

# **Guidelines for Fugitive Emissions Calculations**

**June 2003**



**Office of Planning, Rule Development,  
and  
Area Sources**

**South Coast Air Quality Management District**

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## PREFACE

The South Coast Air Quality Management District (District) Rule 301 (e) requires facilities operating under District permit to annually report their emissions from all equipment (permitted and non-permitted) to the District. This guidelines document represents a revision to the District's "Guidelines for Fugitive Emission Calculations – Petroleum Industry", dated June 1999 to reflect the latest amendments to Rule 1173. This guidelines document provides calculation methods for estimating fugitive emissions (component leaks) from the petroleum industry (i.e., oil and gas production facilities, refineries and marketing terminals) as well as guidelines for component counting and leak quantification. The fugitive emissions should be reported in the following applicable forms as part of the District's Annual Emissions Reporting (AER) Program:

- FORM P1:** Permitted Annual Fugitive Emissions Summary – Oil/Gas Production and Chemical Plants
- FORM P1U:** Non-permitted Annual Fugitive Emissions Summary – Oil/Gas Production and Chemical Plants
- FORM R3:** Permitted Annual Refinery Fugitive Emissions Summary
- FORM T1:** Permitted Annual Fugitive Emissions Summary – Terminals/Depots

This guidelines document primarily makes reference to the document entitled, "California Guidelines for Estimating Mass Emissions of Fugitive Hydrocarbon Leaks at Petroleum Facilities", dated February 1999, prepared by the California Air Pollution Control Officers Association (CAPCOA), and the California Air Resources Board (ARB). (The CAPCOA/ARB document represented a multi-year collaborative effort between the industry, the CAPCOA and ARB to provide a consistent approach for estimating fugitive emissions from equipment components used in the California petroleum industry. The CAPCOA/ARB document provides different calculation methodologies as well as component identification and counting guidelines, component-screening procedures and leak quantification methods, which must be followed by facilities in order to more accurately calculate the fugitive emissions. A copy of the CAPCOA/ARB document may be obtained from the District.)

The guidelines document contains a brief description of the 3 different methods of calculating fugitive hydrocarbon emissions from equipment component leaks and also provides guidance on how the components and emissions data should be reported to the District. These 3 methods are as follows:

- Method 1:** Average (Default) Emissions Factor Method;
- Method 2:** Correlation Equation Method; and,
- Method 3:** Screening Value Range Method.

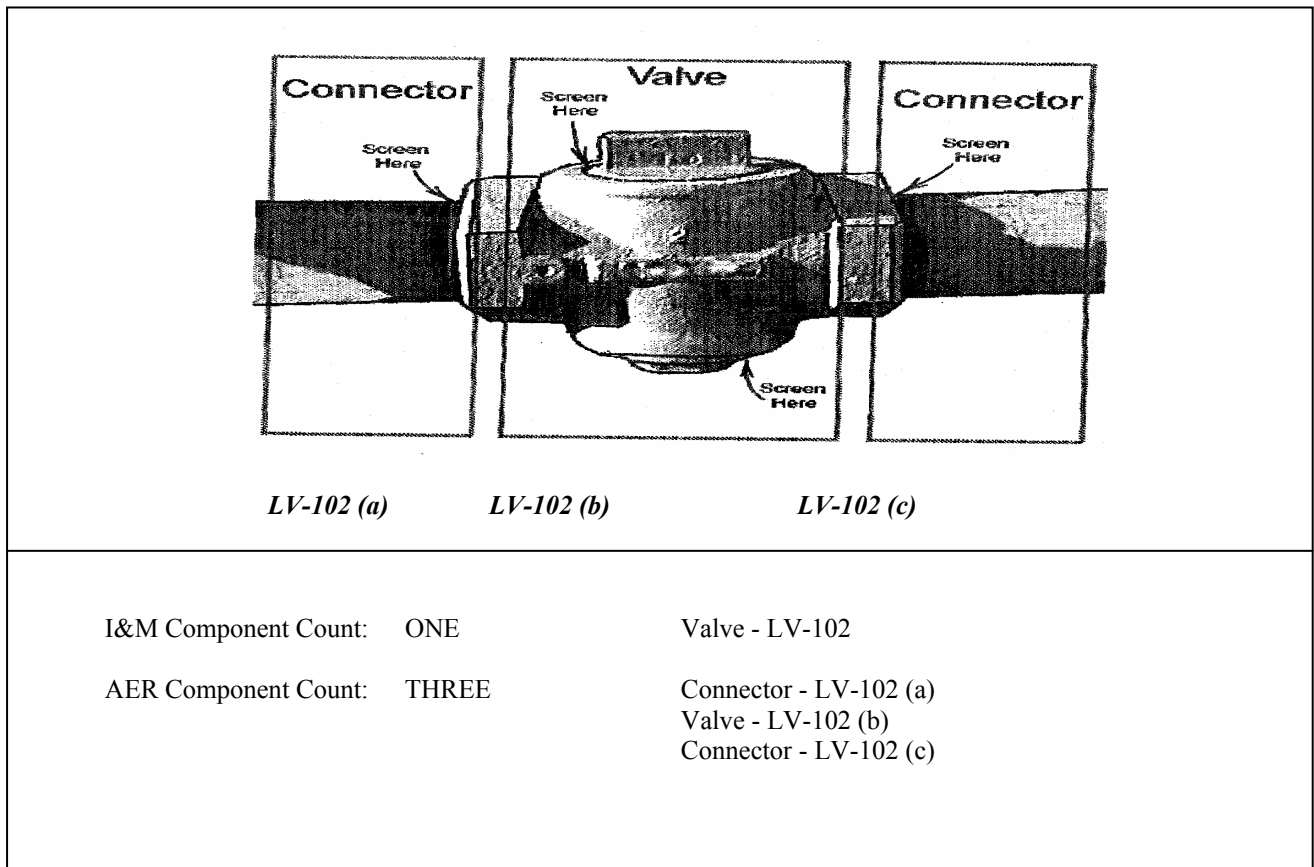
The District may require adjustment of the reported fugitive emissions based on the results of District inspections and/or audits of each refinery's data for discrepancies in reported parameters used for calculating emissions.

