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40 CFR Part 60 Appendix K

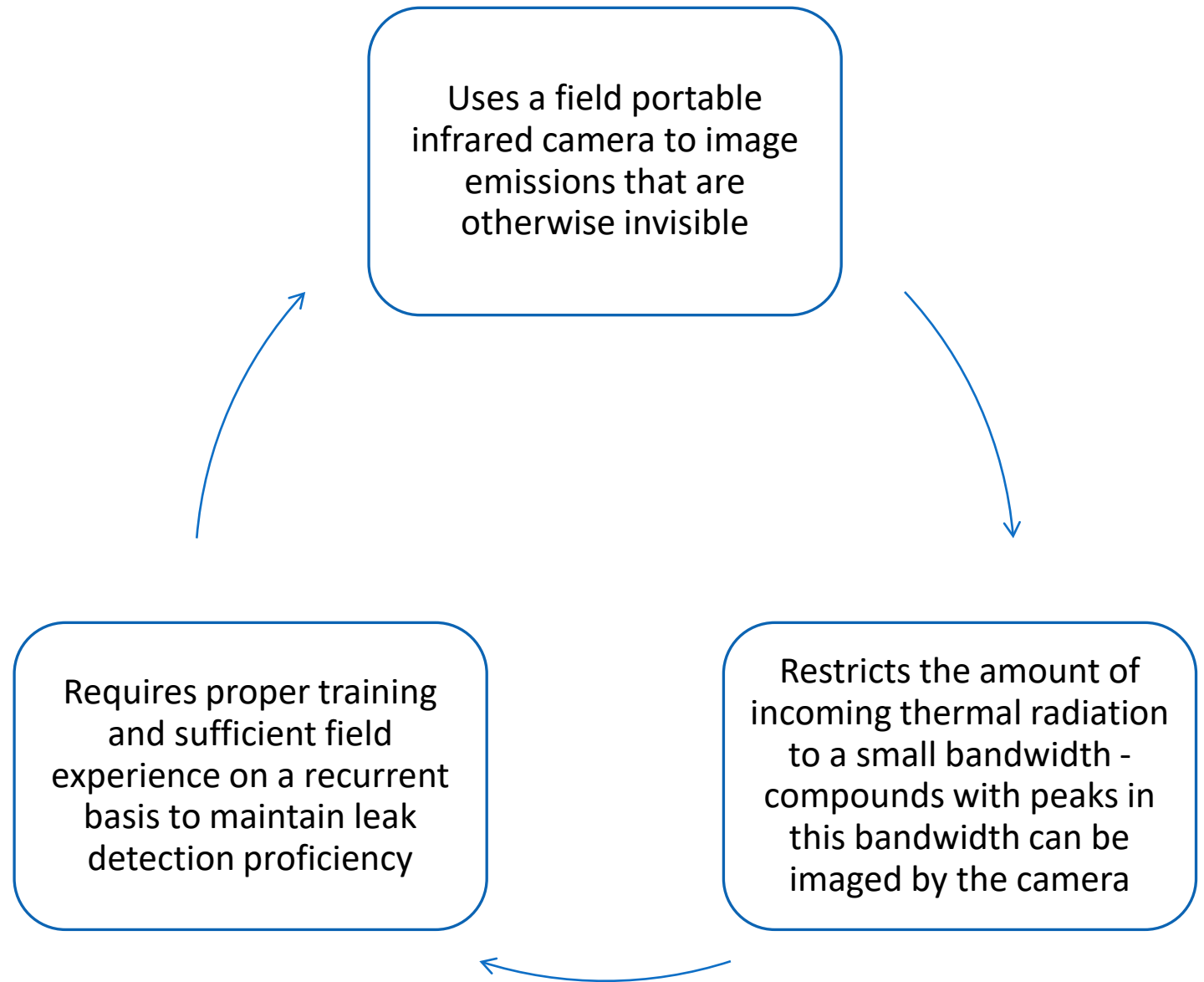
PROTOCOL FOR USE OF OPTICAL
GAS IMAGING CAMERAS

DECEMBER 2021

EPA's Proposal for the Oil and Natural Gas Source Category

- On November 2, 2021, EPA issued a proposed rule to reduce climate- and health-harming pollution from the oil and natural gas industry
- The package included the proposal of 40 CFR part 60 Appendix K, EPA's procedures for use of optical gas imaging (OGI) in leak detection
 - EPA proposed that OGI surveys must be conducted according to Appendix K for OOOOb and OOOOc
 - Appendix K is written for broader applicability than the oil and natural gas sector

Optical Gas Imaging



Appendix K

Section 1.0	Scope and Applicability
Section 2.0	Summary
Section 3.0	Definitions
Section 4.0	Interferences
Section 5.0	Safety
Section 6.0	Equipment and Supplies
Section 7.0	Camera Calibration and Maintenance
Section 8.0	Initial Performance Verification and development of the Operating Envelope
Section 9.0	Conducting the Monitoring Survey
Section 10.0	Camera Operator Training

Section 1.0: Scope and Applicability

Scope

- Oil and gas upstream and downstream sectors, including well heads, compressor stations, boosting stations, petroleum refineries, gas processing plants, and gasoline distribution facilities
- Not applicable to chemical plants at this time
- Specific component focus for surveys determined by the applicable subpart

Applicability

- Analytes: VOC (including hazardous air pollutants), methane, ethane
- Must be referenced by an applicable subpart
- Not currently applicable for use in direct emission rate measurements from sources

