

RULE 4451 VALVES, PRESSURE RELIEF VALVES, FLANGES, THREADED CONNECTIONS AND PROCESS DRAINS AT PETROLEUM REFINERIES AND CHEMICAL PLANTS (Adopted April 11, 1991, Amended December 17, 1992; Amended April 20, 2005)

1.0 Purpose

The purpose of this rule is to limit leaks from valves, flanges, threaded connections and process drains that may result in fugitive emissions of VOC at petroleum refineries and chemical plants. Inspection, repair and maintenance schedules, recordkeeping and administrative requirements, and test methods are specified.

2.0 Applicability

This rule applies to all valves, pressure relief valves, flanges, threaded connections and process drains at petroleum refineries and chemical plants that may be the source of fugitive VOC emissions. The provisions of this rule shall expire on April 19, 2006.

3.0. Definitions

- 3.1 Background: a reading on a portable hydrocarbon detection instrument which is taken at least three (3) meters upwind from any valve, pressure relief valve (PRV), flange, threaded connections, or process drain to be inspected and which is uninfluenced by any specific emission point.
- 3.2 Chemical plant: an establishment that produces organic chemicals and/or manufactures products by organic chemical processes.
- 3.3 Commercial natural gas: a mixture of gaseous hydrocarbons, chiefly methane and less than ten (10) percent VOCs excluding ethane as determined in accordance with ASTM Methods E168-67, E169-63, or E260-73, used as a fuel and obtained from a company licensed to dispense such gases.
- 3.4 Component Type: any one (1) of the following groups: valves, pressure relief valves, flanges, threaded connections, and process drains.
- 3.5 Essential Device: any device which cannot be taken out of service without reducing by more than 33 percent the throughput of the process unit which it serves.
- 3.6 Essential Refinery Operation: any operation which cannot be taken out of service without reducing by more than 33 percent the throughput of the process unit which it serves.
- 3.7 Flange: a projecting rim on a pipe used to attach it to another pipe or any other component in a piping system.

- 3.8 Inaccessible: a location that is over 15 feet above ground when access is required from the ground; or a location that is over six (6) feet away from a platform when access is required from the platform.
- 3.9 Leak:
- 3.9.1 for valves, flanges and threaded connections:
- 3.9.1.1 the dripping of liquid organic compounds at a rate of more than three (3) drops per minute;
- 3.9.1.2 a reading of methane on a portable hydrocarbon detection instrument in excess of 10,000 ppm above background when measured at a distance of one (1) centimeter of the potential source with an instrument calibrated with methane.
- 3.9.2 for pressure relief valves (PRVs) a reading of methane on a portable hydrocarbon detective instrument in excess of 10,000 ppm above background when measured in the plane at the centroid of any atmospheric vent with an instrument calibrated with methane.
- 3.9.3 for process drains a reading of methane on a portable hydrocarbon detection instrument in excess of 10,000 ppm above background when measured at a distance of one (1) centimeter of the potential source with an instrument calibrated with methane.
- 3.10 Maintenance Operation: a routine program of inspection and repair of equipment designed to detect and eliminate conditions which may result in a breakdown.
- 3.11 Portable Hydrocarbon Detection Instrument: a hydrocarbon analyzer which uses the flame ionization detection or thermal conductivity methods and satisfies Method 21, 40 CFR Part 60. The instrument shall be equated to calibrating on methane and sampling at one (1) liter per minute.
- 3.12 Pressure Relief Valve (PRV): an automatic pressure relieving device associated with a process vessel or piping system which is activated by static pressure upstream of the device and relieves to the atmosphere.
- 3.13 Process Drain: any open portion of a non-continuous piping system, including open origination portion(s) of such a system used for collection and transport of liquids discharged from process vessels. Drains used exclusively during breakdown conditions pursuant to Rule 1100 (Equipment Breakdown) or exclusively for maintenance operations are not process drains for the purposes of this rule.

- 3.14 Refinery: an establishment that processes petroleum as defined in the Standard Industrial Classification Code under 2911 (Petroleum Refining).
- 3.15 Unsafe: those components which are operating at temperatures or pressures which make inspection of these components hazardous to inspection personnel.
- 3.16 Valve: any device that regulates the flow of fluid in a piping system by means of an external actuator acting to permit or block passage of fluid.

