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**W0000-02-VOC/SURFACE EMISSIONS/2022/1 LANDFILL GAS SURFACE EMISSIONS  
SURVEY AT BALLYMURTAGH LANDFILL, BALLYGAHAN UPPER, TINNAHINCH, CO.  
WICKLOW**

PERFORMED BY ODOUR MONITORING IRELAND ON BEHALF OF WICKLOW COUNTY COUNCIL

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<b>LICENCE NUMBER:</b>	WL0011-2
<b>LICENCE HOLDER:</b>	Wicklow County Council
<b>FACILITY NAME:</b>	Ballymurtagh Landfill Facility
<b>DATE OF MONITORING VISIT:</b>	26 <sup>th</sup> May 2022
<b>NAME AND ADDRESS OF CLIENT ORGANISATION:</b>	Ballymurtagh Landfill Facility, Ballygahan Upper, Tinnahinch, Co. Wicklow.
<b>NAME AND ADDRESS OF MONITORING ORGANISATION:</b>	Odour Monitoring Ireland, Unit 32 DeGranville Court, Dublin Road, Trim, Co. Meath
<b>DATE OF REPORTING:</b>	24 <sup>th</sup> Jun. 2022
<b>NAME AND THE FUNCTION OF THE PERSON APPROVING THE REPORT:</b>	Dr. Brian Sheridan, Managing Partner, Odour Monitoring Ireland
<b>REPORT NUMBER:</b>	2022923
<b>REVIEWERS:</b>	Dr. Brian Sheridan

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## DOCUMENT AMENDMENT RECORD

**Client:** Wicklow County Council

**Title:** W0011-02-VOC/SurfaceEmissions/2022/1 Landfill Gas Surface emissions Survey at Ballymurtagh Landfill, Ballygahan Upper, Tinnahinch, Co. Wicklow.

<b>Project Number:</b> 2022923			<b>Document Reference:</b> W0011-02-VOC/SurfaceEmissions/2022/1		
2022923(1)	Document for review	JWC	BAS	JWC	24/06/2022
<b>Revision</b>	<b>Purpose/Description</b>	<b>Originated</b>	<b>Checked</b>	<b>Authorised</b>	<b>Date</b>
					

## Executive Summary

Wicklow County Council commissioned Odour Monitoring Ireland to perform a landfill gas surface emissions survey of landfill facility (i.e. Waste licence number W0011-02) in order to ascertain any likely sources of landfill gas surface emissions from the landfill. Landfill gas surface emissions are the predominant source of odour emissions from landfills in Ireland. The survey was carried out on the 26<sup>th</sup> May 2022.

During the surface emissions survey, the following tasks were performed on site:

1. Identification the key mechanisms that lead to the release of landfill gas surface emissions from the site.
2. Identify geographically on a site map, the locations of landfill gas surface emissions in order to perform remediation of the identified surface emissions areas.

The following conclusions were drawn from survey:

- There were no surface emissions zones greater than or equal to 50 ppm averaged over the capped area. There were no surface emissions zones greater than or equal to 500 ppm instantaneous reading on features within the landfill footprint. There were no surface emissions zones greater than or equal to 100 ppm instantaneous reading on open surfaces within the landfill footprint.

## **1. Introduction**

### **1.1. Background to work**

Odour Monitoring Ireland was commissioned by Wicklow County Council to perform a specified independent Volatile organic compound surface emissions survey at Ballymurtagh landfill facility. The assessment involved a Volatile organic compound (VOC) surface emissions survey of the landfill facility in order to ascertain the VOC emission points and mark them upon a map for remediation. This report presents a summary of the findings of a VOC surface emissions survey at Ballymurtagh Landfill Facility. The report is based on scientific measurements and observations made during a site visit conducted on the 26<sup>th</sup> May 2022.

### **1.2. Scope of work**

The main aims of the survey included:

- Surface emissions monitoring in accordance with AG6 requirements.
- Discussion meeting with landfill manager once survey was complete in order to communicate main surface emissions areas for immediate remediation, where necessary.
- Identification of short-term mitigation measured to be implemented within the operating landfill to reduce surface emissions.

