

# Demonstration of Nubo Sphere's capability to measure methane emissions of 17g/h

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# Demonstration of Nubo Sphere's capability to measure methane emissions of 17g/h

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# 1 INTRODUCTION

On 15 December 2021, the European Commission adopted a proposal for a regulation aimed at reducing methane emissions in the energy sector. Among other points, this new legal act provides for improved measurement, reporting and verification of energy sector methane emissions. The legislative procedure for this regulation is still ongoing at the time of this report.

While not finalized yet, most recent drafts of the new European regulation on reducing methane emissions asks for measurement systems that are able to detect emission rates of 17g methane /h for the purpose of a 'Type 1 leak detection and repair survey'.

Sensirion wanted to test and demonstrate in this project the potential of their new Nubo Sphere solution, using laser spectroscopy sensor technology, to comply with this new regulation. Five different setups or events with the Nubo Sphere technology were tested where the distance between source and sensor nodes (6 devices in total) were varied. Duration of each test was approximately 30 minutes.

During the tests a stable continuous emission rate of 17g/h of methane was generated on ground level by using a calibrated mass flow controller and a adequate gas mixture of methane.

Tests were performed on the 29th of August of 2023. During the tests there were no ideal meteorological circumstances with low wind speeds and unstable air movements.

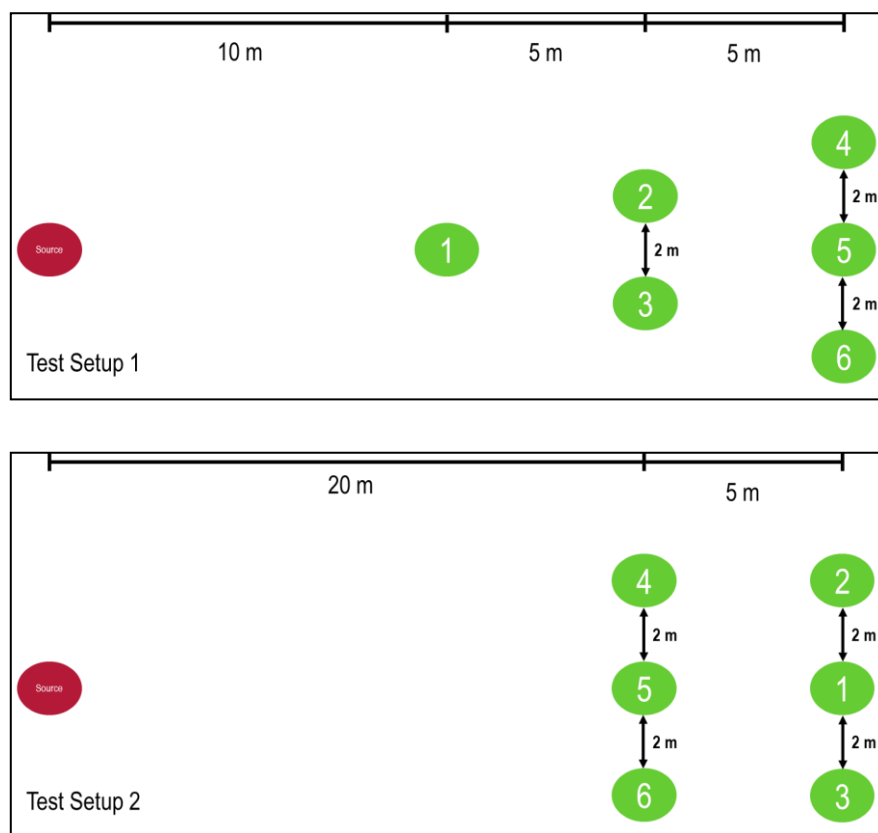
Despite this circumstances and based on the measured data during the test setups, it can be concluded that the Nubo Sphere technology has the technical capability to detect emission rates of 17g/h methane.

## 2 TEST SET-UP

The capability of Nubo Sphere to measure methane emissions of 17g/h has been demonstrated with the following experiment as shown in Figure 1. In this experiment, a methane (ground) source with a well-defined release rate of 17 g/h is applied. The 17 g/h is defined by a mass flow controller and the measured mass flow is displayed on a laptop. The six Nubo Sphere sensor nodes were placed at distances of 5m, 15m, 20m and 30m from the source. Below the different 5 test set-ups are shown. Duration of all tests (5 in total) was about 35 minutes each. See also the timetable of the test under paragraph 2.2.

A meteo station was not present during the tests. Based upon online data of wind speeds of meteo stations in the neighborhood, one can conclude that the test circumstances were not ideal because of low wind speeds (<2m/s) .