#### 4.0 Exemptions

- 4.1 Valves, PRVs, flanges, and threaded connections handling only commercial natural gas are exempt from the provisions of this rule.
- 4.2 Valves, PRVs, flanges, threaded connections, and process drains handling material which has less than ten (10) percent by weight VOCs (as determined in accordance with ASTM Methods E-168-67, E-169-63, E-260-73), are exempt from the provisions of this rule.
- 4.3 The requirements of Section 5.2.1 and 5.2.2 shall not apply to valves, flanges, threaded connections and PRVs that are unsafe to inspect due to conditions of operation (e.g. high temperature). Prior written concurrence of the APCO shall be obtained and such valves, threaded connections and PRVs shall be inspected for signs of leakage during turnaround.
- 4.4 The requirements of Section 5.2.1 and 5.2.2 shall not apply to valves, flanges, threaded connections and PRVs which are in inaccessible locations provided the prior written concurrence of the APCO has been obtained and such valves, threaded connections and PRVs are inspected for leakage during each process unit shutdown or annually, whichever is more frequent.
- 4.5 The requirements of this rule shall not apply to components handling exclusively heavy liquid streams which have less than ten (10) percent evaporation at 150° C as determined by ASTM Method D-86-78 and provided the operator so identifies such components as outlined in Section 6.1 or prior to changing service of existing components.
- 4.6 Except in Kern County, the requirements of Section 5.1.1 shall not apply to components handling VOCs with a TVP less than or equal to 1.55 pounds, process drains and threaded connections, until November 1, 1991. In Kern County, the requirements of Section 5.1.1 shall be effective upon date of adoption.
- 4.7 The requirements of Sections 5.1.4 and 5.2.1 shall not apply to threaded connections provided that the operator inspects each threaded connection after

assembly with a portable hydrocarbon detection instrument to establish such connections do not have VOC emissions under operating conditions, and provided such connections are visually inspected at least quarterly and no leakage is detected. This section shall also apply to threaded connections in service prior to the adoption of this rule.

- 4.8 Ethane shall be excluded from the requirements of this rule if the ethane content of the stream being handled is less than 20 percent by volume. A facility operator requesting exemption of ethane shall demonstrate for each leak detected, that such stream has an ethane content less than 20 percent. Analysis of ethane content shall be by gas chromatographic (qualitative and quantitative determination in accordance with ASTM Method E-260-73) analysis.

## 5.0 Requirements

### 5.1 General

- 5.1.1 A facility operator shall not use any valve, PRV, flange, threaded connections, or process drain at a petroleum refinery or chemical plant for handling VOCs unless such valve, PRV, flange, threaded connection, or process drain does not allow the material being handled to leak into the atmosphere.
- 5.1.2 Emissions from components which have been tagged by the facility operator for repair within fifteen calendar days or which have been repaired and are awaiting re-inspection pursuant to Section 5.2 shall not be in violation of the prohibition in Section 5.1.1 providing the total number of leaking components of any component type does not exceed two (2) percent of the total number of components of that type that were inspected and that are subject to the prohibitions of this rule.
- 5.1.3 In a petroleum refinery or chemical plant a facility operator shall inspect every valve, PRV, flange, threaded connection, and process drain handling VOCs in accordance with Section 5.2. Any such device that leaks shall be repaired in accordance with Section 5.3, such that each device shall not leak.
- 5.1.4 A facility operator shall not use any valve, other than a valve on a product sampling line, a safety pressure relief valve, or a double block and bleeder valve, which is located at the end of a pipe or line containing VOCs unless such valve is sealed with a blind flange, plug or cap. This shall not include loading spouts and water drain valves.
- 5.1.5 Every leaking valve, PRV, flange, threaded connection, and process drain shall be affixed with a record of inspection which shall bear a legible

record of all inspections for at least a fifteen month period or coded with the records kept in a centralized location.

## 5.2 Inspection

- 5.2.1 All valves, threaded connections and PRVs handling VOCs shall be inspected for leakage at least once every three (3) months. If less than two (2) percent of the components of any component type subject to the prohibitions of this rule, except PRVs, are found to leak during each of five (5) consecutive quarterly inspections, the inspection frequency for that component type may be changed from quarterly to annual. If any annual inspection shows that two (2) percent or more of all of a specific component type subject to the prohibitions of this rule are leaking, then quarterly inspections of that component type shall be resumed.
- 5.2.2 All flanges and process drains handling VOCs shall be inspected at least once every 12 months.
- 5.2.3 Within three (3) days after any PRV vents to atmosphere the operator shall inspect with a portable hydrocarbon detection instrument any such PRV and shall repair any leak in accordance with Section 5.3.1.
- 5.2.4 Inspection shall be accomplished by sampling for vapors with a portable hydrocarbon detection instrument and by visual examination for indication of liquid leakage.
- 5.2.5 Any leaking component shall be identified by affixing a weatherproof, readily visible tag bearing the date on which the leak is detected. The tag shall remain in place until repair and reinspection documents compliance with the requirements of this rule.
- 5.2.6 Each leak detected shall be recorded on the inspection record along with the date of inspection, component identification number, actual instrument reading, and the inspector's initials.

## 5.3 Repair

- 5.3.1 Within 15 days after detection any valve, PRV, flange, threaded connection, or process drain found to leak shall be repaired or vented to a flare satisfying the requirements of 40 CFR 60.18 or to a vapor control device that is at least 95 percent efficient as measured by EPA Method 25.
- 5.3.2 The following repair schedule shall apply to any valve, PRV, flange, threaded connection, or process drain that is found to leak and that cannot be repaired to a no-leak condition without requiring the shutdown of essential refinery operations:

5.3.2.1 If the leak rate is less than ten (10) drops per minute the following shall be required and the APCO shall be notified of:

5.3.2.1.1 the expected date of repair, not to exceed one (1) year or the date of the next process unit turnaround whichever is less, for each valve, PRV, flange, threaded connection, and process drain, and

5.3.2.1.2 the actual date of repair for each valve, PRV, flange, threaded connection, and process drain.

