



**TECHNICAL REVIEW AND EVALUATION  
OF APPLICATION FOR  
AIR QUALITY PERMIT No. 97526**

**I. INTRODUCTION**

This Class II air quality synthetic minor permit renewal is issued to Linde Gas & Equipment, Inc. (Linde), the Permittee, for their chemical synthesis and repackaging facility. Permit No. 97526 renews and supersedes Permit No. 70386.

The facility has the potential to emit hazardous air pollutants (HAPs) in excess of major source thresholds. However, the facility has accepted emission limitations and standards on HAPs. Therefore, the facility qualifies for a Class II synthetic minor permit as allowed under Arizona Administrative Code (A.A.C.) R18-2-306.01.A

**A. Company Information**

Facility Name: Linde Gas & Equipment, Inc.

Mailing Address: P.O. Box 6157  
Kingman, AZ 86401

Facility Location: 3426W Griffith Road  
Kingman, AZ 86401

**B. Attainment Classification**

Linde Gas & Equipment, Inc. is located in Mohave County an area that classified as attainment or unclassified for all criteria pollutants.

**II. PROCESS DESCRIPTION**

**A. Process Equipment**

The facility manufactures arsine and phosphine; fills, processes, tests, and warehouses gaseous products which are used by semiconductor and other industries; and stores in bulk argon, liquid helium, hydrogen, nitrogen, nitrous oxide, and nitrogen trifluoride. Gaseous products include arsine, diborane, disilane, diethyltelluride, phosphine, silane, dichlorosilane, dichloromethane, fluoromethane, methyl bromide, methyl iodide, nitrogen dioxide, trichlorosilane, hexafluoroethane, octafluorocyclobutane, octafluorotetrahydrofuran, perfluoropropane, trifluoromethane, sulfur hexafluoride, silicon tetrafluoride, germanium tetrafluoride, silicon tetrachloride, enriched boron-11 trifluoride, boron trifluoride, mixtures of diborane and either boron trifluoride or enriched boron-11 trifluoride, and mixtures of disilane and silicon tetrafluoride. Fluorine and inert gases are stored on-site and are used to mix with other gases to create unique mixture concentrations as specified by the customer.

Arsine is synthesized by the reaction of mixing zinc arsenide with sulfuric acid to produce zinc sulfate and pure arsine gas. The synthesis reaction takes place in isolated production

rooms using a process that is entirely remote-controlled. The isolated production rooms have vent lines that exhaust to a control device which captures any escaping gas from these rooms. Returned cylinders are initially purged of residual product. The purged residual product is sent through the control devices prior to being released into the atmosphere. The emptied cylinders are inspected and reconditioned as necessary (including shot blasting and painting). The facility then refills the cylinders with the gas or gas mixture of choice.

#### B. Control Devices

The facility operates the following equipment to control the emissions of particulate matter: Arsine Baghouse 1, Arsine Baghouse 2, Phosphine Dynawave Wet Scrubber, and Silane Baghouses 1 and 2.

The facility operates the following equipment to control the emissions of hazardous air pollutants: Arsine Guardian 1, Arsine Guardian 2, Phosphine Guardian, and Ventilation Emergency Scrubber 1.

The facility operates the following equipment to control the emissions of non-regulated pollutants: Arsine Guardian 1, Arsine Guardian 2, Silane Guardian, DCS West Scrubbers B and C, TCS Scrubbers A and D, Ventilation Emergency Scrubber 1, Process Caustic Wet Scrubber 1 (PCWS-1), Ventilation Emergency Scrubber 3, Process Dry Scrubber (PDS-1), and Ventilation Emergency Scrubber 2 (VES-2).

### III. COMPLIANCE HISTORY

Three (3) on-site inspections were conducted with no deficiencies noted. One (1) excess emission and nine (9) permit deviations were reported. Only one (1) permit deviation resulted in enforcement action as described below.

#### Performance Testing

Linde is required to conduct annual performance testing on Ventilation Emergency Scrubber 1 (VES-1) for arsine. Five (5) performance tests were conducted during the permit term. One (1) of the tests conducted in May of 2022 was deemed to be invalid due to contamination in the test samples. The performance test was performed again in July of 2022. All valid performance tests passed to demonstrate compliance with the applicable emission limitation. **Table 1** below shows the results of the performance tests conducted.