## 2. Techniques used

This section describes the techniques used throughout the study. The surface emissions surveying and reporting was performed by Dr. John Casey, Odour Monitoring Ireland. Dr. John Casey has performed surface emissions monitoring surveys on behalf of Odour Monitoring Ireland for regulatory bodies in Ireland and Northern Ireland, local authorities in Ireland, private waste operators in Ireland and borough councils in Northern Ireland. A full documented list of previous survey's is available upon request.

### 2.1. "Odour hog" monitoring within the landfill

The "Odour hog" (i.e. Version 2, 4 years old with less than 3.5 second response time for the FID) VOC analyser is a portable, intrinsically safe, survey VOC dual monitor, which provides fast and accurate readings of organic and inorganic vapours. A Photo ionisation detector (PID) uses an Ultraviolet (UV) light source (*photo*) to ionise a gas sample and detect its concentration. Ionisation occurs when a molecule absorbs the high energy UV light, ejecting a negatively charged electron and forming of positively charged molecular ion. The gas becomes electrically charged. These charged particles produce a current that is easily measured at the sensor electrodes. Only a small fraction of the VOC molecules are ionised. A PID does not respond to methane. A FID is similar to a flame thermocouple detector, but measures the ions from the flame instead of the heat generated. The FID detects the methane fraction, which provides greater sensitivity in terms of methane surface emissions detection but not necessarily odour hence why the PID data is also interpreted. The FID/PID analyser was calibrated with certified reference material isobutylene and methane before commencement of the survey, see calibration certificates for gases used in Appendix II. The calibration readings were rechecked in accordance with AG6 requirements.

Using the continuous kinematic "Odour hog" with integrated GPS (i.e Magellan Professional with sub centimetre accuracy post processed), the capping of the landfill was surveyed for potential surface emissions areas. Those areas identified were geo-referenced and highlighted for remediation. This technique is useful for comparison in surface emissions area within the same landfill facility on different survey's. The surface emissions maps generated for the particular facility can be used to assess the effectiveness of implemented mitigation techniques and to qualitatively assess the nature of surface emissions from the facility. All surface emissions surveying was carried out in accordance with "Surface VOC Emissions Monitoring on Landfill Facilities (AG6).

Efforts should be made to attain surface emissions <100 ppm from open surfaces and <500 ppm around features such as vertical wells, leachate collection sumps, leachate slope risers and other projections out of the waste body (Casey et al., 2008). These are minimum standards, which should lead to greater landfill collection efficiencies thus reducing the impact on the general environment.

### 2.2. Meteorological conditions

Table 2.1 illustrates the predominant wind direction during the monitoring exercise. The meteorological conditions were characterised for the day of monitoring and were as follows:

**Table 2.1.** Meteorological conditions during Ballymurtagh landfill facility TVOC survey.

26 <sup>th</sup> May 2022	
Average wind speed 2 m s <sup>-1</sup>	Wind direction southerly
Temperature 14 <sup>o</sup> C	1021 mbar
Dry weather	Capping moisture content low

During the TVOC and gas field survey, wind deviated from a southerly direction. Capping moisture content was low.

### **2.3 Current landfill gas collection infrastructure on the facility**

There is a total of 42 vertical wells and 2 pumped condensate knock out pots on the facility. Horizontal and Vertical landfill gas abstraction is employed in the facility. There is one operational installed landfill gas enclosed flare (500 m<sup>3</sup>/hr).

### **3. Results**

#### **3.1. Volatile organic compound surface emissions locations identified within Ballymurtagh landfill facility**

*Figure 6.2 and Table 3.1* illustrates the results obtained for the capping surface emissions survey. There were no surface emissions zones identified.

**Table 3.1.** Capping VOC surface emissions locations results with source identities correlating with *Figure 6.2 (see Appendix I)*.