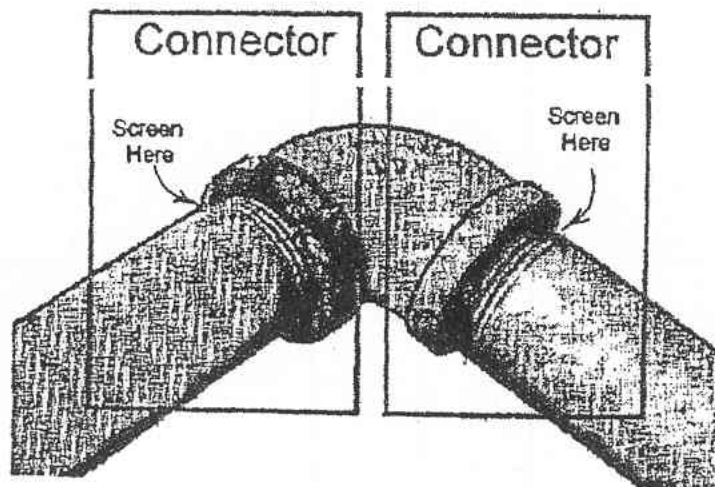
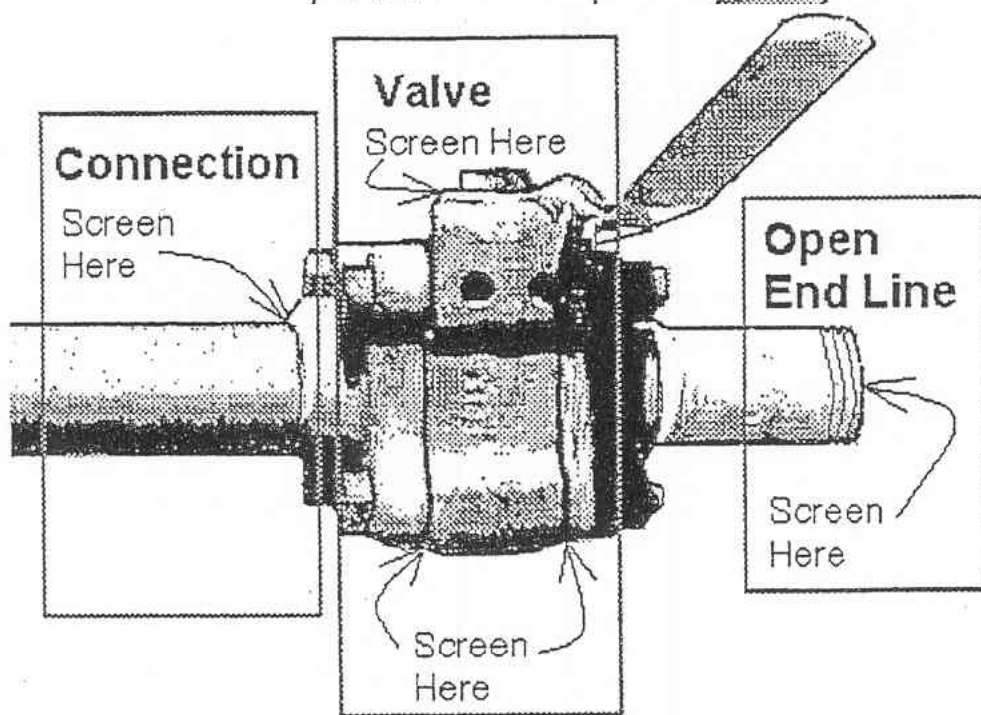
(For questions concerning these guidelines, please call District Help Line at (909) 396-3660.)

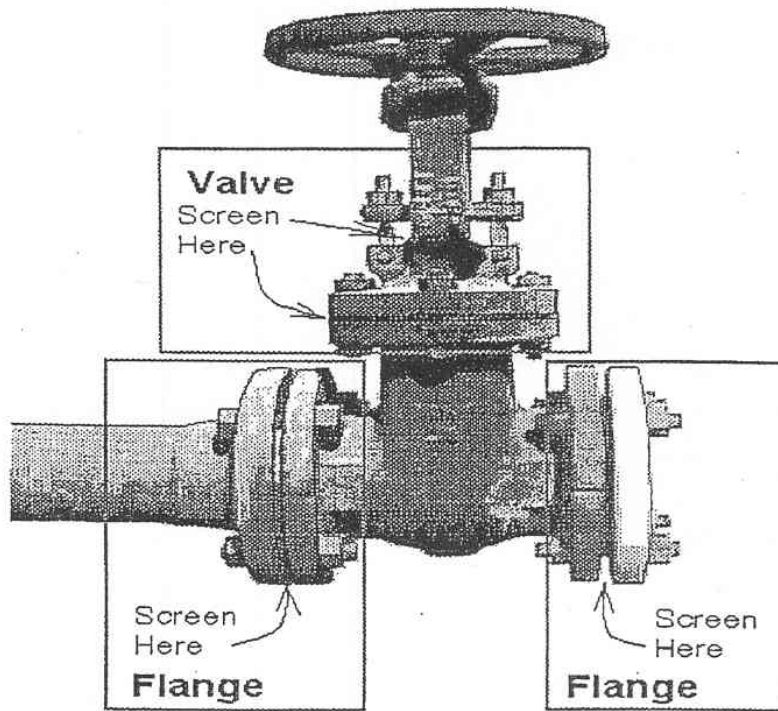
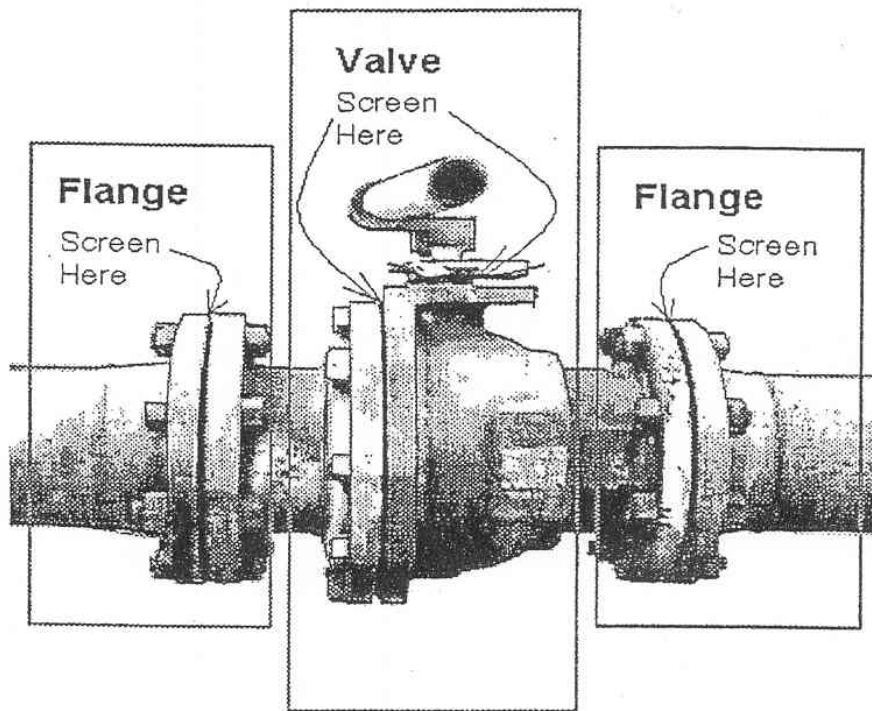
## COMPONENT IDENTIFICATION AND SCREENING ILLUSTRATION

Under Rule 1173 I&M program, components are required to be identified and labeled for screening purposes. For example, as illustrated in the following diagram, a component is identified as a valve and tagged as LV-102.

However, for the Annual Emission Reporting (AER) program, all potential leak points associated with a component must be identified and screened for leaks. For AER purposes, potential leak points are counted as individual components. For example, in the following diagram, although a valve is identified and labeled as LV-102, the potential leak points are identified as 3 individual components: 1 connector (LV-102 (a)), 1 valve (LV-102 (b)), and 1 connector (LV-102 (c)). Emissions for each component are then calculated based on screening values measured. Note that for component LV-102 (b), screening value will be the higher of the two readings from the screening points.