Some additional pictures of the test setups are added below



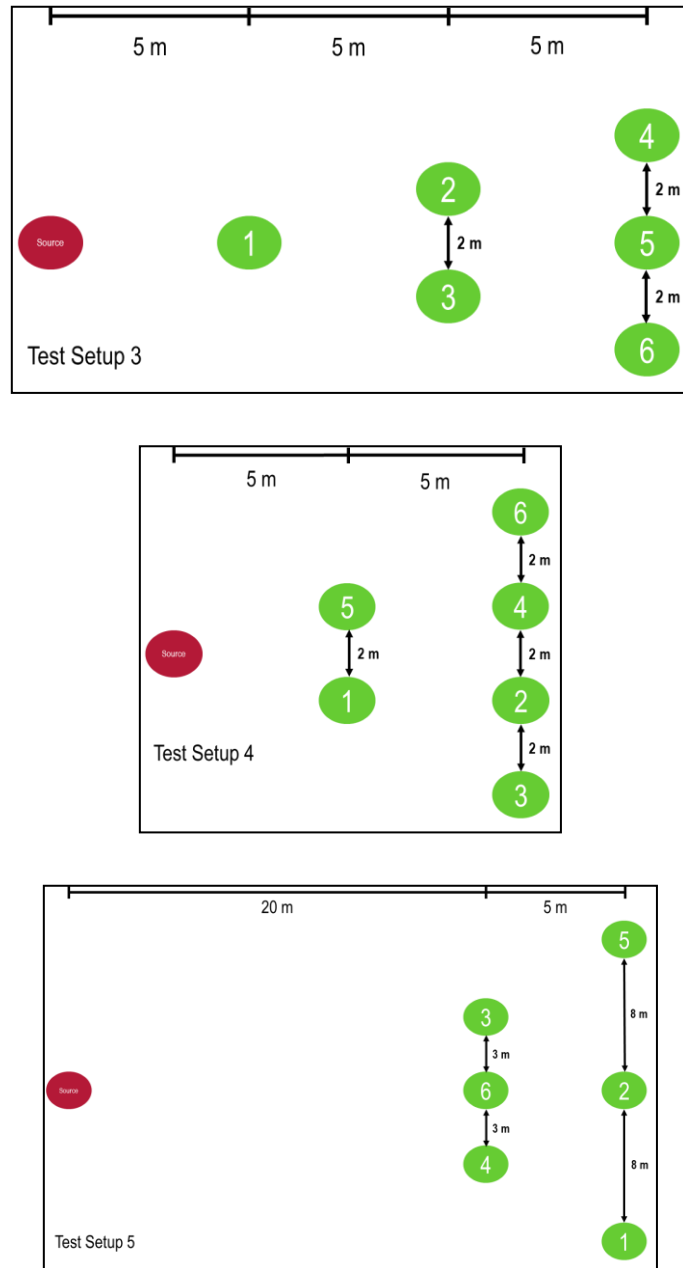


Figure 1: 5 different setups with location distance of the sensor nodes in relation to the generation unit



*Figure 2: Picture of Setup 1 , sensor nodes placed on different distances*





*Figure 3: Picture of the methane generation unit with pure methane gasbottle and the Mass Flow Controller unit*

## 2.1 Timetable of the test

9:00	Arrival at test field and start preparation and installation according to setup 1
11:00	Installation and preparation complete – start 17 g/h emission
11:00 – 11:38	Monitoring in test setup 1
11: 38 – 11:40	Moving devices from setup 1 to setup 2
11:40 – 12:08	Monitoring in test setup 2
12:08 – 12:10	Moving devices from setup 2 to setup 3
12:10 – 12:32	Monitoring in test setup 3
12:32 – 12:35	Moving devices from setup 3 to setup 4
12:35 – 13:20	Monitoring in test setup 4
13:20 – 13:25	Moving devices from setup 4 to setup 5
13:25 – 13:55	Monitoring in test setup 5
13:55	End of 17 g/h emission – Start dismantling test equipment
14:20	Dismantling complete – departure from test field

