Inquire about any special safety alerts or procedures.

## 2.2 PRE-INSPECTION MEETING

Before the inspection at the refinery, the inspector should arrange to meet with source representatives directly responsible for the source LDAR program. The purpose of the opening conference is to inform facility official(s) of the purpose of the inspection, the authority under which it will be conducted, and the procedures to be followed, and answer any questions they may have. The opening conference also offers the inspector the opportunity to completely discuss agency policy and inspection procedures, and to provide relevant information and other assistance. The inspector's effective execution of the opening conference often sets the tone of the remainder of the inspection.

During the pre-inspection meeting, the following items should be discussed:

| | |
|---|---|
| Inspection objectives | ______ |
| Inspection agenda | ______ |
| Health and Safety Requirements | ______ |
| Facility information verification/blue prints of regulated process | ______ |
| Review of records | ______ |
| -- Equipment records (i.e., ID of pumps, valves, pressure relief valves, compressors, etc.) | ______ |
| -- Records of self-monitoring test results | ______ |
| -- Records of equipment in vacuum service | ______ |
| -- Records of repair dates/re-test dates from leaking components | ______ |
| -- Records of leakers (i.e., ID, instrument operator, leak value etc.) | ______ |
| -- Records of equipment which is exempt from the regulations | ______ |
| -- Records of equipment in "skip" periods | ______ |
| -- Records of weekly "visual inspection" of pumps | |
| -- Records of "unsafe-to-monitor," "difficult-to-monitor," and "no detectable emissions" equipment | ______ |
| -- Records of closed vent systems (i.e., schematics, design specification, non-operational periods etc.) | ______ |
| Scheduling of Source Personnel Interviews | ______ |
| Discussion of Inspection Techniques to Be Used | ______ |
| Scheduling of Copying Needs | ______ |
| Any Questions | ______ |

In particular, the inspector should develop his or her understanding of the operation/maintenance of the refinery to ascertain whether the system has been operated according to permit condition since the last inspection. The inspector should be able to support any conclusions by:

- Examination of operation and maintenance records of the equipment;
- Weekly inspections and performance checks over previous reporting period;
- Reviewing the site-specific LDAR program;
- Records comparison ( i.e., correlation of reported leakers, repairs to regulated components, operations and maintenance records, and computer printouts; and
- Reviewing files to identify missing documents (if any).

The following table should be completed by the inspector in conducting the preliminary meeting.

### 2.2.1 Personnel In Attendance

| Name | Affiliation | Address | Phone/email |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
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| | | | |
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| | | | |

### 2.2.2 In-plant Records Checklist

#### 2.2.2.1 Listing of Affected Equipment

Does the plant have the following information pertaining to subject equipment in a permanent log?

_____A list of identification numbers for equipment subject to the standard:
- _____Pumps
- _____Compressors
- _____Pressure Relief Devices in Gas/Vapor Service
- _____Sample Connection Systems
- _____Open Ended Valves or Lines
- _____Valves
- _____Pressure Relief Devices in Liquid Service, Flanges, and Other Connectors
- _____Product Accumulator Vessels
- _____Equipment in Vacuum Service
- _____Flanges
- _____Closed Vent Systems

_____A list of identification numbers for equipment designated to meet "no detectable emissions" compliance option including the owner/operator's authorizing this designation:
- _____Pumps
- _____Compressors
- _____Valves
- _____Pressure Relief Valves

_____The dates of each "no detectable emissions" compliance test, including the background level measured during each test and the maximum instrument reading measured at the equipment during each test.

- _____Pumps
- _____Compressors
- _____Valves
- _____Pressure Relief Devices

_____A list of all valves which are designated "unsafe-to-monitor."

- _____Valve identification number
- _____Explanation why each valve is unsafe-to-monitor
- _____A plan for monitoring each valve

_____A list of all valves which are designated "difficult-to-monitor."

- _____Valve identification numbers
- _____Explanation why each valve is difficult to monitor
- _____A plan for monitoring each valve

[NOTE: One or two of these valves may be field inspected to verify that they are indeed "unsafe or difficult to monitor".]