# METHOD 1

## Average Emission Factor Method

**APPLY THIS METHOD TO EACH COMPONENT WITH NO SCREENING DATA AVAILABLE.**

*The Average Emission Factor Method may be used to calculate fugitive emissions only when an Inspection and Maintenance Program (i.e., Rule 1173 or Rule 1176) is not in place at the facility and reliable site-specific screening data are not available. Enter data from the following steps 1, 2, 3 and 4 on Form P1, P1U, R3 or T1 (see form samples on page 20-23) of your Annual Emissions Report and submit supporting documentation for your component counting method.*

### Step 1 Number of Sources (Components)

- (a) All components should be counted including Rule 1173 major and minor components, Rule 1176 components as well as Rule 1176 exempt components (i.e., components with potential emissions). Component identification and counting should also be conducted in accordance with the guidelines specified in the CAPCOA/ARB document, dated February 1999. Refer to page 2-4 for helpful diagrams and examples for component identification and screening. **[Heavy Liquid components are defined as components with liquid streams that contain less than or equal 10 percent by volume of volatile organic compound (VOC). Light liquid components are defined as components with liquid streams that contain more than 10 percent of VOC by volume.]**
- (b) Enter the total number of components by type and service on the applicable forms (P1, P1U, R3 or T1).
- (c) Facilities are required to provide a description of the counting method. This method may include the following: (1) Field Survey; (2) P and ID; (3) Ratio; and (4) Other Methods.

### Step 2 Emission Factors

- (a) Average (default) emission factors for refineries, oil gas production facilities, and marketing terminals are provided in tables on page 6 for each component type (e.g., valves, pumps, fittings, etc.) and service type (e.g., light liquid, gas/vapor and heavy liquid).
- (b) A facility may propose to use other average emission factors as long as these factors are pre-approved by the District.
- (c) Enter emission factors on the applicable forms (P1, P1U, R3 or T1). Report emission factors in pounds/source/year, consistently.

### Step 3 Sub-Total Emissions

- (a) The number of sources or components in each category group should be multiplied by the corresponding average emission factor to obtain the emissions from each category of components.

$$\text{Emissions (pounds)} = (\text{Number of Sources}) \times (\text{Average Emission Factor})$$

- (b) Enter sub-total emissions (in pounds) by component type and service on the applicable forms (P1, P1U, R3 or T1).

### Step 4 Total Emissions

The sub-total of emissions from all categories of components should be added to calculate the total fugitive emissions from the facility. Enter the total fugitive emissions (in pounds and in tons) on the applicable forms (P1, P1U, R3 or T1).

## DISTRICT'S DEFAULT EMISSION FACTORS

### REFINERIES (Form R3)

SOURCE TYPE	ORGANIC GASES Emission Factor (lbs/source/yr)
Valves HC gas/vapor	72
Valves fuel & natural gas	12
Valves light liquid	57
Valves heavy liquid	4.4
Inaccessible valves HC gas/vapor	120
Inaccessible valves light liquid	74
Pumps light liquid	520
Pumps heavy liquid	402
Compressors	2,570
Others (fittings, hatches, sight-glasses, meters, etc.)	4.9
PRVs (no rupture disc)	1,135
Process drains	398

### OIL/GAS PRODUCTION AND CHEMICAL PLANTS (Form P1 or P1U)

SOURCES TYPE	ORGANIC GASES Emission Factors (lbs/source/yr)	METHANE Emission Factors (lbs/source/yr)
Production Facility – Valves in ROG vapor service	12	60
Others (fittings, hatches, sight-glasses, meters, etc.)	4.9	---
Production Facility – Valves in light liquid service	47	10
Production Facility – Valves in heavy liquid service	4.4	---
Production Facility – PRVs to atmosphere (no rupture disc)	567	567
Gas Plant – Valves in ROG service	12	60
Gas Plant – PRVs to atmosphere (no rupture disc)	193	942
Pumps in light liquid service	432	88
Pumps in heavy liquid	86	18
Compressors in vapor recovery service	145	705
Compressors in gas injection service	437	2,133

### TERMINALS/DEPOTS (Form T1)

SOURCE TYPE	ORGANIC GASES Emission Factors (lbs/source/yr)	METHANE Emission Factors (lbs/source/yr)
Valves in ROG vapor service	12	60
Valves in light liquid service	47	10
Valves in heavy liquid service	4.4	---
Pumps in light liquid service	432	88
Pumps in heavy liquid service	86	18
Compressors in vapor recovery service	145	705
PRVs to atmosphere (no rupture disc)	193	942
Others (fittings, hatches, sight-glasses, meters, etc.)	4.9	---



## METHOD 2

### Correlation Equation Method

**APPLY THIS METHOD TO EACH COMPONENT WITH SCREENING DATA.**

*If an Inspection and Maintenance Program (i. e., Rule 1173 or Rule 1176) is in place at the facility and reliable site-specific screening data are available, the Correlation Equation Method can be used to calculate the fugitive emissions. Oil and Gas Production facilities may use the Correlation Equations and Factors for Refineries and Marketing Terminal. Enter data from the following steps on Form P1, P1U, R3, or T1 (see form sample on page 20-23), of your Annual Emissions Report and submit the following supporting documentation:*

- (1) A printed copy of process unit description and the linkage between the process unit code and the component ID as specified in Step 1 (refer to page 19);
- (2) Data diskette(s) with the information specified in the Step 1 in the format shown on page 17 and 18. Note the number of diskette(s) enclosed in the box at the top of the Form P1, P1U, R3 or T1; and,
- (3) A printed copy of the Summary Report as specified in Step 3 in the format shown on page 19.

#### Step 1            Number of Sources (Components)

- (a) All components should be counted including Rule 1173 major and minor components, Rule 1176 components as well as Rule 1176 exempt components (i.e., components with potential emissions). Component identification and counting should also be conducted in accordance with the guidelines specified in the CAPCOA/ARB document, dated February 1999. Refer to page 2-4 for helpful diagrams and examples for component identification and screening. [**Heavy Liquid components are defined as components with liquid streams that contain less than or equal 10 percent by volume of volatile organic compound (VOC). Light liquid components are defined as components with liquid streams that contain more than 10 percent of VOC by volume]**
- (b) For components that are not inspected and screening data is not available. Method 1 should be used. For components that are inspected under the I & M program but screening data is not maintained for screening values lower than the levels specified in District rules, Method 1 average (default) emission factors may be used.
- (c) Facilities should provide a printed copy of the facility-specific process unit description and codes used in their data file(s) submittals. Refer to page 19 for examples of Process Units and Codes.
  - If the process unit code is part of the component ID, identify such tagging system to link component ID with the process unit code.
  - If the process unit code is not part of the component ID, the linkage between the two should be provided in a separate field in the data files(s) submittal.
  - All components not directly associated with any process units should be described and listed by their geographical locations.
  - Using the Screening Data Reporting File Format specified on page 17 and 18, provide the following information on diskette(s):
    - **Indicate each component identification number**
    - **Indicate the Process Units and Codes for each component (Refer to page 19)**
    - **Identify components by their accessibility**
      - Indicate either "A", for accessible or "I", for inaccessible
    - **Identify components by component type**
      - Indicate connector, flange, open-ended line, pump, compressor, etc.
    - **Identify components by service type**
      - Indicate light liquid, gas/vapor, heavy liquid, etc.
    - **Indicate the date of inspection** (not the date of data entry)
    - **Indicate Inspection Date Screening Value (PPMv)**
      - Inspect and report all components and leak points associated with each component, e.g., flanges associated with a valve should be screened and reported separately (refer to page 2-4).
      - Record each component's screening value from the direct readings of the monitoring instrument. Screening values should include screening data recorded by individual facilities as well as the screening data recorded by District (through inspections) for each component for each reporting cycle.

