Work instructions
Gas measurement of containers
1. Introduction

1.1 Occasion

A study commissioned by the VROM [Housing, Regional Development and the Environment] inspectorate (Gas measurements in import containers [1]) demonstrated that many containers contain (residues of) gaseous pesticides. These pesticides form a potential risk for the inspectors when they inspect such containers.
The VROM ministry study did not specifically look at the situation of containers loaded with dangerous goods. The IVW [Transport and Water Management Inspectorate] then, together with the VROM Ministry and the RIVM [National Institute for Public Health and Environmental Protection], conducted a study on the situation of gaseous pesticides in containers loaded with dangerous goods. \(^b\)

The following conclusions can be drawn from the study on gas measurements in sea containers with dangerous goods \(^b\):

- 7% of the containers contained an excessively high concentration of pesticide;
- 19% of the containers gave an excessively high value for other compounds \(^1\);
- 23% of the containers constituted a risk for the inspector during the check.

The report made the following recommendations:

- always conduct measurements for explosion risk and oxygen content;
- always be prepared for the presence of gaseous pesticides and conduct measurements for them;
- coordinate safety measures in advance for the presence of gaseous pesticides and other risks, such as explosion risk or oxygen content.

In addition, in the sub-report "risk inventory and evaluation" of the IVW-Transport Division (field service) \(^c\), the Occupational Health and Safety Union gave the following advice:

- establish the gassed containers protocol;
- check all containers which one wants to open in advance for the presence of gas, and in so doing take all necessary precautionary measures.

1.2 Purpose

The purpose of these work instructions is to minimise the risk of exposure to gaseous pesticides and/or explosion danger during the inspection of a container, so that it is possible to work responsibly and safely in the immediate vicinity of the container’s doors.

\(^a, b, c\) See book list, Annex I

\(^1\) Other volatile organic compounds, carbon monoxide, carbon dioxide, ammonia, explosion risk, too high or low oxygen content.
1.3 Background information

The origin of a container is not a reliable indicator for determining whether a container has been fumigated. Fumigated containers are also found within Europe. Moreover, the nature of the load is not a good indicator either, since the wood pallets in a container can already provide a sufficient cause for having a container fumigated.

2.0 Responsibilities and powers

2.1 Laws and orders

The General Administrative Law Act art. 5.18 provides that designated officials are authorised to examine certain things, open them and take samples of them.

In addition, the Working Conditions Decree art 4.6 provides the following:

- If one can suspect that employees, by remaining in a place or in a space, might be exposed to substances to such an extent that there is a danger of asphyxiation, intoxication or poisoning or fire or explosion, an employee may not enter this place or this space before an adequate study has ascertained whether that danger is in fact present.
- If from the study referred to in the first paragraph it appears that the danger of asphyxiation, intoxication, poisoning, fire or explosion is present, effective measures must be taken so that the employees may enter this place or this space without the aforementioned dangers.
- If immediate danger arises in a place or a space such as those referred to in the first paragraph, effective measures must be taken so that the employees who entered this place or this space can immediately leave it. If that is not possible and nevertheless it is necessary to enter this place or this space, then this may be done only if work equipment is used which cannot itself cause the relevant danger and personal protective gear will be made available and used. As necessary, the employees who must enter the place or the space are constantly observed from outside.

2.2 Inspector (initiator of transport inspection)

- An inspector will not open any closed space before he/she knows for certain that this space can be safely inspected.
- If there is any doubt whether the closed space can be safely inspected, one must always first conduct measurements for residues of gaseous pesticides / oxygen / explosion danger. For this he/she can call on the assistance of an inspector from the gas measurement team.
- The inspector who has taken the initiative to organise an inspection remains fully responsible for the completion of this inspection. The inspector himself will consult with the involved parties (sender/receiver) in order to have the closed space rendered gas-free. In so doing he follows the handling flow chart (chapter 4.0)
- The inspector ensures that the completed measurement form (completed by the inspector from the gas measurement team) has been received.
- The inspector is responsible for entering the measurement results into BIC-II during the inspection questions.
2.3 Inspector gas measurement team