5.3.2.2 If the leak rate is greater than nine (9) drops per minute or 10,000 ppm measured one (1) centimeter from the source, the following shall be required and the APCO shall be notified of:

5.3.2.2.1 an emergency repair, within 15 days after detection, to reduce the leak to less than ten (10) drops per minute or 10,000 ppm as methane measured one (1) centimeter from the source, or

5.3.2.2.2 the venting, within 30 days after detection, of the emission to a flare or vapor control system that satisfies the requirements of Section 5.3.1, or

5.3.2.2.3 a demonstration, within 30 days after detection, that measures in Sections 5.3.2.1 and 5.3.2.2 are infeasible. The demonstration shall include documentation that the component is an essential device and that no vapor control device that satisfies the requirements of Section 5.3.1 exists.

5.3.2.3 Repair an essential device to eliminate the leak during the next process unit shutdown, but in no case later than one (1) year from the date of the original leak detection.

## 6.0 Administrative Requirements

### 6.1 Operator Management Plans

6.1.1 Each operator shall, not later than November 1, 1991, submit a management plan to the APCO. The management plan shall describe how the operator will comply with the requirements of this rule.

The management plan must include:

6.1.1.1 description of any hazard which might affect the safety of an inspector;

6.1.1.2 identification of process units which cannot be immediately shutdown for repair of leaks;

6.1.1.3 identification of components for which an exemption in accordance with Sections 4.1 through 4.6 of this rule is requested;

6.1.1.4 specific identification of the resource commitment to a program to implement, inspect, and repair components;

6.1.1.5 schedule of quarterly inspections to be conducted in accordance with EPA Method 21.; and

6.1.1.6 repair procedures to be used within 15 calendar days following leak detection which results in compliance with the requirements of this rule.

6.1.2 The operator of a new facility or a facility to be modified shall submit a new or modified operator management plan to the APCO prior to implementation of an Authority to Construct.

6.1.3 Each management plan shall:

6.1.3.1 specify whether contractor or employee inspection will be used;

6.1.3.2 specify training standards for personnel performing inspections, and

6.1.3.3 provide leak detection training (using a portable hydrocarbon detection instrument) for new operators, and for experienced operators as necessary.

6.1.4 Changes to the management plan must be submitted to the APCO before implementation. If the APCO fails to respond to the plan in writing within 30 days, it shall be deemed approved.

## 6.2 Recordkeeping

6.2.1 Each facility operator shall maintain an inspection log containing, at a minimum, the following:

6.2.1.1 name, location, type of components, and description of any unit where leaking components are found.

6.2.1.2 date of leak detection, emission level (ppm) of leak, and method of detection.

6.2.1.3 date and emission level of recheck after leak is repaired.

6.2.1.4 identification of leaks that cannot be repaired until next process unit turnaround.

6.2.1.5 total number of components inspected, and total number and percentage of leaking components found.

6.2.2 Copies of the inspection log shall be retained by the operator for a minimum of two (2) years after the date of an entry.

6.2.3 Copies of the inspection log shall be made available upon request to District personnel.

## 6.3 Test Methods:

6.3.1 Analysis of halogenated exempt compounds shall be by ARB Method 432.

6.3.2 Efficiency of VOC destruction device shall be measured by EPA Method 25, 25a, or 25b, as applicable, and analysis of halogenated exempt compounds shall be analyzed by ARB Method 422.

6.3.3 The TVP of organic liquids, including light crude and petroleum distillates, shall be measured using Reid vapor pressure ASTM Method No. D-323-82 modified by maintaining the hot water bath at storage temperature. Where storage temperature is above 1000F, TVP may be determined by Reid Vapor pressure at 1000F and ARB approved calculations. Organic liquids listed in Table 1 shall be deemed to be in compliance with the appropriate vapor pressure limits for the material, provided actual operating temperature does not exceed the corresponding maximum temperature listed.



6.3.4 Leak detection shall be performed with a portable hydrocarbon detection instrument in accordance with EPA Method 21.

Table 1  
TEMPERATURE VERSUS VAPOR PRESSURE

ORGANIC LIQUID	Reference Properties		Maximum Temp °F Not to Exceed	
	Gravity °API	IBP °F	0.5 (psia)	1.5 (psia)
Middle Distillates				
Kerosene	42.5	350	195	250
Diesel	36.4	372	230	290
Gas Oil	26.2	390	249	310
Stove Oil	23	421	275	340
Jet Fuels				
JP-1	43.1	330	165	230
JP-3	54.7	110	---	25
JP-4	51.5	150	20	68
JP-5	39.6	355	205	260
JP-7	44-50	360	205	260
Fuel Oil				
No. 1	42.5	350	195	250
No. 2	36.4	372	230	290
No. 3	26.2	390	249	310
No. 4	23	421	275	340
No. 5	19.9	560	380	465
Residual	19.27	---	405	---
No. 6	16.2	625	450	---
Asphalts				
60-100 pen.	---	---	490	550
120-150 pen.	---	---	450	500
200-300 pen.	---	---	360	420

IBP = Initial Boiling Point