- All screening should be conducted according to the applicable District rules as well as the CPACOA/ARB guidelines, dated February 1999.
- Screening values should be measured by a calibrated monitoring instrument using EPA Method 21 (Refer to Section “Monitoring Instrument Performance Quality Assurance” below)
- All readings must be taken at the interface of component leak points except for rotating shafts which can be taken within 1 cm (centimeter) of the shaft-seal interface.
- Report all screening values including those less than as well as greater than 1,000 PPMv, (i.e., from 0 PPMv up to 100,000 PPMv or greater). Do not subtract background concentration from the direct readings.
- For screening values exceeding the maximum instrument readings of 10,000 or 100,000 PPMv, report as 10,000 or 100,000 PPMv, respectively. (Use the 10,000 PPMv or 100,000 PPMv pegged factors for these screening values, without adjustment for background concentration, during emission calculations.)
- Screening values for components with “liquid leak” should always be reported as “999,999 PPMv”. (For these readings, use the 100,000 PPMv pegged factors without adjustment for background concentration during emission calculations.)

[Monitoring Instrument Performance Quality Assurance

- *Monitoring instrument testing, calibration and measurements should follow EPA Method 21*
- *Facilities should exclusively use Flame Ionization Detectors(FIDs) for monitoring, calibrated with methane with no response factor correction applied.*
- *Records of calibration gas specification as required by EPA Method 21, including but not limited to gas manufacturer, PPMv value, and expiration date should be maintained at the facility for at least two years and made available upon request. Calibration of monitoring instrument should be conducted on a daily basis.*
- *Records of testing and calibration of a monitoring instrument and calibration gas should be maintained at the facility for at least 2 years and made available upon request.]*

- **Indicate the date of repair** (not the date of data entry)
- **Indicate Repair Date Screening Value (PPMv)**
  - Indicate the screening value after the repair. Screening value should be reported “as measured” before the repair and after the repair.
  - Follow the same instruction under “Inspection Date Screening Value (PPMv)”
- **Indicate Background Concentration (PPMv)**
  - A default background concentration of 5 PPMv should be used, if not measured for each component.
  - Report background concentration for each component, if a higher than 5 PPMv concentration is selected. In a separate hard copy, describe the method(s) and locations where measurements were taken.
  - Do not subtract the background concentration from pegged screening values (i.e., values exceeding the instrument’s maximum readings) at 10,000 or 100,000 PPMv. (To calculate emissions, only use 10,000 PPMv or 100,000 PPMv pegged factors, whichever is applicable.) For non-pegged readings, subtract the background concentration from screening values during emission calculations.

(d) Enter the total number of components by type and service on the applicable forms (P1, P1U, R3 or T1).

## Step 2 Emission Factor (Correlation Equation and Factors)

- (a) Use the correlation equations and factors for each component type specified in Table IV-3a on page 10 of this document to calculate fugitive emissions.
- (b) After calculating emissions (outlined in Step 3) for each component type, calculate a composite emission factor by dividing the total emissions for each component type by total number of components as follows:

$$\text{Composite Emission Factor For a Component Type (pounds/source/year)} \\ = (\text{Sub-Total Emissions for a Component Type}) / (\text{Total Number of Components for a Component Type})$$

- (c) Enter the composite emission factors on applicable Forms (P1, P1U, R3 or T1). Report emission factors in pounds/source/year, consistently.

### Step 3 Sub-Total Emissions

- (a) Calculate emissions (in pounds) by component type based on emission rates and correlation equations specified on page 10 of this guidelines document for the following screening ranges: (1) Default Zero Source Range; (2) Correlation Equations Range; (3) The 10,000 PPMv Pegged Source Range; and (4) The 100,000 PPMv Pegged Source Range. (Note that when default zero factors, 10,000 PPMv pegged factors and 100,000 PPMv pegged factors are used, you should not use the correlation equations for calculation emissions.)
- **Default Zero Range Emissions:** When the screening value, adjusted for background, equals to “0.0 (zero)” PPMv, use the default zero.
  - **Correlation Equations Range Emissions:** When the non-pegged screening value (SV), adjusted for background, equals to a value between 0.0 (zero) PPMv and 10,000 PPMv or 100,000 PPMv, use the applicable Correlation Equations.
  - **10,000 PPMv Pegged Source Range Emissions:** When the screening values are pegged at 10,000 PPMv, use 10,000 PPMv pegged factor. Do not adjust for background concentration.
  - **100,000 PPMv Pegged Source Range Emissions:** When the screening values are pegged at 100,000 PPMv, use the 100,000 PPMv pegged factor. Do not adjust for background concentration.
- (b) When a component inspection results in a higher or lower screening value than its previous inspection (e.g., between quarterly inspections), the average of the two calculated mass emission rates is used to calculate mass emissions during that reporting period.
- (c) The emission rate from the first inspection of a component during each reporting period will be used to calculate mass emissions from the beginning of that reporting period (i.e., January 1 for calendar year annual emissions reporting and July 1 for fiscal year annual emissions reporting) through the date of the first inspection.
- (d) The emission rate from the last inspection of a component during each reporting period will be used to calculate mass emissions from the date of the last inspection through the end of that reporting period (i.e., December 31 for calendar year annual emissions reporting, and June 30 for fiscal year annual emissions reporting).
- (e) Enter sub-total emissions (in pounds) by component type and service on the applicable forms (P1, P1U, R3 or T1).
- (f) Provide Summary Report (refer to example on page 19). In the Summary Report, include total number of records submitted and report total emissions by process unit code to assure the data integrity and to assist in identifying possible discrepancies. The facility-specific process unit code should be consistent with the hard copy provided to the District in facility submittals.

### Step 4 Total Emissions

The sub-total of emissions from all categories of components should be added to calculate the total fugitive emissions from the facility. Enter total fugitive emissions (in pounds and in tons) on the applicable forms (P1, P1U, R3 or T1).

**TABLE IV-3a: CAPCOA-REVISED 1995 EPA CORRELATION EQUATIONS AND FACTORS FOR REFINERIES AND MARKETING TERMINALS <sup>a</sup>**

Component Type/ Service Type	Default Zero Factor <sup>b</sup> <b>lb/hr</b> [kg/hr]	Correlation Equation <sup>c</sup> <b>lb/hr</b> [kg/hr]	Pegged Factor <sup>d</sup> <b>lb/hr</b> [kg/hr]	
			10,000 ppmv	100,000 ppmv
Valves/All	<b>1.7E-05</b> [7.8E-06]	<b>5.00E-06(SV)^0.747</b> [2.27E-06(SV)^0.747]	<b>0.141</b> [0.064]	<b>0.304</b> [0.138]
Pump seals/All	<b>4.2E-05</b> [1.9E-05]	<b>1.12E-04(SV)^0.622</b> [5.07E-05(SV)^0.622]	<b>0.196</b> [0.089]	<b>1.342</b> [0.610] <sup>e</sup>
Others <sup>f</sup> /All	<b>8.8E-06</b> [4.0E-06]	<b>1.92E-05(SV)^0.642</b> [8.69E-06(SV)^0.642]	<b>0.181</b> [0.082]	<b>0.304</b> [0.138]
Connectors/All	<b>1.7E-05</b> [7.5E-06]	<b>3.37E-06(SV)^0.736</b> [1.53E-06(SV)^0.736]	<b>0.066</b> [0.030]	<b>0.075</b> [0.034]
Flanges/All	<b>6.8E-07</b> [3.1E-07]	<b>9.92E-06(SV)^0.706</b> [4.53E-06(SV)^0.706]	<b>0.209</b> [0.095]	<b>0.209</b> [0.095]
Open-ended lines/All	<b>4.4E-06</b> [2.0E-06]	<b>4.19E-06(SV)^0.724</b> [1.90E-06(SV)^0.724]	<b>0.073</b> [0.033]	<b>0.180</b> [0.082]

<sup>a</sup>Source: SBCAPCD Report, dated May 1, 1997, entitled *Review of the 1995 Protocol: The Correlation Equation Approach To Quantifying Fugitive Hydrocarbon Emissions At Petroleum Industry Facilities*. Technical corrections and adjustments were made to the refineries and marketing terminals bagged data, obtained by use of the blowthrough method, to account for the hydrocarbon leak flow rate.