**Table 1: Performance Test Results**

Source Tested	Date of Test	Pollutant Tested	Tested Emission Rate (grams/hr)	Permitted Emission Rate (grams/hr)	Pass / Fail
VES-1	June 26 & 27, 2019	Arsine	0.66	10.23	PASS
VES-1	April 28 & 29, 2020	Arsine	0.04	10.23	PASS
VES-1	May 20 & 21, 2021	Arsine	0.06	10.23	PASS
VES-1	May 19 & 20, 2022	Arsine	14.66	10.23	INVALID
VES-1	July 12 & 13, 2022	Arsine	0.08	10.23	PASS

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A Notice of Opportunity to Correct (NOC) was issued to Linde on September 20, 2018 for the permit deviation they submitted on September 17, 2018.

After a planned upgrade of the PLC's, the data collection nodes weren't updated which resulted in the pressure differential data of baghouse 1 to not be recorded. Linde reported that the data was still being monitored. Linde attached emissions data to ensure that there were no excess emissions.

The facility's deadline to achieve compliance was September 27, 2018. Linde was required to submit a plan describing how all data collection nodes will be promptly checked if PLC units are replaced. Compliance was documented and the NOC was closed on September 21, 2018.

**IV. EMISSIONS**

The facility's potential to emit (PTE) was calculated based on their processes and products capacity for HAPs in conjunction with the efficiency of any applicable control devices. The PTE from emergency generators was calculated based on engine certifications and AP-42 Chapter 3.3 for ?. The facility's PTE is provided in Table 2 below:

**Table 2: Potential to Emit (tpy)**

<b>Pollutant</b>	<b>PTE</b>
NO <sub>x</sub>	1.53
PM <sub>10</sub>	0.17
PM <sub>2.5</sub>	0.07
CO	0.45
SO <sub>2</sub>	0.21
VOCs	2.81
HAPs	0.21

**V. VOLUNTARILY ACCEPTED EMISSION LIMITATIONS AND STANDARDS**

On December 19, 2007, the facility accepted a voluntary emission limitation of 3,344.15 grams in any rolling 365-day period to avoid exceeding major source thresholds for arsine during Permit No. 31904. The facility is required to conduct annual performance testing to demonstrate compliance with this emission limitation.

**VI. APPLICABLE REGULATIONS**

Table 3 identifies applicable regulations and verification as to why each standard applies. The table also contains a discussion of any regulations the emission units are exempt from.

**Table 3: Applicable Regulations**

Unit	Control Device	Rule	Discussion
Synthesis and Handling Operations	Combustion Units, Baghouses, and Scrubbers	A.A.C R18-2-702; A.A.C R18-2-730	Synthesis and handling operations are unclassified sources and thus, they are subject to A.A.C. R18-2-730.
Ammonia Operations	Scrubber	A.A.C R18-2-702; A.A.C R18-2-730	Synthesis and handling operations are unclassified sources and thus, they are subject to A.A.C. R18-2-730.
Emergency Generators	N/A	A.A.C R18-2-719; 40 CFR 63 Subpart ZZZZ; 40 CFR 60 Subpart IIII	These standards are applicable to particulate matter, opacity, sulfur dioxide, and hazardous air pollutant standards apply to the internal combustion engines.
Fugitive Dust Sources	Water Trucks, Dust Suppressants	A.A.C. R18-2 Article 6; A.A.C. R18-2-702	These standards are applicable to all fugitive dust sources at the facility.
Abrasive Blasting	Wet Blasting, Dust Collecting Equipment, Other Approved Methods	A.A.C. R-18-2-702; A.A.C. R-18-2-726	These standards are applicable to any abrasive blasting operation.
Spray Painting	Enclosures	A.A.C. R18-2-702; A.A.C. R-18-2-727	These standards are applicable to any spray painting operation.
Demolition/Renovation	N/A	A.A.C. R18-2-1101.A.12	This standard is applicable to any asbestos related demolition or renovation operations.

**VII. PREVIOUS PERMIT REVISIONS AND CONDITIONS****A. Previous Permit Revisions**

Table 4 provides a description of the permit revisions made to Permit No. 70386 during the previous permit term.

**Table 4: Permit Revisions to Permit No. 70386**

Permit Revision No.	Permit Revision Type	Brief Description
75970	Minor Permit Revision	Replacement of existing emergency generator with a newer unit.
77315	Significant Permit Revision	Rerouting of chlorosilane emissions from VES-1 to VES-3.
92074	Minor Permit Revision	Addition of a fluorine gas mixing system.
92074	Minor Permit Revision	Paint booth replacement.