Comments:______________________________________________________________
____________________________________________________________________
____________________________________________________________________

**2.2.2.2 Records of Fugitive VOC Emission Monitoring**

Does the plant have the following information for two (2) years regarding compliance testing of regulated equipment?

- _____ID of regulated components
- _____Type of service
- _____Location of equipment
- _____Component type
- _____Measured leak values
- _____Ambient background values

**2.2.2.3 Records of Performance Test Data**

Does the plant have the following information for two (2) years regarding performance test data of regulated components?

- _____ID of regulated components
- _____Type of service
- _____Location of equipment
- _____Component type
- _____Measured leak values
- _____Ambient background values

## 2.2.2.4 Leak Equipment

Does the plant have the following information in a two year log regarding leaks located on pumps, compressors, valves, flanges, and other connectors?

_____The instrument and operator identification numbers and the equipment identification number.
_____The date the leak was detected and the dates of each attempt to repair the leak.
_____Repair methods applied in each attempt to repair the leaks.
_____Record of "above leak definition" if the maximum instrument reading measured by the methods specified in the CFR after each attempt is equal to or greater than the leak detection limit.
_____Record of "repair delayed" and the reason for the delay if a leak is not repaired within 15 calendar days after discovery of the leak.
_____The signature of the owner or operator (or designated) whose decision it was that repair could not be effected without a process shutdown.
_____The expected date of successful repair of the leak if a leak is not repaired within 15 calendar days after discovery of the leak.
_____The date of successful repair of the leak.

Comments:______________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

## 2.2.2.5 Skip Periods

For valves complying with the "skip period leak detection and repair" compliance option, does the plant have a permanent log containing:

_____A schedule for monitoring
_____The percent of valves found leaking during each monitoring period
_____Example of calculation for determining present skip period

Pumps and compressors that are equipped with a dual mechanical seal system must have sensors to detect failure of the seal system, the barrier fluid system, or both. The following information should be in a permanent log regarding these types of pumps and compressors:

_____For each pump, the design criterion (or parameter chosen to monitor) and an explanation of that criterion.
_____For each compressor, the design criterion (or parameter chosen to monitor) and an explanation of that criterion.
_____Any changes to this criterion and the reasons for the changes.

---

Comments:______________________________________________

______________________________________________

______________________________________________

______________________________________________

**2.2.2.6 Records of Visual Inspection of Pumps**

Does the plant have the following information for two (2) years regarding compliance with weekly visual inspection of regulated pumps?

_____ID of pump
_____Type of Service
_____Location of pump
_____Date of inspection
_____Initials of inspector

**2.2.2.7 Calculation of Leakers**

Determine the total number of components in each category and calculate the per cent leakers in each category.

_____Calculate the total number of regulated components in each group (i.e., valves, flanges, pump etc.)
_____Valves
_____Flanges
_____Pumps
_____Connectors
_____Calculate the total number of "leakers" in each group. Are the regulations addressing "leakers" and "skip periods" being met?
_____Valves
_____Flanges
_____Pumps
_____Connectors
_____"Difficult-to-monitor"
_____"Unsafe-to-monitor"

**2.2.2.8 Review of Source Fugitive VOC Monitoring Equipment Records**

Examine the source logbooks associated with the fugitive VOC monitors.

_____Does the source maintain logbooks for monitoring equipment?
_____Do the logbooks contain the following information:
_____Operator name
_____Monitor ID number
_____Identification of calibration gases

_____List of applicable response factors (RFs)
_____Calibration precision data results
_____Response time data results

**2.2.2.9 Records Review Summary**

Examination of the logs may also reveal noncompliance due to improper or inadequate recording procedures. Facilities are in direct noncompliance under the following situations:

- Failure to report leaks and dates of repair
- Failure to report the reason for delaying repair of leaks past an allotted time frame
- Failure to develop a schedule to observe visual emissions from flares (benzene NESHAP)
- Failure to record periods when the control device is not operating (benzene NESHAP)

The in-plant logs and records should be examined for inconsistencies with the information presented to the regulatory agencies in the initial and semiannual reports. Some typical reporting inconsistencies are as follows:

- Facilities records leak testing and repair data in logs but fails to report information in semiannual reports
- Facility records periods of noncompliance for control and vent systems but only reports results of annual emission tests.