<sup>b</sup>The default zero factors apply only when the screening value (SV), corrected for background, equals 0.0 ppmv (i.e., the screening value is indistinguishable from background reading). The default zero factors were based on the combined 1993 refinery and marketing terminal data only; default zero data were not collected from oil and gas production facilities.

<sup>c</sup>The correlation equations apply for actual screening values, corrected for background, between background and 9,999 ppmv and can be used for screening values up to 99,999 ppmv at the discretion of the local district.

<sup>d</sup>The 10,000 ppmv pegged factors apply for screening values, corrected for background, equal to or greater than 10,000 ppmv and are used when the correlation equations are used for screening values between background and 9,999 ppmv. The 100,000 ppmv pegged factors apply for screening values reported pegged at 100,000 ppmv and are used when the local district authorizes use of the correlation equations for screening values between background and 99,999 ppmv.

<sup>e</sup>Only 3 data points were available for the pump seals 100,000 ppmv pegged factor.

<sup>f</sup>The “other” component type includes instruments, loading arms, pressure relief valves, vents, compressors, dump lever arms, diaphragms, drains, hatches, meters, and polished rods stuffing boxes. This “others” component type should be applied for any component type other than connectors, flanges, open-ended lines, pumps, or valves. However, if an acceptable emission estimate exists which more accurately predicts emissions from the source, then that emission estimate applies (e.g., positive flowing junction boxes in SCAQMD). (For components such as junction box vents with positive flow, use the following correlation equation:  $3.148E-04 (SV)^{1.02}$  lb/hr [ $1.428E-04(SV)^{1.02}$  kg/hr]).

Reference: California Implementation Guidelines for Estimating Mass Emissions of Fugitive Hydrocarbon Leaks at Petroleum Facilities, CAPCOA/ARB, February 1999
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## METHOD 3

### Screening Value Range Method

**APPLY THIS METHOD TO EACH COMPONENT WITH SCREENING DATA AS AN ALTERNATIVE TO METHOD 2 – CORRELATION EQUATION METHOD.**

*If an Inspection and Maintenance Program (i.e., Rule 1173 or Rule 1176) is in place at the facility and reliable site-specific screening data are available, the facility may choose to use the Screening Value Range Method to calculate the fugitive emissions as an alternative to Method 2 – Correlation Equation Method. In the Screening Value Range Method, emissions are calculated using the average screening value range factors based on two specific leak levels. Note that facilities may not use the Screening Value Range Method in combination with the Correlation Equation Method. Enter data from the following steps on Form P1, P1U, R3, or T1 (see form sample on page 20-23), of your Annual Emissions Report and submit the following supporting documentation:*

- (1) A printed copy of process unit description and the linkage between the process unit code and the component ID as specified in Step 1 (refer to page 19);
- (2) The diskette(s) with the information specified in the Step 1 in the format shown on page 17 and 18. Note the number of diskette(s) enclosed in the box at the top of the Form P1, P1U, R3 or T1; and,
- (3) A printed copy of the Summary Report as specified in Step 3 in the format shown on page 19.

#### Step 1            Number of Sources (Components)

- (a) All components should be counted including Rule 1173 major and minor components, Rule 1176 components as well as Rule 1176 exempt components (i.e., components with potential emissions). Component identification and counting should also be conducted in accordance with the guidelines specified in the CAPCOA/ARB document, dated February 1999. Refer to page 2-4 for helpful diagrams and examples for component identification and screening. [**Heavy Liquid components are defined as components with liquid streams that contain less than or equal 10 percent by volume of volatile organic compound (VOC). Light liquid components are defined as components with liquid streams that contain more than 10 percent of VOC by volume]**
- (b) For components that are not inspected and screening data is not available. Method 1 should be used.
- (c) Facilities should provide a printed copy of the facility-specific process unit description and codes used in their data file(s) submittals. Refer to page 19 for examples of Process Units and Codes.
  - If the process unit code is part of the component ID, identify such tagging system to link component ID with the process unit code.
  - If the process unit code is not part of the component ID, the linkage between the two should be provided in a separate field in the data files(s) submittal.
  - All components not directly associated with any process units should be described and listed by their geographical locations.
- (d) Using the Screening Data Reporting File Format specified on page 17 and 18, provide the following information on diskette(s):
  - **Indicate each component identification number**
  - **Indicate the Process Units and Codes for each component**
  - **Identify components by their accessibility**
    - Indicate either “A”, for accessible or “I”, for inaccessible
  - **Identify components by component type**
    - Indicate connector, flange, open-ended line, pump, compressor, etc.
  - **Identify components by service type**
    - Indicate light liquid, gas/vapor, heavy liquid, etc.
  - **Indicate the date of inspection** (not the date of data entry)
  - **Indicate Inspection Date Screening Value (PPMv)**

- Inspect and report all components and leak points associated with each component, e.g., flanges associated with a valve should be screened and reported separately (refer to page 2-4).
- Record each component's screening value from the direct readings of the monitoring instrument. Screening values should include screening data recorded by individual facilities as well as the screening data recorded by District (through inspections) for each component for each reporting cycle.
- All screening should be conducted according to the applicable District rules as well as the CPACOA/ARB guidelines, dated February 1999.
- Screening values should be measured by a calibrated monitoring instrument using EPA Method 21 (Refer to Section "Monitoring Instrument Performance Quality Assurance" below)
- All readings must be taken at the interface of potential leak sources except for rotating shafts which can be taken within 1 cm (centimeter) of the shaft-seal interface.
- Report all screening values including those less than as well as greater than 1,000 PPMv, (i.e., from 0 PPMv up to 100,000 PPMv or greater). Do not subtract background concentration from the direct readings.
- For screening values less than or greater than 100,000 PPMv, report all the values as measured. (Use the applicable <10,000 PPMv or ≥10,000 PPMv screening value range emission factors during emission calculations.)
- Screening values for components with "liquid leak" should always be reported as "999,999 PPMv". (For these readings, use the applicable ≥10,000 PPMv screening range value emission factors without subtracting background concentration during emission calculations.)

Monitoring Instrument Performance Quality Assurance

- *Monitoring instrument testing, calibration and measurements should follow EPA Method 21*
- *Facilities should exclusively use Flame Ionization Detectors(FIDs) for monitoring, calibrated with methane with no response factor correction applied.*
- *Records of calibration gas specification as required by EPA Method 21, including but not limited to gas manufacturer, PPMv value, and expiration date should be maintained at the facility for at least two years and made available upon request. Calibration of monitoring instrument should be conducted on a daily basis.*
- *Records of testing and calibration of a monitoring instrument and calibration gas should be maintained at the facility for at least 2 years and made available upon request.]*

- **Indicate the date of repair** (not the date of data entry)
- **Indicate Repair Date Screening Value (PPMv)**
  - Indicate the screening value after the repair. Screening value should be reported "as measured" before the repair and after the repair.
  - Follow the same instruction under "Inspection Date Screening Value (PPMv)"
- **Indicate Background Concentration (PPMv)**
  - A default background concentration of 5 PPMv should be used, if not measured for each component.
  - Report background concentration for each component, if a higher than 5 PPMv concentration is selected. In a separate hard copy, describe the method(s) and locations where measurements were taken.
  - Do not subtract the background concentration from pegged screening values. Subtract the background concentration only from screening values during emission calculations.