Location ID	Easting (m)	Northing (m)	Max VOC conc. (ppm)	Identification and Mitigation	Recommended trigger levels
--	--	--	--	--	--

There were no sources of landfill gas surface emissions identified (*see Figures 6.2 and Table 3.1*) within the landfill.

There were no surface emissions zones greater than or equal to 50 ppm averaged over the capped area. There were no surface emissions zones greater than or equal to 500 ppm instantaneous reading on features within the landfill footprint. There were no surface emissions zones greater than or equal to 100 ppm instantaneous reading on open surfaces within the landfill footprint.

### **3.2. Close out meeting with landfill manager**

Following completion of the surface emissions survey, the surface emissions team and the landfill management discussed all aspects and general conclusions of the survey.

## **4. Conclusions**

The following conclusions were drawn from the survey of Ballymurtagh landfill facility:

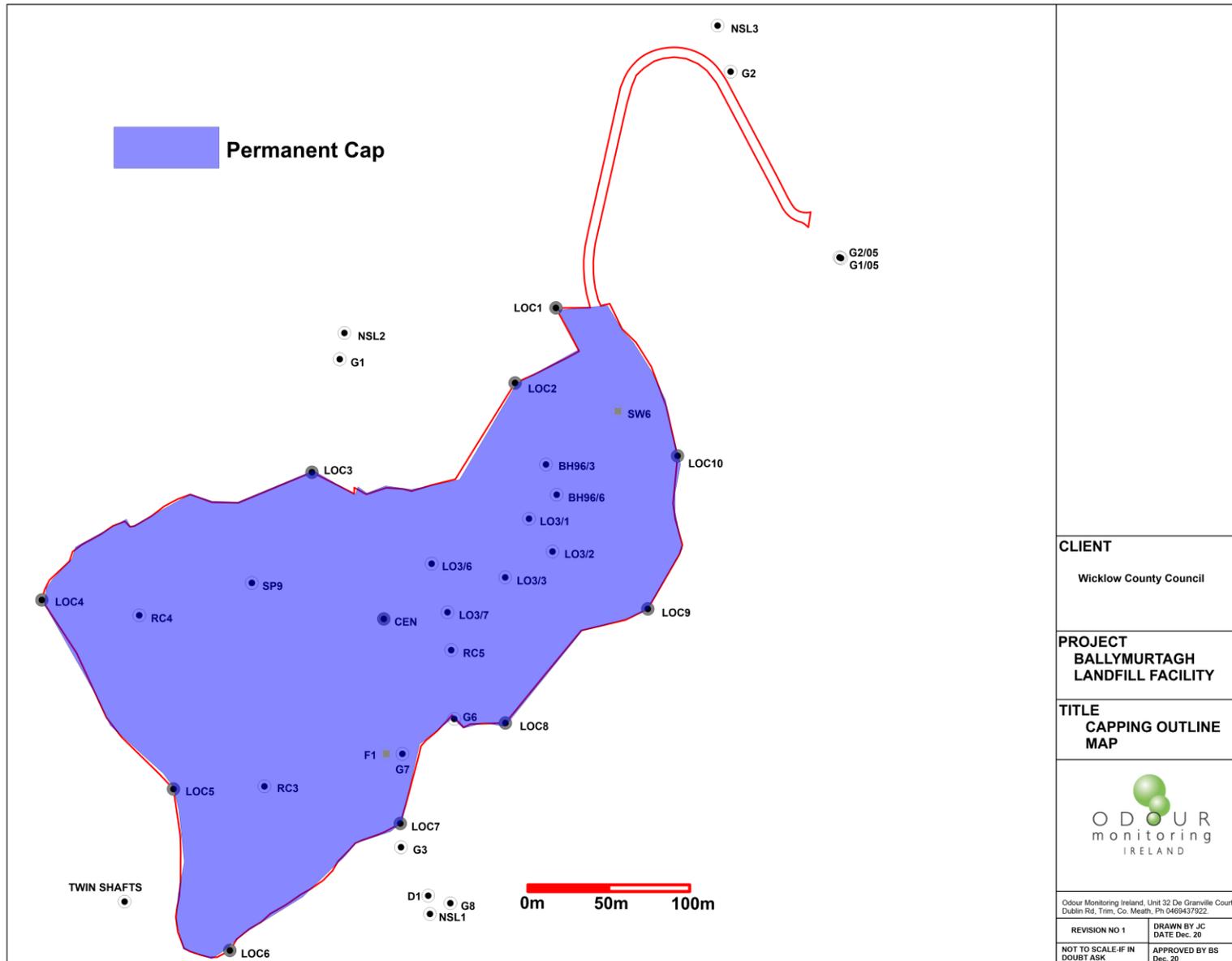
- The surface emissions contour map generated from the kinematic Volatile organic compound (VOC) survey illustrated surface areas of landfill gas surface emissions.
- There were zero surface emissions zones greater than or equal to 50 ppm averaged over the capped area. There were no surface emissions zones greater than or equal to 500 ppm instantaneous reading on features within the landfill footprint. There were no surface emissions zones greater than or equal to 100 ppm instantaneous reading on open surfaces within the landfill footprint.