Following is a list of questions the inspector should be able to answer at the conclusion of the record inspection:

- Are in-plant records being properly kept and are semiannual reports being properly submitted?
- Is the equipment in the facility that should be subject to the standard being treated as such?
- When detected leaks are not repaired in the required time frame, are the delays justifiable in accordance with the provisions?

COMMENTS________________________________________________________________

## 2.3 WALK-THROUGH INSPECTION

The walk-through inspection should be performed with the plant personnel. Select an area that hasn't been previously inspected and observe the source using their own fugitive VOC leak detection monitor to evaluate various pieces of regulated equipment. During the walk-through, note the following:

_____Plant blueprints correspond with site area?
_____Regulated components identified properly and documented on blueprints?
_____Any visual leaks associated with observed pumps?
_____Unusual smells or odors in regulated area?
_____Leak detection performed by facility personnel at random selected components perfomed according to Federal Reference Method 21?
_____Any "hissing" sounds at regulated components?
_____"Difficult-to-monitor" and "unsafe-to-monitor" equipment properly labeled and identified in the records?
_____Spot check the following components based upon the records review (Level 2):
  _____Recently leaking components
  _____"No detectable emissions" components
  _____Exempt devices (verify compliance)
_____If flares are being used as a control device, inspect for "no visible emissions" as determined by Federal Reference Method 22.

## 2.4 LEVEL 2 EXIT INTERVIEW

Once the "walk-through" inspection has been completed, the inspector should conduct an exit interview. The exit interview serves to summarize the findings of the inspection (Level 1 and 2). During the exit interview, the following topics should be covered:

_____Review of Inspection Data
_____Summary of Findings
_____Discussion of Findings
_____Declaration of Confidential Business Information
_____Additional Informational Needs

Comments_______________________________________________
_______________________________________________________
_______________________________________________________
_______________________________________________________
_______________________________________________________
_______________________________________________________
_______________________________________________________
_______________________________________________________
_______________________________________________________

## 3.0 LEVEL 3 CHECKLIST (FIELD SCREENING)

### 3.1 BACKGROUND INFORMATION

Company______________________________________________
Address______________________________________________
Telephone Number__________ ______________________________
Tester Name__________ __________________________________

### 3.2 INSTRUMENT INFORMATION

1. Instrument Type:____________________________________
2. Manufacturer and Model:______________________________
3. Serial Number:______________________________________
4. Calibration Gas:_____________________________________
5. Instrument Lower Limit of Detection (ppmv):_____________________
6. Saturation Point of Instrument Without Dilution Probe:_______________
7. Was a dilution probe used? Yes_____No_____
8. Can instrument scale read +/- 5% of leak definitions? Yes_____No_____
9. Does instrument include a pump capable of ½ to 1/3 of 1 L/min? Yes_____No____

### 3.3 INSTRUMENT PERFORMANCE

#### 3.3.1 General Information

1. Has response factors (RFs) for the instrument been determined? Yes_____No_____
2. Are the response factor < 10? Yes_____No_____
3. Report response factor:________________________________
4. Has a response time (RT) test been performed Yes_____No_____
5. Is the response time </= 30 seconds? Yes_____No_____
6. Report response time:_________________________________
7. Have there been any changes to the sample pumping system or flow configuration since the response time test? Yes_____No_____
8. Has a calibration precision test been completed? Yes_____No_____
9. Report date of last calibration precision test:____________________
10. Is calibration precision </= 10 % of calibration gas value? Yes_____No_____

#### 3.3.2 Calibration Gas

1. Is a zero gas used as a first step in calibrating the detector? Yes_____No_____
2. For calibration gas:
   -Has it been certified by the manufacturer to be +/- 2 % accurate?
   -Reported shelf life?____________________________
3. Are the standards re-analyzed or replaced after shelf life?_______________
4. Manufacturer of cylinder standards:___________________
   A. Is the mixture accurate to within +/- 2 %? Yes_____No_____
   B. Are the standards replaced each day of use? Yes_____No_____