(e) Enter the total number of components by type and service on the applicable forms (P1, P1U, R3 or T1).

## Step 2 Emission Factor (Screening Value Range Factors)

- (a) Use the Screening Value Range Emission Factors provided in Table IV-2a, 2b, and 2c on page 14-16 to calculate the fugitive emissions.
- (b) After calculation emissions (outlined in Step 3) for each component type, calculate a composite emission factor (in pounds/source/year) by dividing the total emissions for each component type by total number of components as follows:

$$\text{Composite Emission Factor For a Component Type (pounds/source/year)} \\ = (\text{Sub-Total Emissions for a Component Type}) / (\text{Total Number of Components for a Component Type})$$

- (c) Enter the composite emission factors on applicable Forms (P1, P1U, R3 or T1). Report emission factors in pounds/source/year, consistently.

### **Step 3            Sub-Total Emissions**

- (a) Calculate emissions (in pounds) by component type based on screening value range emission factor specified on page 14-16 of this guidelines document for the following screening ranges: (1) <10,000 PPMv Emission Factor; and (2) ≥10,000 PPMv Emission Factor.
- (b) When a component inspection results in a higher or lower screening value than its previous inspection (e.g., between quarterly inspections), the average of the two calculated mass emission rates is used to calculate mass emissions during that reporting period.
- (c) The emission rate from the first inspection of a component during each reporting period will be used to calculate mass emissions from the beginning of that reporting period (i.e., January 1 for calendar year annual emissions reporting and July 1 for fiscal year annual emissions reporting) through the date of the first inspection).
- (d) The emission rate from the last inspection of a component during each reporting period will be used to calculate mass emissions from the date of the last inspection through the end of that reporting period (i.e., December 31 for calendar year annual emissions reporting, and June 30 for fiscal year annual emissions reporting).
- (e) Enter sub-total emissions (in pounds) by component type and service on the applicable forms (P1, P1U, R3 or T1).
- (f) Provide Summary Report (refer to example on page 19). In the Summary Report, include total number of records submitted and report total emissions by process unit code to assure the data integrity and to assist in identifying possible discrepancies. The facility-specific process unit code should be consistent with the hard copy provided to the District in facility submittals.

### **Step 4            Total Emissions**

The sub-total of emissions from all categories of components should be added to calculate the total fugitive emissions from the facility. Enter the total fugitive emissions (in pounds and in tons) on the applicable forms (P1, P1U, R3 or T1).

TABLE IV-2a: 1995 EPA PROTOCOL REFINERY  
SCREENING VALUE RANGE EMISSION FACTORS<sup>a</sup>

Component Type	Service Type	< 10,000 ppmv Emission Factor (kg/hr/source) <sup>b</sup>	< 10,000 ppmv Emission Factor (lbs/hr/source) <sup>b</sup>	≥ 10,000 ppmv Emission Factor (kg/hr/source) <sup>b</sup>	≥ 10,000 ppmv Emission Factor (lbs/hr/source) <sup>b</sup>
Valves	Gas	6.0E-04	<b>1.3E-03</b>	2.626E-01	<b>5.8E-01</b>
	Light liquid	1.7E-03	<b>3.7E-03</b>	8.52E-02	<b>1.9E-01</b>
	Heavy liquid	2.3E-04	<b>5.1E-04</b>	2.3E-04	<b>5.1E-04</b>
Pump seals <sup>c</sup>	Light liquid	1.20E-02	<b>2.6E-02</b>	4.37E-01	<b>9.6E-01</b>
	Heavy liquid	1.35E-02	<b>3.0E-02</b>	3.885E-01	<b>8.5E-01</b>
Compressor seals	Gas	8.94E-02	<b>2.0E-01</b>	1.608	<b>3.54</b>
Pressure relief valves	Gas	4.47E-02	<b>9.8E-02</b>	1.691	<b>3.72</b>
Connectors	All	6.0E-05	<b>1.3E-04</b>	3.75E-02	<b>8.3E-02</b>
Open-ended lines	All	1.5E-03	<b>3.3E-03</b>	1.195E-02	<b>2.6E-02</b>

<sup>a</sup>Source: *1995 EPA Protocol for Equipment Leak Emission Estimates* (EPA-453/R-95-017, November 1995) which referenced the 1982 Petroleum Refining Study (EPA-450/3-82-010, 1982). These factors are based on the 1980 and 1982 refining fugitive emissions studies.

<sup>b</sup>These factors are for non-methane organic compound emission rates.

<sup>c</sup>The light liquid pump seals factor can be used to estimate the leak rate from agitator seals.

Reference: California Implementation Guidelines for Estimating Mass Emissions of Fugitive Hydrocarbon Leaks at Petroleum Facilities, CAPCOA/ARB, February 1999.
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**TABLE IV-2b: 1995 EPA PROTOCOL MARKETING TERMINAL  
SCREENING VALUE RANGE EMISSION FACTORS<sup>a</sup>**

Component Type	Service Type	< 10,000 ppmv THC Emission Factor (kg/hr/source) <sup>b</sup>	< 10,000 ppmv THC Emission Factor (lbs/hr/source) <sup>b</sup>	≥ 10,000 ppmv THC Emission Factor (kg/hr/source) <sup>b</sup>	≥ 10,000 ppmv THC Emission Factor (lbs/hr/source) <sup>b</sup>
Valves	Gas	1.3E-05	<b>2.9E-05</b>	N/A	N/A
	Light liquid	1.5E-05	<b>3.3E-05</b>	2.3E-02	<b>5.1E-02</b>
Pump seals	Light liquid	2.4E-04	<b>5.3E-04</b>	7.7E-02	<b>1.7E-01</b>
Others (compressors and others) <sup>c</sup>	Gas	1.2E-04	<b>2.6E-04</b>	N/A	N/A
	Light liquid	2.4E-05	<b>5.3E-05</b>	3.4E-02	<b>7.5E-02</b>
Fittings (connectors and flanges) <sup>d</sup>	Gas	5.9E-06	<b>1.3E-05</b>	3.4E-02	<b>7.5E-02</b>
	Light liquid	7.2E-06	<b>1.6E-05</b>	6.5E-03	<b>1.4E-02</b>

<sup>a</sup>Source: 1995 EPA Protocol for Equipment Leak Emission Estimates (EPA-453/R-95-017, November 1995). NOTE: These factors have not been corrected to reflect the technical corrections and adjustments discussed in Section III of the implementation guidelines.

<sup>b</sup>These factors are for total organic compound emission rates (including non-VOC's such as methane and ethane). "NA" indicates that not enough data were available to develop the indicated emission factor.

<sup>c</sup>The "Others" component type should be applied for any component type other than fittings, pump seals, or valves.

<sup>d</sup>"Fittings" were not identified as flanges or non-flanged connectors; therefore, the fitting emissions were estimated by averaging the estimates from the connector and the flange correlation equations.

