

San Joaquin Valley Air Pollution Control District

EPA Method 21 – Determination of Volatile Organic Compound Leaks

Leak Detection and Repair (LDAR) Requirements

Southern Region Compliance

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Purpose

- Today's presentation will include the requirements of both EPA Method 21 and Leak Detection and Repair for District rules & State regulation
- EPA Method 21 was codified in the Federal Register in 1981 and appeared in both State and Local air quality regulations shortly thereafter
- Provides a means to quantify VOC emissions from regulated components (valves, threaded connections, flanges, etc.)
- Creates the foundation for a Leak Detection and Repair (LDAR) program
- EPA Method 21 includes:
 - Equipment specifications
 - Calibration procedures

Online Resources

<https://www.epa.gov/emc/method-21-volatile-organic-compound-leaks>

https://www.epa.gov/sites/default/files/2017-08/documents/method_21.pdf

Equipment Specifications

Portable Instrument

- A Portable Instrument is used to detect VOC leaks from individual sources
- The instrument detector type is not specified, but must meet EPA Method 21 standards specified in Section 6.0
- If standards are met, may be used for any inspections referring to EPA Method 21 leak detection

Equipment and Supplies (Section 6.0)

The Portable Instrument Requirements:

- Detector types: catalytic oxidation, flame ionization, infrared absorption, and photoionization
- Must be able to measure the defined leak concentrations to within +/- 2.5% (ex. For 100ppm leak definition, accuracy scale must be +/- 2.5ppm)
- Electrically driven pump providing constant flow rate to the detector
- Flow rate at probe tip must be 0.01 - 0.1 *liter/min*
- Probe tip cannot exceed 6.4mm in outside diameter
- Intrinsically safe

Qualitative vs Quantitative

- Instruments and leak detection screening used for EPA Method 21 inspections can be Qualitative or Quantitative
- Let's discuss what these mean

Qualitative Instruments/Tools

- Qualitative Instruments give an indication there may be a leak, but do not give a parts per million (ppm) value
- Are used to identify possible leaks to be further inspected by quantitative instruments
- Are helpful for difficult to reach locations or locations that have large number of components
- Can be used as an Alternative Screening Procedure
- These methods include Soap and Bubbles and Optical Gas Imaging (OGI)*

*OGI used for screening only, not EPA Method 21 approved

Quantitative Instruments

- Are used to identify a leak and provide a ppm value
- Used to determine compliance with applicable rule or regulation
- Need to be in close proximity to the leaking component
- Must survey one component at a time
- Includes, but not limited to, Eagles and TVAs (Toxic Vapor Analyzers)



RKI Eagle



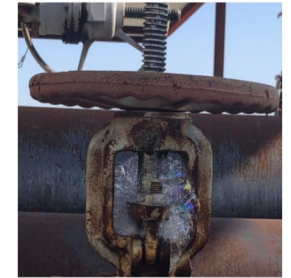
TVA

Soap and Bubbles

Qualitative Tool

- Any leaks observed must be quantified
- Used only on components/equipment that:
 1. Do not have continuously moving parts
 2. Do not have surface temperatures greater than the boiling point or less than the freezing point of the soap solution
 3. Do not have open areas to the atmosphere that the soap solution can bridge
 4. Do not exhibit evidence of liquid leakage

Threaded Connection
with Soap Solution



Valve Stem with Soap
Solution

Optical Gas Imaging (OGI)

Qualitative Tool

- Searches a wide area quickly
- Can pick up steam, dust, and other emissions
- Leaks must be verified with a quantitative instrument
- Excellent for screening high and hard to reach areas
- Operators using OGI as a screening tool must still quantify the emissions per the requirements of EPA Method 21



RKI Eagle

- Quantitative
- Catalytic Oxidation
- Battery powered
- Flow rate is 0.7-1.0l/min,
- Outside diameter is 1/4" (Section 6.0 compliant)
- Intrinsically safe



RKI Eagle

TVA (Toxic Vapor Analyzer)

- Quantitative
- Flame Ionization
- Battery and hydrogen powered
- Flow rate is 1 liter/min
- 6.35mm probe diameter (Section 6.0 compliant)
- Intrinsically safe



Equipment – Key Points

- Portable Instruments must be EPA Method 21 approved to conduct compliance inspections of components
- Instruments and Tools can be qualitative or quantitative
- Leaks must be verified quantitatively
- Qualitative: Soap and Bubbles, OGI
- Quantitative: RKI Eagle, TVA, may include other instruments