## **5. References**

- Casey, J.W., Sheridan, B.A., Henry, M., Reynolds, K., (2008). Effective tools for managing odours from landfill facilities. International Conference on Environmental Odour Monitoring and Control, Rome, Italy, July 6-8, 2008.

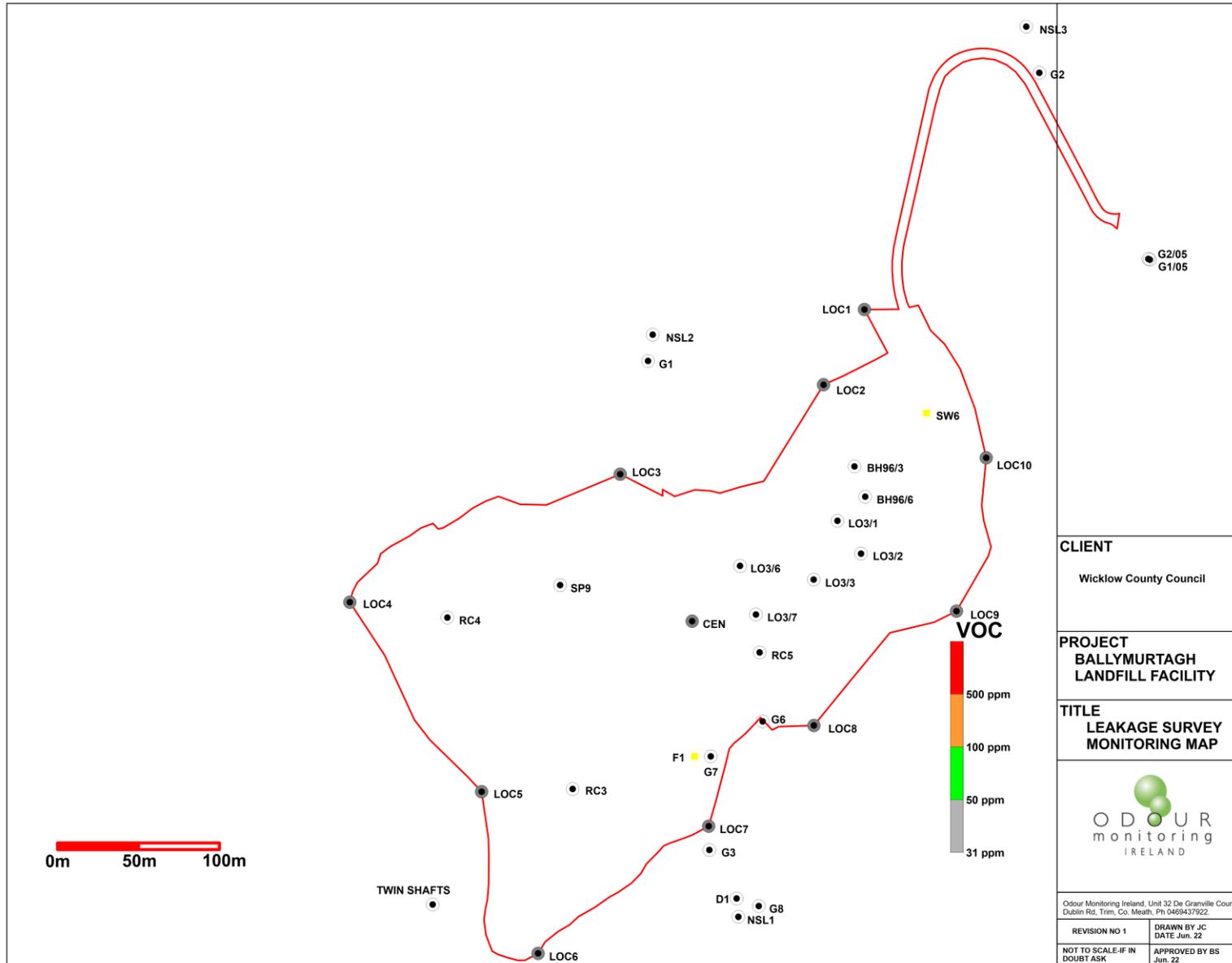
## **6. *Appendix I- Volatile organic compound surface emissions contour map & Cell capping outline & LFG infrastructure map***