Reference: California Implementation Guidelines for Estimating Mass Emissions of Fugitive Hydrocarbon Leaks at Petroleum Facilities, CAPCOA/ARB, February 1999.
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**TABLE IV-2c: CAPCOA OIL AND GAS PRODUCTION  
SCREENING VALUE RANGE EMISSION FACTORS<sup>a</sup>**

Component Type	Service Type	< 10,000 ppmv THC Emission Factor (kg/hr/source) <sup>b</sup>	< 10,000 ppmv THC Emission Factor (lbs/hr/source) <sup>b</sup>	≥ 10,000 ppmv THC Emission Factor (kg/hr/source) <sup>b</sup>	≥ 10,000 ppmv THC Emission Factor (lbs/hr/source) <sup>b</sup>
Valves	Gas/Light Liquid	3.5E-05	<b>7.7E-05</b>	1.386E-01	<b>3.0E-01</b>
	Light Crude Oil	1.90E-05	<b>4.2E-05</b>	7.07E-02	<b>1.6E-01</b>
	Heavy Crude Oil	1.40E-05	<b>3.1E-05</b>	N/A	<b>N/A</b>
Pump seals	Gas/Light Liquid	9.96E-04	<b>2.2E-03</b>	8.9E-02	<b>2.0E-01</b>
	Light Crude Oil	2.65E-04	<b>5.8E-04</b>	8.9E-02	<b>2.0E-01</b>
	Heavy Crude Oil	N/A	<b>N/A</b>	N/A	<b>N/A</b>
Others <sup>c</sup>	Gas/Light Liquid	1.47E-04	<b>3.2E-04</b>	1.376E-01	<b>3.0E-01</b>
	Light Crude Oil	1.31E-04	<b>2.9E-04</b>	7.1E-03	<b>1.6E-02</b>
	Heavy Crude Oil	5.7E-05	<b>1.3E-04</b>	N/A	<b>N/A</b>
Connectors	Gas/Light Liquid	1.20E-05	<b>2.6E-05</b>	2.59E-02	<b>5.7E-02</b>
	Light Crude Oil	1.0E-05	<b>2.2E-05</b>	2.34E-02	<b>5.1E-02</b>
	Heavy Crude Oil	8.0E-06	<b>1.8E-05</b>	N/A	<b>N/A</b>
Flanges	Gas/Light Liquid	2.80E-05	<b>6.2E-05</b>	6.1E-02	<b>1.3E-01</b>
	Light Crude Oil	2.4E-05	<b>5.3E-05</b>	2.6E-01	<b>5.7E-01</b>
	Heavy Crude Oil	2.3E-05	<b>5.1E-05</b>	N/A	<b>N/A</b>
Open-ended lines	Gas/Light Liquid	2.4E-05	<b>5.3E-05</b>	5.49E-02	<b>1.2E-01</b>
	Light Crude Oil	1.8E-05	<b>4.0E-05</b>	2.22E-02	<b>4.9E-02</b>
	Heavy Crude Oil	1.5E-05	<b>3.3E-04</b>	7.11E-02	<b>1.6E-01</b>

<sup>a</sup>Source: Fax Transmittal from STAR Environmental, dated December 17, 1997, entitled *Comparison of Screening Value Range Factors for Oil and Gas Production Operations*. These factors were developed using the separated oil and gas production default zero factors and pegged factors. Correlation equations for the petroleum industry (revised to reflect the technical corrections and adjustments discussed in Section III of the implementation guidelines) were used for components with screening values between background and 9,999 ppmv.

<sup>b</sup>These factors are for total organic compound emission rates (including non-VOC's such as methane and ethane) and apply to light crude, heavy crude, gas plant, gas production, and off shore facilities.

<sup>c</sup>The "Others" component type was derived from compressors, diaphragms, drains, dump arms, hatches, instruments, meters, pressure relief valves, polished rods stuffing boxes, relief valves, and vents. This "Others" component type should be applied for any component type other than connectors, flanges, open-ended lines, pumps, or valves.

Reference: California Implementation Guidelines for Estimating Mass Emissions of Fugitive Hydrocarbon Leaks at Petroleum Facilities, CAPCOA/ARB, February 1999.
---

## Screening Data Reporting File Format

1. Component Identification and Count
  - Sort the file so that each inspection of a component is listed consecutively by component ID.
  - This field shall be up to 20 alpha-numeric characters in length.
2. Process Unit/Code (Optional)
  - This field shall be up to 10 alpha-numeric characters in length.
  - Leave this field blank if no information is provided.
3. Accessible Versus Inaccessible Component Identification
  - This field shall be 1 alpha character (A or I).
4. Component Type (Description of Component)
  - This field shall be up to 10 alpha characters in length.
5. Component Service Type
  - This field shall be up to 12 alpha characters in length.
6. Inspection Date
  - This field shall be a date field with a length of 8 (MM/DD/YY).
7. Inspection Date Screening Value (PPM)
  - This field shall be a numeric field with a length of 7.
8. Repair Date
  - This field shall be a date field with a length of 8 (MM/DD/YY).
9. Repair Date Screening Value (PPM)
  - This field shall be a numeric field with a length of 7.
10. Background Concentration (PPM)
  - This field shall be a numeric field with a length of 7.

**Note:**

- ✓ An example of the data and format is given on next page.
- ✓ This data should be submitted on floppy disks in fixed length ASCII format with 90 characters per record.
- ✓ If you have any questions concerning the data format, please contact AQMD Help Hotline (909) 396-3660.

## Screening Data Reporting File Format (Continued)

### DATA FORMAT

Component ID	Process Code	A or I	Component Type	Service Type	Inspection Date	Inspection Date Screening Value (PPM)	Repair Date	Repair Date Screening Value (PPM)	Background Concentration (PPM)
20 alpha	10 alpha	1 alpha	10 alpha	12 alpha	8(MM/DD/YY)	7 numeric	8(MM/DD/YY)	7 numeric	7 numeric

### Example:

Component ID	Process Code	A or I	Component Type	Service Type	Inspection Date	Inspection Date Screening Value (PPM)	Repair Date	Repair Date Screening Value (PPM)	Background Concentration (PPM)
BXAAQ12345	DCU	A	Pump	Heavy Liquid	01/12/94	300			
BXAAQ12345	DCU	A	Pump	Heavy Liquid	04/20/94	5500	04/21/94	80	
BXAAQ12345	DCU	A	Pump	Heavy Liquid	07/03/94	100			
BXAAQ12345	DCU	A	Pump	Heavy Liquid	11/20/94	50			
011AB23467	DCU	I	Valve	Heavy Liquid	01/12/94	100			
011AB23467	DCU	I	Valve	Heavy Liquid	04/20/94	8000	04/21/94	50	
011AB23467	DCU	I	Valve	Heavy Liquid	07/03/94	50			
011AB23467	DCU	I	Valve	Heavy Liquid	11/20/94	20			

## Example of Summary Report of Emissions

**FACILITY ID: 800888**

Process* Code	Process Description	Number of Records	Total Emissions (lbs)
XXX	Crude Unit	10000	5000
XXX	FCCU	20000	10000
XXX	Gasoline Blending	2000	5000
XXX	#1 SRU	480	200
XXX	#2 SRU	720	100
XXX	Tail Gas Unit	800	500
TOTAL		34000	20800

\*Facility-specific process unit/code used in the data file(s)

### EXAMPLES OF PROCESS UNITS AND CODES

- 01 ATMOSPHERIC DISTILLATION UNIT
- 02 VACUUM DISTILLATION UNIT
- 03 COKING UNIT
- 04 HYDROTREATING UNIT
- 05 FCCU
- 06 FCCU GAS PLANT
- 07 CATALYTIC REFORMING UNIT
- 08 ALKYLATION UNIT
- 09 HYDROCRACKING UNIT
- 10 GASOLINE BLENDING
- 11 SULFUR ACID PLANT
- 12 TAIL GAS UNIT
- 13 SULFURIC ACID PLANT
- 14 HYDROGEN PLANT
- 15 LOADING FACILITY
- 16 TANK FARMS
- 17 LPG STORAGE
- 18 FUEL GAS TREATING UNIT
- 19 PRODUCT TREATING UNIT
- 20 FLARE SYSTEM
- 99 OTHERS

# Form P1

## PERMITTED ANNUAL FUGITIVE EMISSIONS SUMMARY - OIL/GAS PRODUCTION & CHEMICAL PLANTS

Annual Emissions Report  
July 2002 - June 2003

- Read instructions on the back and Guidelines for Fugitive Emission Calculations before completing form.
- Record each row on Form ES.