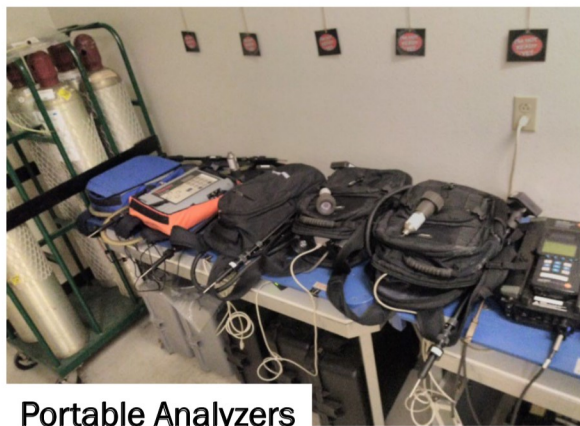
Instrument Calibration Procedures

Calibration (Section 10.0)

- Calibration is the adjustment of the portable analyzer's instrument meter readout to correspond to the calibration gas value
 - Warm up period
 - Zero Internal Calibration Procedure
 - Calibration of Span Gas
- EPA Method 21 does not explicitly mention a calibration frequency
 - District conducts daily calibration, per manufacturer recommendations

Instrument Performance Evaluation (Section 8.1)

- Response Factor (Section 8.1.1)
- Calibration Precision (Section 8.1.2)
- Response Time (Section 8.1.3)



Portable Analyzers



Calibration Gases

Response Factor (Section 8.1.1)

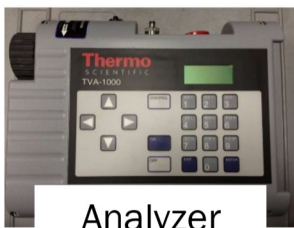
- Response factor means the ratio of the known concentration of a VOC compound to the observed meter reading when measured using an instrument calibrated with the reference compound specified in the applicable regulation
- Response factor must be <10
- Required prior to putting analyzer in service
 - Does **NOT** have to be repeated at subsequent intervals
- If response factor for the compounds of interest is published, existing results may be referenced
 - Methodology on how to calculate is found in Section 8.1.1.1

Calibration Precision (Section 8.1.2)

- Calibration precision means the degree of agreement between measurements of the same known value, expressed as the relative percentage of the average difference between the meter readings and the known concentration
- Calibration precision must be $\leq 10\%$
- Must be conducted prior to putting instrument into service and at subsequent 3-month intervals or at next use (whichever is later)



Calibration Gas
10,000 ppm



Analyzer

1st Reading: 9,800 ppm


2nd Reading: 10,300 ppm

3rd Reading: 9,600 ppm

Calibration Precision = 3%



Calculating Calibration Precision

- Calibration Gas Value = 10,000ppm
- Analyzer Measurements: 9,800ppm, 10,300ppm, and 9,600ppm
- $|10,000ppm - 9,800ppm| = 200 ppm$
- $|10,000ppm - 10,300ppm| = 300 ppm$
- $|10,000ppm - 9,600ppm| = 400 ppm$
- *Calculate the average:* $200 + 300 + 400 = \frac{900}{3} = 300$
- $\left(\frac{300}{10,000}\right) \times 100 = 3\%$ 

Response Time (Section 8.1.3)

- Response time means the time interval from a step change in VOC concentration at the input of the sampling system to the time at which 90 percent of the corresponding final value is reached as displayed on the instrument readout meter
- Response time must be ≤ 30 seconds
- Required prior to putting analyzer in service
 - NOT required again unless a modification is made to the sample pump system



Calculating Response Time

- Introduce zero gas
- Once stable, quickly switch to calibration gas
- Measure the time required to attain 90% of the final stable reading
- Perform this test sequence 3 times and record results
- Calculate the average response time
- Example: Reading stabilized at 10,000ppm, and took 12, 15, and 9 seconds to reach 9,000ppm. Average 90% response is 12 seconds: ≤ 30 seconds



Calibration - Key Points

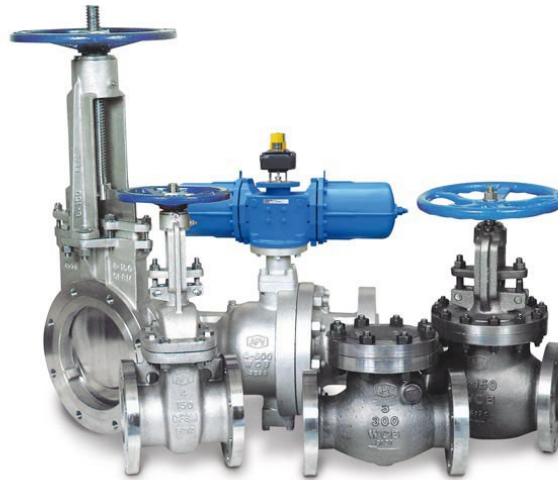
- The District calibrates TVAs and RKI Eagles per both EPA Method 21 and manufacturer specifications
- EPA Method 21 does not explicitly state a calibration frequency but rather speaks to how calibrations shall be conducted
- Response Factor: Must be <10 and must be determined prior to putting the instrument in service; Can use existing published response factors for compounds of interest
- Calibration Precision: must be $\leq 10\%$ difference and must be done prior to putting instrument into service and at subsequent 3-month intervals or at next use (whichever is later)
- Response Time: must be ≤ 30 seconds and must be determined prior to putting the instrument in service and again if any modifications are made to the sample pumping system

Questions?