**Figure 6.1.** Cell capping outline & LFG infrastructure on the facility.



<b>CLIENT</b>	
Wicklow County Council	
<b>PROJECT</b>	
BALLYMURTAGH LANDFILL FACILITY	
<b>TITLE</b>	
CAPPING OUTLINE MAP	
 ODOUR monitoring IRELAND	
<small>Odour Monitoring Ireland, Unit 32 De Granville Court,                  Dublin Rd, Trim, Co. Meath, Ph 0469437922.</small>	
REVISION NO 1	DRAWN BY JC DATE Dec. 20
NOT TO SCALE-IF IN DOUBT ASK	APPROVED BY BS Dec. 20

**Figure 6.2.** Landfill gas surface emissions monitoring within the operating landfill facility (colour scale area indicating TVOC gas colour scale).



<b>CLIENT</b>	
Wicklow County Council	
<b>PROJECT</b>	
BALLYMURTAGH LANDFILL FACILITY	
<b>TITLE</b>	
LEAKAGE SURVEY MONITORING MAP	
 <p>ODOUR monitoring IRELAND</p>	
<small>Odour Monitoring Ireland, Unit 32 De Granville Court,                  Dublin Rd., Trim, Co. Meath, Ph 0469437922.</small>	
REVISION NO 1	DRAWN BY JC
	DATE Jun. 22
NOT TO SCALE-IF IN DOUBT ASK	APPROVED BY BS Jun. 22

## **7. Appendix II-Calibration certificates and procedures.**

### **7.1 Span & Calibration procedure**

Necessary Calibration gases: Zero gas (0ppm), 100.2ppm and 1003ppm methane (Calibration certificates below).

Calibration is carried out in accordance with manufacturers guidelines.

Location: Zero span instrument onsite.

Frequency: Before, midway through, and after the surface emissions survey, typically therefore at 3-4 hour intervals. If the survey only last 2 to 3 hours the instrument is checked before and after the event.

Instrument settling: The FID is switched on and left to settle for a period of 30 minutes minimum.

Span Procedure: The zero and span gases shall be introduced under the same flow and pressure conditions using the sample probe at the end of the sample line. The adjustment procedure shall be as follows:

- a) Feed the zero gas (0ppm) into the FID and set the zero;
- b) Feed the span gas (98.8ppm) and adjust the instrument accordingly;
- c) Feed the zero gas into the FID once more and check that the reading returns to zero; if not repeat steps a) to c).
- d) repeat procedure A to C to verify

Equipment is maintained and operated as specified by the manufacturer.