FACILITY NAME \_\_\_\_\_

FACILITY I.D. NUMBER

--	--	--	--	--	--

If you used Correlation Equations / Screening Value Range Method, please enter the number of data diskettes you are enclosing.

ROG Source (a)	TAC/ ODC (Y/N) (b)	Number of Sources (c)	EMISSION FACTORS (lbs/source)		ANNUAL EMISSIONS (lbs)	
			Organic Gases (d)	Methane (e)	Organic Gases (c) x (d)	Methane (c) x (e)
Valves in vapor service						
Valves in light liquid service						
Valves in heavy liquid service						
Pumps in light liquid service						
Pumps in heavy liquid service						
Compressors in vapor recovery service						
Compressors in gas injection service						
PRVs/P-V valves to atmosphere (no rupture disc)						
Connectors						
Flanges						
Others (hatches, drains, sight-glasses, meters, etc.)						
1. TOTAL EMISSIONS (lbs)						
2. Divide each TOTAL EMISSIONS (lbs) by 2000 then transfer to Form R1, Line 10 (tons)						

- Oil/Gas Production Facility   
 Gas Plant   
 Chemical Plant

1. TOTAL EMISSIONS (lbs)

2. Divide each TOTAL EMISSIONS (lbs) by 2000 then transfer to Form R1, Line 10 (tons)

S.C.A.Q.M.D. reserves the right to audit the reported emissions. All records and calculations used in completing this summary are recommended to be retained for a minimum of five years.



South Coast Air Quality Management District  
Form P1 7/1/03

Sample

# Form P1U

## NON-PERMITTED ANNUAL FUGITIVE EMISSIONS SUMMARY - OIL/GAS PRODUCTION & CHEMICAL PLANTS

Annual Emissions Report  
July 2002 - June 2003

- Read instructions on the back and Guidelines for Fugitive Emission Calculations before completing form.
- Record each row on Form ES.

FACILITY NAME \_\_\_\_\_

FACILITY I.D. NUMBER \_\_\_\_\_

If you used Correlation Equations / Screening Value Range Method, please enter the number of data diskettes you are enclosing.

ROG Source (a)	TAC/ ODC (Y/N) (b)	Number of Sources (c)	EMISSION FACTORS (lbs/source)		ANNUAL EMISSIONS (lbs)	
			Organic Gases (d)	Methane (e)	Organic Gases (c) x (d)	Methane (c) x (e)
Valves in vapor service						
Valves in light liquid service						
Valves in heavy liquid service						
Pumps in light liquid service						
Pumps in heavy liquid service						
Compressors in vapor recovery service						
Compressors in gas injection service						
PRVs/P-V valves to atmosphere (no rupture disc)						
Connectors						
Flanges						
Others (hatches, drains, sight-glasses, meters, etc.)						
<b>1. TOTAL EMISSIONS (lbs)</b>						
<b>2. Divide each TOTAL EMISSIONS (lbs) by 2000 then transfer to Form R1, Line 10 (tons)</b>						

Oil/Gas Production Facility

Gas Plant

Chemical Plant

1. TOTAL EMISSIONS (lbs)

2. TOTAL EMISSIONS (tons)

S.C.A.Q.M.D. reserves the right to audit the reported emissions. All records and calculations used in completing this summary are recommended to be retained for a minimum of five years.



# Form R3

## PERMITTED ANNUAL REFINERY FUGITIVE EMISSIONS SUMMARY

Annual Emissions Report  
July 2002 - June 2003

- Read instructions on the back and Guidelines for Fugitive Emission Calculations before completing form.
- Record each row on Form ES.

If you used Correlation Equations / Screening Value Range Method, please enter the number of data diskettes you are enclosing.

FACILITY NAME \_\_\_\_\_

FACILITY I.D. NUMBER

--	--	--	--	--	--

Source Type (a)	TAC/ ODC (Y/N) (b)	Number of Sources (c)	Emission Factor [lbs/source] (d)	Organic Gases (lbs) (e) = (c) x (d) (e)	METHANE Annual Emissions for Fuel & Natural Gas Valves (f)
Valves HC gas/vapor					
Valves fuel and natural gas					
Valves light liquid					
Valves heavy liquid					
Inaccessible valves HC gas/vapor					
Inaccessible valves light liquid					
Pumps light liquid					
Pumps heavy liquid					
Compressors					
Others (connectors, hatches, sight-glasses, meters, etc.)					
PRVs (no rupture disc)					
Process drains					
Pumps equipped with double mechanical/landem seals					
Compressor equipped with a closed vent system					
<b>1. TOTAL EMISSIONS (lbs)</b>					
<b>2. Divide Total Emissions (lbs) by 2000 then transfer to Form R1, Line 5 (tons)</b>					
					<b>x 60.0</b>

Sample

S.C.A.Q.M.D. reserves the right to audit the reported emissions. All records and calculations used in completing this summary are recommended to be retained for a minimum of five years.





# Form T1

## PERMITTED ANNUAL FUGITIVE EMISSIONS SUMMARY - TERMINALS/DEPOTS

Annual Emissions Report  
July 2002 - June 2003

- Read instructions on the back and Guidelines for Fugitive Emission Calculations before completing form.
- Record each row on Form ES.

FACILITY NAME \_\_\_\_\_

FACILITY I.D. NUMBER 

--	--	--	--	--

If you used Correlation Equations / Screening Value Range Method, please enter the number of data diskettes you are enclosing.

ROG Source (a)	TAC/ ODC (Y/N) (b)	NUMBER OF SOURCES (c)	EMISSION FACTORS (lbs/source)		ANNUAL EMISSIONS (lbs)	
			Organic Gases (d)	Methane (e)	Organic Gases (c) x (d)	Methane (c) x (e)
Valves in ROG vapor service						
Valves in light liquid service						
Valves in heavy liquid service						
Pumps in light liquid service						
Pumps in heavy liquid service						
Compressors in vapor recovery service						
PRV's to atmosphere (no rupture disc)						
Others (connectors, hatches, sight-glasses, meters, etc.)						
<b>1. TOTAL EMISSIONS (lbs)</b>						
<b>2. Divide Line 1 by 2000 then transfer to Form R1, Line 12 (tons)</b>						

Sample

S.C.A.Q.M.D. reserves the right to audit the reported emissions. All records and calculations used in completing this summary are recommended to be retained for a minimum of five years.