### 3.3.3 Calibration Procedure Checklist

1. Assemble and start-up VOC analyzer.______________________________
2. Allow the instrument to warm-up.______________________________
3. Zero internal calibration procedure.______________________________
4. Introduce calibration gas into sample probe.______________________________
5. Adjust meter readout to correspond to calibration gas value.__________________

### 3.3.4 Instrument Evaluation Procedures

#### 3.3.4.1 Response Factor
1. Calibrate with reference compound.______________________________
2. Obtain/prepare known standard of the organic species to be measured._______
3. Introduce standard to analyzer/record observed meter reading.____________
4. Introduce zero air until a stable reading is obtained.____________________
5. Repeat 3 and 4 twice more to obtain three measurements.______________
6. Calculate 3 individual and 1 average response factors.________________
7. Was a published response factor used? Yes_____No_____

#### 3.3.4.2 Calibration Precision
1. Make three measurements by alternately using zero gas and specified calibration gas.______________________________
2. Record meter reading______________________________
3. Calculate calibration algebraic difference between meter reading and known value.______________________________
4. Calculate calibration precision (%).______________________________

#### 3.3.4.3 Response Time
1. Introduce zero gas into sample probe.______________________________
2. When meter has stabilized, switch quickly to specified calibration gases._____
3. Measure time from switching to 90 % of final stable reading.____________
4. Repeat twice more.______________________________
5. Calculate average response time.______________________________

## 3.3 GENERAL GUIDELINES FOR SYSTEM OPERATION USING A PID ANALYZER

### 3.3.1 Assembly/Startup
1. Install probe assembly.______________________________
2. Test power (battery) level.______________________________
3. Turn on electronics and very lamp operation.______________________________
4. Leak-check sample line.______________________________
5. Set electronic zero and alarm levels (if applicable).______________________
6. Set zero using background (<10 ppm VOC) air.______________________
7. Calibrate using reference, or other suitable calibration compound at a concentration approximately 80% of the leak detection definition.__________________

## 3.3.2 Fugitive Leak Detection Inspection of Regulated Components

### 3.3.2.1 Placement of Probe

1. Place sample probe at source to be measured and perform fugitive leak inspection on an "individual source (as described in Method 21)" and record results on Field Test Data Sheet (FTDS).
2. Following is a brief description on how to locate the probe for individual components to record maximum leak rates.

**Valves:** Place the probe as close as possible to where the stem exits the packing gland and move the probe around the circumference. The maximum reading is the screening value. Also, move the probe around the periphery of the packing gland take-up flange seat. In addition, the valve housing of multi-part assemblies should be screened at all points where leaks could occur. Record the maximum value as the screening value.

**Connectors:** Place the probe at the outer edge of the flange-gasket interface and sample the circumference of the flange. It may be impossible to get to the flange-gasket leak interface because the probe cannot get between the two flange edges. In these cases, the only alternative is to get as close as physically possible to the interface. For threaded connectors, the threaded connector interface must be screened. Record the maximum value as the screening value.

**Pumps, Compressors, and Agitators:** Pumps, compressors, and agitators are screened where the shaft exits the housing. Sample along the circumference of the shaft-seal interface by holding the probe as close to the shaft as possible (attach a piece of Tygon tubing to the end of the probe to prevent accidental damage to the rotating shaft and instrument probe). If the housing of the pump, compressor, or agitator prevents sampling all the way around the seal, sample all accessible portions. All other joints on the pump, compressor, or agitator housing that could leak should also be sampled. Record the maximum reading as the screening value.

**Pressure Relief Valves:** Because of their design and function, pressure relief valves must be approached with extreme caution and should not be tested in times of process upsets or any other time when activation seems likely. For devices with an enclosed extension, or horn, place the probe inlet at approximately the center of the exhaust area. Only the probe tip should be placed in the horn. If a "weep hole" is accessible, test at that location also. Record the maximum reading as the screening value.