### Certificate of Analysis

Air Products PLC  
 Hershaw Place Technology Park  
 Molesey Road  
 WALTON-ON-THAMES  
 Surrey  
 KT12 4RZ  
 UNITED KINGDOM  
 Date Printed: 02 MAR 2021

Container Type: C1.6A - 1.6L Aluminum Canister  
 Outlet Valve Connection: 5/8" - 18 UNF  
 Fill Pressure @ 15 °C: 69.0 bar-g  
 Fill Pressure @ 15 °C: 70.360 kg/cm2  
 Contents @ 0°C, 1013 mbar: 0.107 Nm3

Material <b>322144</b> Mixture of Gases	Mfg. Date 26 FEB 2021	Analysis Date 26 FEB 2021	Best if Used By 26 FEB 2026
Batch <b>2981830</b>	Source Location 0925		

LOWER LIMIT	UPPER LIMIT	NOMINAL VALUE	ACTUAL VALUE	UNIT	EXPANDED UNCERT.	NO REPS STD DEV	ANALYTICAL		
							PHASE	FREQ	METHOD
		100.0	100.2	ppm mo	± 2%rel		B		Ana
		20.90	21.13	% mole	± 2%rel		B		Ana
			78.8	% mole	± 2%rel		B		Ana

**REMARKS:**

This certificate is issued electronically and is valid without a signature.

Analytic Freq : I = Individual analysis, B = Batch analysis, C = Calculated value, S = Source.  
 The suffix (m) in the Unit of Measure refers to mass.

The expanded uncertainty has been calculated with a coverage factor k=2.

This certificate is produced in accordance with ISO 6141.  
 The results shown above are traceable to national or international standards through a rigorous preparation system in which International Reference Materials, ISO 6142 and ISO 6143 are used.

To obtain details about the applicable traceability, please contact us.

Do not use below a pressure of 3 bar (excluding product supplied at less than 10 bar).  
 Maintain storage and use temperature between -10 and 50 °C.

ASLTM 21 ING 5 16



### Certificate of Analysis

Air Products PLC  
 Hershaw Place Technology Park  
 Molesey Road  
 WALTON-ON-THAMES  
 Surrey  
 KT12 4RZ  
 UNITED KINGDOM  
 Date Printed: 02 MAR 2021

Container Type: C1.6A - 1.6L Aluminum Canister  
 Outlet Valve Connection: 5/8" - 18 UNF  
 Fill Pressure @ 15 °C: 69.0 bar-g  
 Fill Pressure @ 15 °C: 70.380 kg/cm2  
 Contents @ 0 °C, 1013 mbar: 0.110 Nm3

Material 314092 Mixture of Gases	Mfg. Date 19 FEB 2021	Analysis Date 19 FEB 2021	Best if Used By 19 FEB 2026
Batch 2977266		Source Location 0925	

LOWER LIMIT	UPPER LIMIT	NOMINAL VALUE	ACTUAL VALUE	UNIT	EXPANDED UNCERT.	NO REPS	ANALYTICAL			
							STD DEV	PHASE	FREQ	METHOD
		1000	1003	ppm mo	± 2%rel			B		Ana
		20.90	21.01	% mole	± 2%rel			B		Ana
			78.8	% mole	± 2%rel			B		Ana

**REMARKS:**

This certificate is issued electronically and is valid without a signature.

Analytic Freq : I = Individual analysis, B = Batch analysis, C = Calculated value, S = Source.  
 The suffix (m) in the Unit of Measure refers to mass.

The expanded uncertainty has been calculated with a coverage factor k=2.

This certificate is produced in accordance with ISO 6141.  
 The certified results are traceable to gas reference materials, or to mass traceable to national standards.

To obtain details about the applicable traceability, please contact us.

Do not use below a pressure of 3 bar (excluding product supplied at less than 10 bar).  
 Maintain storage and use temperature between -10 and 50 °C or lower if stipulated by local regulation.

ASLTM 2110517