In order to be able to guarantee the safety and the continuation of the work, it is necessary to take the following items into consideration:

- use equipment in accordance with the manual;
- necessary training for using the equipment;
- order new Venturi tubes in due time, in accordance with stock and use-by date;
- order personal protective gear and needle container in due time;
- arrange for timely maintenance (annual) of the measuring equipment;
- complete the measurement form;
- submit measurement form to the inspector who is responsible for the inspection to be performed;
- in the event of leave of one week or more, transfer the case with the measuring equipment to a colleague from the gas measurement team;
- used filter boxes and Venturi tubes (needle container) are hazardous waste and must be dealt with as such. This waste is collected and processed in conformity with the sampling waste plan.

The new Venturi tubes must be ordered from the team leader, the material is then sent to the home address. In order to refine and adapt the measurement procedure to developments, it is necessary to pass on supplements and comments to the coordinator of the gas measurement team.

2.4 Coordinator

The coordinator is responsible for the:

- annual calibration of the equipment;
- processing of supplements to/comments on the working procedure;
- correct transfer of the measuring equipment in the event of leave;
- analysis of the delivered measurement results on the basis of BIC-II.

In addition, the coordinator must be reachable in case of any questions during the activities.

2.5 Team leader

The team leader is authorised to designate people who can participate in the gas measurement team, and the new Venturi tubes must be ordered from the team leader.

3.0 Measurement procedure

3.1 Safety

Working with dangerous goods can entail risks. Acting responsibly and using the proper protective gear and measuring equipment helps to minimise the risks. Given that no universal protective gear exists against all dangers, it is necessary to use the right protective gear in a given situation.

The following personal protective gear must be worn during the measurement for gas in a container along with the standard equipment (annex V):
- - respiratory protection, at a minimum a full face mask with ABEK2/P3;
- - hand protection, at a minimum nitrile disposable gloves.

The measurement procedure is discontinued if it appears that:

- - ≥ 10% of lowest explosion limit (LEL);
- - oxygen percentage ≤19.5%;
- - oxygen percentage > 23%;
- - discourting of Venturi tubes.

In the above cases, the container may not be opened and/or entered. In case of doubt, always play it safe and do not open/enter the container.
In any event, the container, even if it may be regarded as safe, must always be aired for several minutes before entering. If, after the container has been opened, there are indicators that there is a risk for health or the environment, the inspection must be stopped.

The measurements may be performed at most 30 minutes before the start of the activities. If the activities are interrupted, the measurements must be performed once again before resuming them.

During the activities, regularly measure for the lowest explosion limit and the oxygen content.

3.2 Indication for fumigation

Sometimes there is an indication that a container has been fumigated. This can appear (among other things) from the documentation or from the following external characteristics:

- - labels with warnings;
- - residues of tape on the rubbers of the doors;
- - residues of tape on the ventilation openings;
- - remnants of pesticide (bottles, bags, powder traces, holders);
- - pieces of hose into and on the container;
- - odour
3.3 Measurement flow chart

Container

Proof fumigated

Yes

No

Gas concerned found by measurement

Yes

No

Measure oxygen content and explosion danger

Yes

No

Oxygen <19.5%>23%

Yes

No

Oxygen <19.5%>23%

Yes

No

Lowest explosion limit LEL >10%

Yes

No

STOP MEASUREMENT PROCEDURE

DO NOT ENTER CONTAINER

BLOCK

DIAGRAM 4.1

COMPLETE GAS MEASUREMENT

Yes

No

Oxygen <19.5%>23%

No

Yes

No

Yes

No

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3.4 Use of explosion/oxygen meter

Because of the difference in vapour density between the various types of gaseous chemicals, it is necessary to measure at three different heights.

Guidelines for vapour density:

- $< 0.9 \rightarrow$ vapour rises;
- $0.9-1.0 \rightarrow$ vapour remains suspended;
- $> 1.0 \rightarrow$ vapour settles.