Section 6.0: Equipment and Supplies

- OGI cameras must meet two specifications:
 - The camera **spectral range** must overlap with a major absorption peak for the chemical target(s) of interest
 - Response factor of at least 0.25 when compared to the response factor of propane for >75 percent of the constituents of the expected gaseous emissions composition
 - Response factors can be obtained from peer reviewed articles or may be developed
 - Response factor determined at a concentration path-length of 10,000 part per million-meter
 - Must be able to produce a **detectable image** of methane emissions of 17 g/hr and butane emissions of 18.5 g/hr at a viewing distance of 2 meters and a delta-T of 5 °C in an environment of calm wind conditions (around 1 meter per second or less)
 - Section 6.2 describes the equipment and supplies necessary for determining that the camera meets this second specification

Section 7.0: Camera Calibration and Maintenance

- The camera does not require routine calibration for purposes of gas leak detection but may require calibration if it is used for thermography (such as with ΔT determination features)

Section 8.0: Initial Performance Verification and Development of the Operating Envelope

- The **initial performance verification** must demonstrate that the camera meets Section 6.0
- **Operating envelope** must be established for all potential configurations
 - Camera configuration means different ways of setting up an OGI camera that affect the detection capability
 - Can include the operating mode (*e.g.*, standard versus high sensitivity or enhanced), the lens, the portability (*e.g.*, handheld versus tripod), and the viewer (*e.g.*, OGI camera screen versus an external device like a tablet)
- Use the test gas composition, flow rate, and orifice diameter described in Section 6.0 for performance specification for both methane and butane
 - Vary ΔT , viewing distance to the component, and wind speed at constant flow
 - Leak is observed if 3 out of 4 observers see the image

Section 9.0: Conducting the Monitoring Survey

- Procedures must be described in a **monitoring plan**
- **Daily verification check** to confirm that the camera is operating properly
- Ensure conditions in the field are within the **operating envelope**
 - Daily determination of the maximum viewing distance based upon wind speed and expected delta-T at the monitoring site
 - How conditions will be monitored throughout the day to ensure the survey is conducted within the limits of the operating envelope
 - How the operator will ensure an adequate delta-T is present
 - How the operator will recognize and deal with potential interferences

Section 9.0: Conducting the Monitoring Survey, continued

- Approach used to monitor **all regulated components**
 - Use of a route map or a map with designated observation locations.
 - Use of visual cues (tags, streamers, color-coded pipes)
 - Use of global positioning system route tracing
- How components will be **viewed** with the camera
 - View from at least two different angles
 - Divide complex scenes into manageable subsections
 - Dwell on each angle for a minimum of 5 seconds per component in the field of view
 - Dwell time is the active time the operator is looking for potential leaks –when the scene is in focus and steady
 - Can be reduced based on the monitoring area and number of components as prescribed in Table 14-1
 - Manageable subsection must fill greater than half of the field of view of the camera

Section 9.0: Conducting the Monitoring Survey, continued

- Avoid camera operator fatigue by breaking up surveys **every 20 minutes**
- **Document** monitoring surveys
 - Record the weather conditions
 - If a leak is found, capture a 10-second video clip and tag for repair
- At least once each monitoring day, each operator must record a **5-minute video** that documents the **survey technique and procedures**

Section 10.0: Camera Operator Training

Initial Classroom

- Fundamental concepts of OGI camera technology
- Description of the components to be surveyed and examples of leaks that can be expected
- Calibration, operation, and maintenance for the camera
- Parameters that can affect image detection and procedures for performing the monitoring survey
- Common mistakes and best practices
- Regulatory requirements, including recordkeeping

Initial Field

- 10 surveys where the trainee is observing a senior OGI camera operator
- 40 surveys where the trainee performs the survey with a senior operator verifying side-by-side
- 50 surveys where the trainee performs the survey independently with the senior operator providing oversight and instruction/correction
- Final site survey test where the trainee conducts the survey and a senior operator follows behind with a second camera to confirm the results with zero missed persistent leaks

Section 10.0 Camera Operator Training, continued

- Annual Classroom Refresher
 - Can be shorter in duration than the initial classroom training but must cover procedures for conducting surveys
- Quarterly Performance Audits
 - **Option 1: Comparative monitoring.** senior OGI camera operator performs an independent monitoring survey of at least 4-hours to ensure no persistent leaks were missed
 - **Option 2: Video review.** Unedited and uncut video footage of OGI survey technique is reviewed by senior OGI camera operator for missed leaks and survey technique
 - **Retraining.** Required if the senior OGI camera operator finds any leaks missed by the camera operator being audited or finds that the survey techniques during the video review do not match the monitoring plan
 - 10 surveys where the trainee is observing a senior OGI camera operator
 - 5 surveys where the trainee performs the survey with a senior operator verifying the results side-by-side
 - 10 surveys where the trainee performs the survey independently with the senior operator providing oversight and instruction/correction
 - Final survey test
 - Audit can be delayed if operator will not be performing a survey during the quarter
- If an OGI camera operator has not conducted a monitoring survey in over 12 months, they must repeat the initial training requirements

Appendix K

Section 11.0

Quality Assurance and Quality Control

Section 12.0

Recordkeeping

- Performance verification and operating window
- Monitoring plan
- Training plan and training records
- Monitoring survey documentation

Section 13.0

References

Section 14.0

Tables, Diagrams, and Flow Charts

Rulemaking Process



Proposal

- November 2021

Comment Period

- January 31, 2022

Supplemental Proposal

(and comment period)

- 2022

Final Rule

- 2022

To learn how to make a comment, go to <https://www.epa.gov/system/files/documents/2021-11/epas-2021-oil-and-gas-proposal.-how-to-comment.pdf>