



## Executive Summary

# EPA Alternative Test Method Application

## Periodic Screening

### Submission date

2025-01-10

### Focus

This document is part of Qube's application package for regulatory approval as a periodic screening alternative test method at a minimum detection threshold of 5 kg/hr as per Title 40 CFR part 60 NSPS OOOO Rules Section §60.5398b(b) and §60.5398b(d).

The document focus is to provide an executive summary of the ATM application.

### Team

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**Qube Technologies Methane Alternative Test Method Request – Executive Summary****Request number – ALTTECH-78****Submission Date – January 10, 2025**

<b>Company name</b>	Qube Technologies Inc.
<b>Submission point of contact name</b>	Eric Wen
<b>Product name</b>	Qube Continuous Monitoring
<b>Technology type</b>	Periodic screening
<b>Target applicability</b>	Broadly applicable across the sector
<b>Target emission leak rate threshold</b>	5 kg/hr
<b>Request Numbers of any connected submitted requests</b>	ALTTECH-40 (Continuous) ALTTECH-78 (5 kg/hr) ALTTECH-79 (10 kg/hr) ALTTECH-80 (15 kg/hr)

## Technical summary of technology

This method outlines the Qube Technologies (Qube) emissions monitoring system used for periodic screening at a minimum detection threshold of 5 kg/hr. The Qube emission monitoring system is designed to detect, locate, and quantify methane emissions using a network of fixed devices. The system comprises three components:

1. **IIoT Devices:** These battery-powered, solar-recharged devices house calibrated metal oxide semiconductor (MOS) sensors and environmental sensors for meteorological data. They transmit data to the cloud via cellular or wireless networks.
2. **Cloud-Based Platform:** This platform records and analyzes data from the IIoT devices, using physics-based models to identify leak locations and quantify emissions.
3. **Web-Based Dashboard:** This dashboard aggregates critical insights from the analyzed data for user access.

Qube seeks approval as a broadly applicable alternative test method, showcasing its technology's robustness across various basins. To date, Qube has deployed over 6,000 monitoring devices with more than 120 upstream, midstream, and downstream operators at over 1,500 facilities, including well pads, tank batteries, compressor stations, and processing facilities. Below is a list of U.S. basins, plays, and states where Qube is deployed:

Basin	Play	State
Anadarko	Anadarko	Oklahoma
Denver-Julesburg (DJ)	Denver-Julesburg (DJ)	Colorado
Appalachian	Marcellus	Pennsylvania
Appalachian	Utica	Pennsylvania
Fort Worth	Barnett	Texas
Los Angeles	Los Angeles	California
Piceance	Piceance	Colorado
Permian	Spraberry	Texas
Permian	Delaware	Texas, New Mexico
Powder River	Powder River	Wyoming
TX-LA-MS	Haynesville	Texas and Louisiana
San Joaquin	San Joaquin	California
Uinta	Uinta	Utah
Western Gulf	Eagle Ford	Texas
Williston	Bakken	North Dakota

Furthermore, Qube is among the few technologies approved for regulatory use instead of intermittent inspections like Optical Gas Imaging (OGI). Qube has obtained approval from the Alberta Energy Regulator under the Alternative Technology Fugitive Emissions Management Plan (Alt-FEMP) and the Advanced Leak and Repair Monitoring (ALARM) program in New Mexico.

## Notes for the MATM review team

As of the date of this document, this is the only application being considered for submission by Qube Technologies.

## Updates to the application

Date	Description
January 10, 2025	Initial submission of periodic screening application

## Summary of documents submitted

Document description submission category:

Document name(s) with extension	Document description
Qube – Description of Technology for Periodic Screening – non CBI.pdf	Provides a complete overview of Qube’s technology but with confidential information removed. This includes an overview of each component and how they work from first principles, how the components interact with each other to form a complete solution, how the solution performs in the field including maintenance and support and how the solution can be used to comply with OOOO rules

Supporting documents (please reference ALTTECH-40):

Document name(s) with extension	Document description
1. Riddick, S. N. et al (2020). The calibration and deployment of a low-cost methane sensor.pdf	Peer-reviewed paper in Atmospheric Environment journal on the use of calibrated metal oxide sensors to detect methane change between 2-6ppm over long term field deployments
2. Eugster, W et al (2020). Long-term reliability of the Figaro TGS 2600 under low-Arctic conditions.pdf	Peer-reviewed paper in Atmospheric Measurement Techniques on the long-term reliability of a Figaro TGS2600 metal oxide sensor deployed in low-arctic environments
3. Yadav et. al (2023). Chemiresistive Hybrid Zinc Oxide and Nanocomposites for Gas Sensing.pdf	Peer-reviewed paper in I&EC Research on how metal oxide sensors operate from first principles
4. Figaro. TGS 2611-C00 Data Sheet rev 0422 (2022).pdf	Technical data sheet on the TGS2611-C00 metal oxide sensor made by Figaro
5. Qube. The Role of Qube Technologies Controlled Release Test Facility, SPE (2024).pdf	Technical poster made by Qube Technologies on its Controlled Release Testing Facility (CRTF) as presented at the SPE Forum: Methane Emissions Management for a Sustainable Future