The operating instructions of the explosion/oxygen meter are contained in annex IV.

The explosion/oxygen meter is calibrated on methane, whose explosion limits lie between 5-15 vol% in air. Other gases which can present a danger have other explosion limits, such as diethyl ether 1.7-36 vol% in air. In most cases, the meter measures a different gas than that for which it has been calibrated. Between the measured LEL and the real LEL there is a conversion factor. The real LEL can be higher or lower than the measured LEL, therefore it is necessary not to open the container at a value greater than or equal to 10% LEL.

If, during the measurement, the meter rises to over 40% LEL, you must turn off the meter to avoid wear and tear and damage of certain parts. Also, never measure near pure product, and do not expose the meter to moisture, because this will damage the measuring unit.

Five minutes before beginning with the actual measurement of the container, the explosion/oxygen meter must be started up in clean air upwind of the container. The explosion/oxygen meter then automatically sets itself at 20.9% oxygen and 0% LEL. During the measurement, it is necessary to watch the result of the meter and the input hose for the possibility of sucking up (for example) liquid or dust particles. The minimum time that must be measured is one minute, the recommended time is two minutes.

If measuring several containers, after each one the input hose must be rinsed out with clean air in order to return the meter to the starting value. It is recommended to keep the input hose as short as possible and to replace it regularly and to check for dust and leakage. The device must be stored clean and dry in its case.

3.5 Use of test tubes

The measurement principle of the test tubes is based on a colorimetric reaction, a discolouring of the reagent. Each substance or substance group has its own test tube, with its own specific discolouring. Due to cross-sensitivity of the reagent, the test tube can also discolor if another substance is sucked in, this can produce the same or some other discolouring. A discolouring of a test tube means that there are contaminants in the container and that this can constitute a health danger. Due to cross-sensitivity, a result can be produced that is lower or higher than for the original gas.

Each test tube has its own pre-reagent, breaking ampoule, scale division, discolouring etc. It is therefore necessary to carefully read the operating instructions in order to correctly use the
tubes so that the measurement is properly performed. Before the test tubes are used, the pump must first be tested for leaks.

Measurement errors can be caused by the following points:

- use-by date;
- incomplete pumping strokes;
- incorrect use;
- leaky pump/hose;
- material of hose;
- temperature;
- ambient pressure;
- cross-sensitivity;
- reading accuracy.

In the measurement table it is indicated whether for that specific gas a correction is necessary for the temperature (if it is greater or less than 20°C) or the ambient pressure (if it is greater or less than the atmospheric pressure of 1013mbar). For the conversion table or conversion formula, reference is made to the operating instructions of the tube in question.

The measuring accuracy of the test tubes is 10 to 40%; this means that the measuring method is not precise, but only gives an indication of the presence of gaseous chemicals in the container. After measurement of the lowest concentration of gaseous chemicals, do not open the container (=discolouring of detection tube).

Annex VII contains the tables which can be used to determine the number of pumping strokes of the different test tubes as well as the MAC value, colour change, etc. These tables are derived from the instructions for using the various test tubes.
4.0 Handling

4.1 Handling Flow Chart

4.2 Explanation of flow chart

If, from the measurements of the first flow chart, it appears that a container contains gaseous chemicals, it is stopped from being used for further transportation. On the basis of article 5:20 (1) in conjunction with 5:18 (1) of the General Administrative Law Act, one demands the co-operation of the involved party (shipping company/agent/sender/receiver, etc.) in order to have the container measured by a certified expert. If the expert declares the container to be gas-free, then a regular inspection is performed of the first row * of the container with personal protective gear, see §3.1.

However, if the container is declared not to be gas-free, then it must first be degassed. Before a check of the first row * can be done with personal protective gear, a new measurement must first be performed by an expert.

* Goods which are stowed on the 1st row in the container.
5 Archive

These instruction were drafted by Eng. M.J.J. Weemhoff-Steeneke.

The coordinator of the gas measurement team controls these work instructions and is responsible for the necessary adaptations. These work instructions are evaluated annually and are included in the handbook.