**B. Changes to Current Renewal**

Table 5 addresses the changes made to the sections and conditions from Permit No. 70386:

**Table 5: Previous Permit Conditions**

Section No.	Determination			Comments
	Added	Revised	Deleted	
Att. "A"		X		General Provisions: Revised to represent the most recent template language
Att. "B" Section I		X		Facility-Wide Requirements: Revised to represent the most recent template language
Att. "B" Section II		X		Synthesis and Handling Operations: Revised rule citations.
Att. "B" Section VII			X	Mobile Source Requirements: Deleted section. No longer applicable.
Att. "B", Section VIII		X		Other Periodic Activities: Added survey of visible emissions requirements.
Att. "C"		X		Operation and Maintenance Plan: Updated table formatting.
Att. "D"		X		Equipment List: Revised to reflect the most recent equipment operating at the facility and to include equipment information provided.

**VIII. MONITORING, RECORDKEEPING, AND REPORTING REQUIREMENTS**

Table 6 contains an inclusive but not an exhaustive list of the monitoring, recordkeeping and reporting requirements prescribed by the air quality permit. The table below is intended to provide insight to the public for how the facility is required to demonstrate compliance with the emission limitations in the permit.

**Table 6: Permit No. 97526**

<b>Emission Unit</b>	<b>Pollutant</b>	<b>Emission Limit</b>	<b>Monitoring Requirements</b>	<b>Recordkeeping Requirements</b>	<b>Reporting Requirements</b>
VES-1	Arsine	10.23 g/hr  618.18 g per rolling 24-hour period  3,343.15 g per rolling 365-day period	Conduct performance testing on an annual basis.	N/A	N/A
Engines	PM	40% opacity for any period greater than 10 seconds	Conduct periodic opacity monitoring on a quarterly basis.	Maintain records of the lower heating value of the fuel.	Report all 6-minute periods which the opacity exceeded 15%.
	SO <sub>2</sub>	1.0 lb/MMBtu	N/A	Record the daily sulfur content of the fuel used in the engines.	Report to the Director any daily period which the sulfur content exceeds 0.8%.
Fugitive Dust	PM	40% Opacity	A Method 9 observer is required to conduct a monthly survey of visible emissions.	Record of the dates and types of dust control measures employed, and if applicable, the results of any Method 9 observations, and any corrective action taken to lower the opacity of any excess emissions.	N/A

<b>Emission Unit</b>	<b>Pollutant</b>	<b>Emission Limit</b>	<b>Monitoring Requirements</b>	<b>Recordkeeping Requirements</b>	<b>Reporting Requirements</b>
Abrasive Blasting	PM	20% Opacity	A Method 9 observer is required to conduct a quarterly survey of visible emissions.	Record the date, duration and pollution control measures of any abrasive blasting project.	N/A
Spray Painting	VOC	20% Opacity Control 96% of the overspray	A Method 9 observer is required to conduct a quarterly survey of visible emissions.	Maintain records of the date, duration, quantity of paint used, any applicable MSDS, and pollution control measures of any spray painting project.	N/A
Demolition/ Renovation	Asbestos	N/A	N/A	Maintain records of all asbestos related demolition or renovation projects including the "NESHAP Notification for Renovation and Demolition Activities" form and all supporting documents	N/A
Fenceline Monitoring	Arsine	N/A	Operate and maintain the Vertex monitoring system in accordance with the Ambient Air Monitoring Plan.	N/A	Report to the Director any one-hour average exceeding 7.5 ppb.

**IX. LIST OF ABBREVIATIONS**

A.A.C.	Arizona Administrative Code
ADEQ	Arizona Department of Environmental Quality
AQD	Air Quality Division
A.R.S.	Arizona Revised Statutes
CFR	Code of Federal Regulations
CO	Carbon Monoxide
EPA	Environmental Protection Agency
g	Gram
HAP	Hazardous Air Pollutant
hp	Horsepower
hr	Hour
IC	Internal Combustion
NO <sub>x</sub>	Nitrogen Oxides
NO <sub>2</sub>	Nitrogen Dioxide
N <sub>2</sub> O	Nitrous Oxide
NSPS	New Source Performance Standards
O <sub>3</sub>	Ozone
Pb	Lead
PM	Particulate Matter
PM <sub>10</sub>	Particulate Matter less than 10 µm nominal aerodynamic diameter
PM <sub>2.5</sub>	Particulate Matter less than 2.5 µm nominal aerodynamic diameter
ppb	Parts Per Billion
PTE	Potential to Emit
sec	Seconds
SO <sub>2</sub>	Sulfur Dioxide Significant Impact Levels
TPY	Tons per Year
VOCs	Volatile Organic Compounds
yr	Year