## 3 RESULTS

### 3.1 Description of the generation system

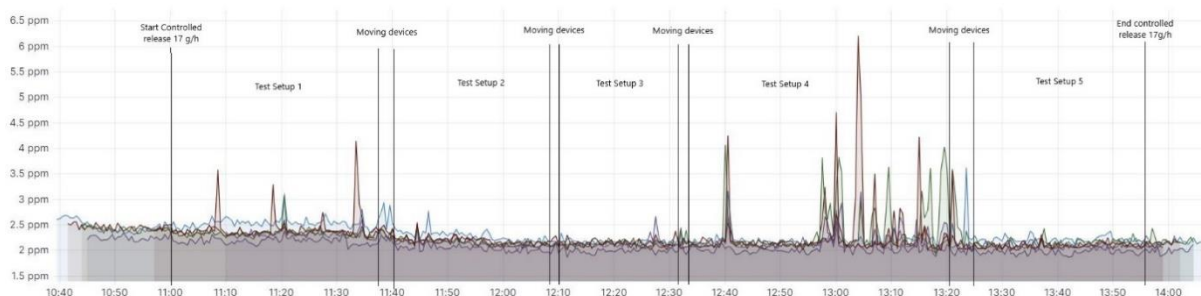
The pure methane from the bottle (99,9% purity) was dosed using an Mass Flow Controller with a 50% setting at 1l/min, resulting in an emission of 17g methane/h. The methane was emitted via a Teflon hose and a stainless-steel tube at 1.5m above the ground. The settings of the MFC were checked every fifteen minutes. See also picture 3

### 3.2 Results of the concentration measurements of the sensor nodes

#### Test results

The following plot gives an overview of the data during the different events

Full test results are provided separately as a csv file in annex, containing CH<sub>4</sub> measurements in ppm of all 6 devices, at a frequency of 5 seconds.



Some comments on the execution and results of the test:

- Wind conditions:
  - There was no live wind data available on the site.
  - It was clear that the wind was very low (<2m/s, based on information of local weather stations) for the duration of the test, with a slight increase in wind speeds in the second half of the test.
  - Without live wind data it was difficult to determine the exact wind direction and therefore to make sure the devices were positioned downwind from the release. As is often the case in low wind conditions, the wind direction seemed to shift quite a bit during the test.
- Test Setup 1:
  - In this test setup the devices were positioned at 10m, 15m and 20m distance.
  - We can see clear concentration spikes up to more than 4 ppm from the device at 10m distance (device #1). We also see multiple smaller spikes to 2.8 - 3.1 ppm from a device at 15m distance (device #3) and one clear spike to 3.1 ppm from the device at 20m distance (device #5).
- Test Setup 2
  - In this test setup the devices were positioned at 20m and 25m distance.
  - There was only 1 considerable concentration spike of 2.8 ppm, and that was from a device at 25 m distance (device #3), with a few other minor spikes of 2.5-2.6 ppm from different devices at 20m and 25m distance.

- Test Setup 3
  - In this test setup the devices were positioned at 5m, 10m and 15m distance.
  - Even though the devices were positioned much closer to the source, this test did not yield any significant spikes with the highest measurement being 2.7ppm from a device at 10m distance (#2). Based on observations on the field, our assumption was that the wind had turned to point away from where the devices were installed, so we decided to change the setup of the devices to setup 4.
- Test setup 4
  - This test setup had devices at 5m and 10m distance, positioned in a wider arc to be able to capture emissions from a wider angle of wind directions.
  - This test yielded the best results and clearest measurements so far, with concentration spikes above 3 ppm from almost all devices and large spikes above 4 ppm and even above 6 ppm from the devices installed at 5m distance
- Test setup 5
  - In the final test setup, we installed the devices at 20m and 25m distance, again positioned in a wider arc to be able to capture emissions from a wider angle of wind directions.
  - In the final test, no clear concentration spikes were measured, with only 2 measurements reading above 2.4 ppm.

## 4 CONCLUSION

Experiments on the capacity of the Nubo Sphere technology to detect methane leaks of 17g/h were performed on Tuesday 29/08/23.

5 different test setups were tested in succession while a constant leak of 17g/h of methane was generated by using a system of calibrated MFC's.

Due to low wind speed, meteorological circumstances were not ideal.

In two setups (1 and 4) significant peaks of methane concentration were observed at almost all devices. Highest and most frequent peaks are observed at the nodes placed at 5m, but also smaller but less frequent peaks were observed at higher distances, up to 20m in test 1.

In the other 3 test setups no (test set-up 5) or low peaks (setups 2 and 3) were observed.

Based on this observation it can be concluded that the Nubo Sphere technology is capable to detect elevated methane concentrations due to methane emission from leaks of 17/g hour.

However, and probably mainly due to the unfavorable meteorological circumstances, following conclusions can be made:

- Only a few peaks could be observed during the different set-ups. Only in test setup 4 higher frequency peaks at the different nodes were observed; 24 peaks with a total duration of  $\pm 3$  minutes
- There was no constant elevation of the concentration level, also not on the nodes nearest by the methane source; only short lasting peaks of 10-25 seconds (maximum duration of 65 seconds at sensor node 5 in test set-up 4) .

We think that clearer results, leading to a higher certainty, would have been achieved under better meteorological circumstances but only additional test can prove this assumption.



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