Leak Detection and Repair (LDAR)

- Most facilities have LDAR provisions required by Federal, State, or local rules
- These requirements vary in frequency, applicable thresholds, and repair timeframes
- LDAR is time and labor intensive
- The LDAR section will include the following topics:
 - Components
 - Rule Applicability
 - District Inspection
 - Operator Inspection

Components



Key Definitions

- **Compressor:** a device used to compress gases or vapors, includes all associated components used for connecting and sealing purposes. The phrase "all associated components used for connecting and sealing purposes" means the first VOC leak points (first components) connected on the body of the compressor.
- **Pressure Relief Device:** pressure-relieving device associated with a process vessel or piping system that is activated by pressure upstream of the device and relieves to the atmosphere.
- **Pump:** a device used to transport fluids, includes all associated components used for connecting or sealing purposes. The phrase "all associated components used for connecting and sealing purposes" means the first VOC leak points (first components) on the body of the pump.
- **Valve:** a 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.

Types of Oil and Gas Components

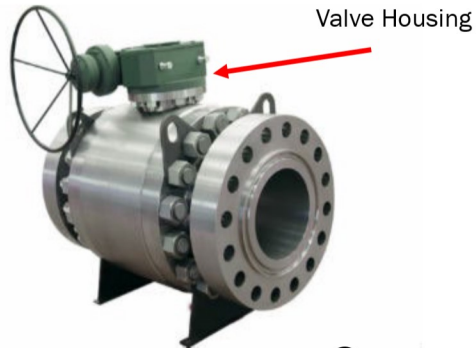
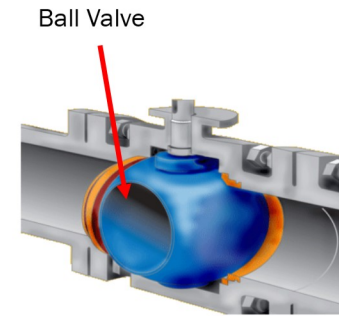
Ball Valve

- A one-way valve that is opened and closed by pressure on a ball that fits into a cup-shaped opening.

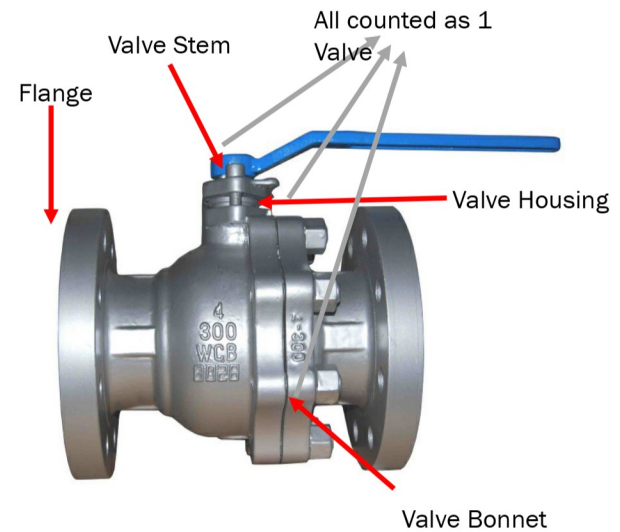
Ball Valve



Component
Count = 3



Component
Count = 3

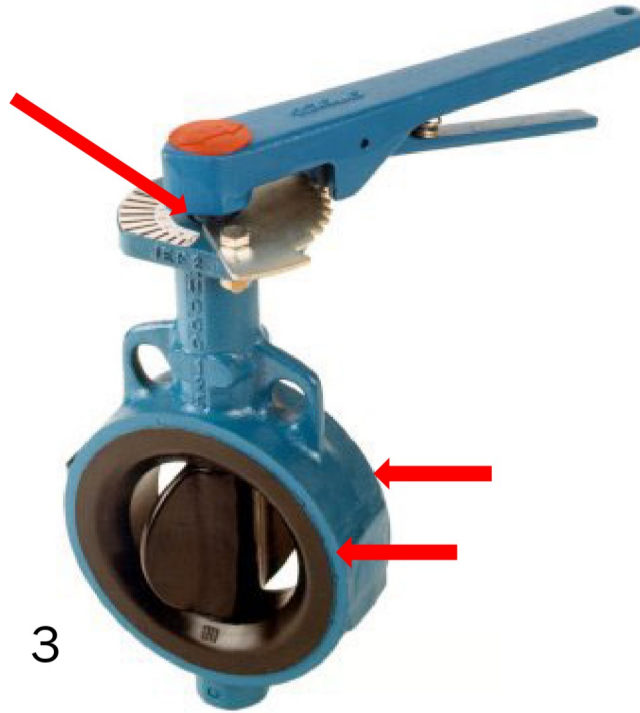


Component
Count = 3

Butterfly valve

- Valve that isolates or regulates the flow of a fluid. The closing mechanism is a disk that rotates.