6. ABB Measurement & Analytics Data Sheet GLA132GGA Greenhouse gas analyzer Ultraportable (2021).pdf	Technical data sheet on the GLA132-GGA greenhouse gas analyzer made by ABB
8. J. Pudykiewicz (1998). Applications of adjoint tracer transport equations for evaluating source parameters.pdf	Peer-reviewed paper in Atmospheric Environment on the adjoint tracer transport equation and its use to evaluate the emission field of atmospheric contaminants
9. C.A. Brereton (2018). Fugitive emission source characterization using a gradient-based optimization scheme.pdf	Peer-reviewed paper in Atmospheric Environment on how a scalar transport adjoint-based optimization method can be used to locate and quantify emission sources from downstream measurements
10. Pasquill, F. (1976). Atmospheric dispersion parameters in Gaussian plume modeling EPA.pdf	Paper published by the US EPA Office of R&D on the use of atmospheric dispersion parameters in Gaussian plume modeling
11. Allen, D.T., et al (2014) Methane emissions from process equipment	Peer-reviewed paper in Environmental Science & Technology on the distribution of emission volumes on pneumatic controllers across US production sites
12. Brandt. A. R., Heath. G.A., Cooley, D. (2016). Methane leaks from natural gas systems follow extreme dist.pdf	Peer-reviewed paper in Environmental Science & Technology on how emissions from natural gas systems tend to follow an extreme distribution where 5% of leaks contribute over 50% of the volume
13. Veigle, Wm. J (1978). Derivation of the Gaussian Plume Model, Journal of the Air Pollution Control.pdf	Peer-reviewed paper in Journal of the Air Pollution Control Association on the derivation of the Gaussian plume model
14. Isakov, V. (2004). Near-Field Dispersion Modeling for Regulatory Applications.pdf	Peer-reviewed paper in Journal of the Air Pollution Control Association on the application of dispersion models to estimate near-field pollutant concentrations
16. Qube Validation of Qube Concentration Readings White Paper.pdf	Whitepaper published by Qube on the validation of the metal oxide calibration using 100ppm calibration gas
17. Qube Solution Specifications – 2024.pdf	Technical specifications of Qube’s solution including resolution and environmental operating ranges
18. METEC Comprehensive Report on the Performance of Solution A.pdf	Summary of Qube’s performance at METEC ADED1 in 2022
19. Qube Probability of Detection White Paper.pdf	Whitepaper of Qube’s probability of detection based on a blinded study conducted by Highwood Emissions
20. Benko et. al. (2023). Equivalency Evaluation of Regulator-Approved Alt-FEMP. SPE.pdf	Peer-reviewed SPE paper on the use of Qube’s technology for Alberta’s methane regulations as part of Enhance Energy’s Alt-FEMP
21. Qube and Enhance Alt-FEMP Performance Report (2023)	Summary of the performance of Enhance’s Alt-FEMP as published on the Alberta Energy Regulator’s (AER) website

Alt test method:

Document name(s) with extension	Document description
Qube – Formal ATM for Periodic Screening 5kg/hr.pdf	The formal alternative test method in the prescribed format which includes the protocols for deploying the technology in the field

CBI submitted documents:

Document name(s) with extension	Document description
Qube – Description of Technology for Periodic Screening - CBI.pdf	Provides a complete overview of Qube’s technology including an overview of each component and how they work from first principles, how the components interact with each other to form a complete solution, how the solution performs in the field including maintenance and support and how the solution can be used to comply with OOOO rules
7. Qube Technologies Inc, System and Method to Auto Calibrate and Auto Baseline a Pollutant Gas Detector.pdf	Qube’s patent application for its auto-calibration and auto-baseline algorithm
15. Qube SOC 2 Type 2 Certificate – 2024.pdf	An independent service auditor’s report provided by Laika on Qube for its SOC2 Type 2 accreditation
22. Qube Installation Guide (v3.1) - June 2024.pdf	Installation guide for Qube’s solution intended for field teams either by Qube, a 3 <sup>rd</sup> party or the operator
23. Qube Dashboard Training Manual (v1.0) - Aug 2024.pdf	Training manual for Qube’s dashboard intended for end users of the solution
24. Qube Preventative Maintenance Manual (v1.1) - Jan 2023.pdf	Preventative maintenance manual published by Qube intended for field teams

### Additional information

Qube Technology Inc. is a Canadian corporation headquartered in Calgary, Alberta, Canada at 632 Confluence Way SE, Suite 300 T2G-0G1. Qube has a wholly owned US subsidiary named Qube Technologies (US) Inc. that is registered in the state of Delaware. Qube’s US office is in Houston, Texas at 1117 W16th Street, Unit C, 77008.