**Open-ended Lines and Vents:** Emissions from most other components leak through regularly shaped openings. If the opening is less than 1 inch in diameter, a single reading in the center is sufficient. For larger openings (up to 6 inches in diameter), screen in the center of the hole and around the hole. Components greater than 6 inches, screen across the opening every 3 inches. Record the maximum value as the screening value.

3. Periodically recheck zero setting using background (zero) air.________________
4. Avoid direct measurement of obvious leaks to avoid gross contamination of the instrument.______________________
5. Periodically check battery level and visually lamp operation.________________
6. Perform a single point calibration of the fugitive VOC analyzer every three (3) hours of operation. The single point check should be within +/- 10 % or a full multipoint calibration must be performed and the data collected between the last good calibration and this calibrations must be suspect.
7. Check ambient background readings every 3-hours and record on the FTDS.

**3.3.2.2 Shutdown of Fugitive VOC Analyzer**

1. Place instrument in a standby position.______________________________
2. Shut off electronics.________________________________________

**3.3.2.3 Routine Maintenance**

1. Charge or replace batteries._____________________________________
2. Replace/clean particle filter.___________________________________
3. Replace charcoal filter (dilution system).__________________________
4. Replace/clean lamp cell window.________________________________
5. Replace lamp._______________________________________________
6. Leak-check sample flow system.__________________________________

**3.3.2.4 Quality Control/Performance Verification Procedures**

1. Check background (zero) air reading several times each day and after each high level measurement.___________________________________________
2. Check calibration daily using calibration compound at level near the leak detection definition.
3. Check air flow daily (observing instrument flow meter) and whenever any maintenance is performed on the sample flow system.______________________
4. Leak-check air flow system daily (less frequently if no problems are observed historically).________________________________________________
5. Check instrument response factor for regulated compound (relative to reference compound ) before performing measurements. Literature values may be used, but are not recommended because of differences between instruments._________________
6. Check calibration precision for three replicate determinations every three months or each use, whichever is longer.____________________________________
7. Check response time before performing leak detection measurements and whenever changes are made in the air flow, detector, or electronic portions of the instrument._____

## 4.0 CLOSING CONFERENCE

The closing conference is held with the facility personnel at the conclusion of the record and leak screening inspections. The conference is mainly designed to answer questions the facility may have, identify confidential information, and obtain last minute details and information in order to complete the mandatory inspection report. The inspector should keep the closing conference brief, refrain from making compliance judgement and cover the following topics:

- **Review of Inspection Data-** Identify and fill in any gaps in the data collected and clear up any inconsistencies concerning technical data so a determination of compliance can be made at a later date.
- **Summary of Findings-** Review the adequacy of the established LDAR program and identify weaknesses and strengths within the program. Remember, determination of compliance should be made after leaving the facility and you have an opportunity to review *all data.*
- **Discussion/Evaluation of Source LDAR Program-** Answer any inspection-related question from the facility personnel but politely refrain from making on-the-spot judgements concerning facility compliance or enforcement consequences. Provide recommendations to the facility on how they might improve their program based upon your review.
- **Declaration of Confidential Business Information-** Facility officials should be given the opportunity to make confidentiality claims on documents collected by the inspector. It is the inspector's responsibility to note all information claimed confidential and handle the materials accordingly.
- **Additional Information Needs-** At this time, make arrangements for acquiring other data needs that were not available during the inspection.

As a final note, it should be emphasized that it is the inspector's responsibility to establish and maintain a working relationship with the facility. Offering or suggesting available resources such as technical guidelines, referring questions and concerns to other personnel and discussing problems and possible solutions will indicate to the facility a professionalism that will reflect favorably on the inspector and the regulatory agency.

FEDERAL REFERENCE METHOD 21
MONITOR SURVEY LOG SHEET
LEAK DETECTION AND REPAIR

Date____________________Time__________________Inspector________________

Analyzer__________________Serial No.______________Calibrated?____________

| Component ID | Stream Composition (Gas/Liquid) | Tag Number | Background Reading | Screening Value | Comments |
|---|---|---|---|---|---|
| | | | | | |
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