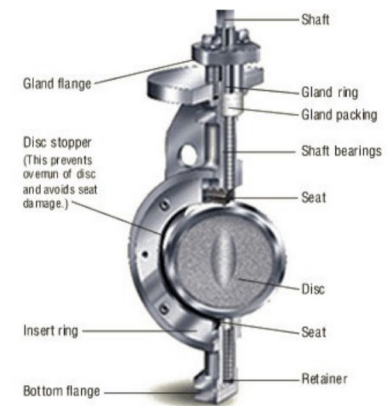
Butterfly Valve



Number of Inspection Points 3

Components Counted

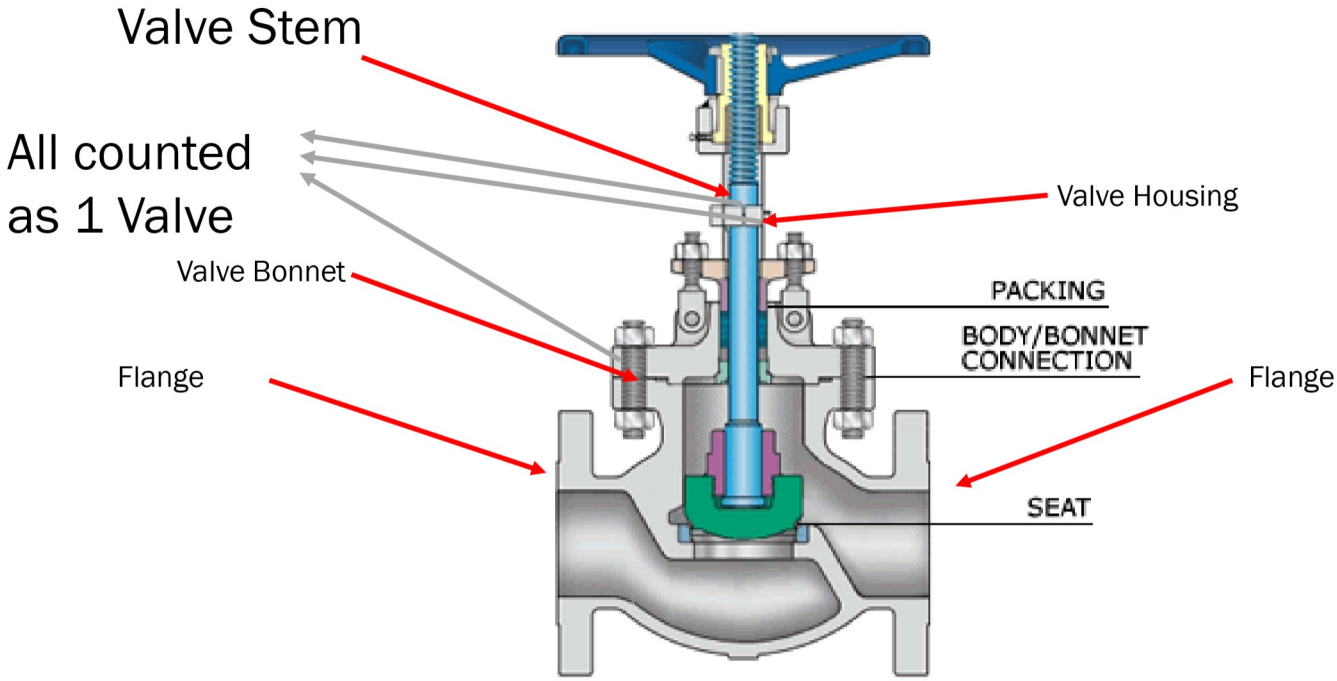
One Valve , Two Flanges



Globe valve

- A type of valve used for regulating flow in a pipeline, consisting of a movable disk-type element and a stationary ring seat in a generally spherical body.

Globe Valve



Number of Inspection Points 5

Components Counted One Valve Two Flanges

Plug Valves

- Valves with cylindrical or conically tapered "plugs" which can be rotated inside the valve body to control flow through the valve. The plugs in plug valves have one or more hollow passageways going sideways through the plug, so that fluid can flow through the plug when the valve is open.