

## Appendix 1: Commonly used fumigants

SUBSTANCE	WHAT IS IT?	EXPOSURE SYMPTOMS INCLUDE	EQUIPMENT TO DETECT IT IN CONTAINERS	EQUIPMENT TO MEASURE HOW MUCH IS IN CONTAINERS	WHAT IS THE WES VALUE?*
<b>Methyl bromide</b>	<ul style="list-style-type: none"> <li>- It's a colourless gas</li> <li>- It's practically odourless but has a sweet chloroform-like smell at high levels (over 21 ppm)</li> <li>- It's toxic if you breathe it, ingest it or absorb it through the skin</li> </ul>	<ul style="list-style-type: none"> <li>- Headaches, dizziness, nausea, vomiting, tremor, slurred speech</li> <li>- Irritation to eyes, respiratory system and skin (eg blistering)</li> <li>- Death at high doses</li> </ul>	<ul style="list-style-type: none"> <li>- Colorimetric gas detection tubes</li> <li>- Halogen leak detector</li> <li>- Methyl bromide-specific gas detectors (electrochemical sensor) – this may give the most accurate results (<i>recommended</i>)</li> <li>- Portable mass spectrometer (<i>recommended</i>)</li> </ul>	<ul style="list-style-type: none"> <li>- Photoionisation detectors (PIDs) – <i>these must be set up correctly and regularly calibrated for methyl bromide</i></li> <li>- Colorimetric gas detection tubes</li> <li>- Methyl bromide-specific gas detectors (electrochemical sensor)</li> <li>- Portable mass spectrometer</li> </ul>	5 ppm (19 mg/m <sup>3</sup> ) averaged over 8 hours*
<b>Phosphine</b>	<ul style="list-style-type: none"> <li>- It's a colourless gas that's produced when moisture in the air reacts with aluminium phosphide or magnesium phosphide</li> <li>- It may smell like garlic. But just because you can't smell it doesn't mean that it's not there</li> <li>- It's extremely toxic if you breathe in the gas</li> <li>- It's also toxic if you ingest solid phosphine or absorb it through the skin</li> <li>- You may find a greyish white powder in the container left over from the fumigation. <i>This is usually a non-harmful residue. However if you find this you should contact a local fumigation company. They will usually mix it with detergent and water to react any aluminium phosphide left. As this will produce phosphine gas this should be done safely.</i></li> </ul>	<ul style="list-style-type: none"> <li>- Headaches, dizziness, nausea, vomiting, irregular heartbeat, double vision, breathing problems</li> <li>- Heart, liver or kidney damage</li> <li>- Anaemia, speech and motor problems, and weight loss (with longer term exposures)</li> </ul>	<ul style="list-style-type: none"> <li>- Colorimetric gas detection tubes</li> <li>- Halogen leak detector</li> <li>- Phosphine-specific gas detectors that are used at low sensor range (0-20 ppm, 0.1 ppm resolution) (<i>recommended</i>)</li> <li>- Portable mass spectrometer (<i>recommended</i>)</li> </ul>	<ul style="list-style-type: none"> <li>- PIDs – <i>these must be set up correctly and regularly calibrated for phosphine</i></li> <li>- Colorimetric gas detection tubes</li> <li>- Phosphine-specific electrochemical sensor</li> <li>- Portable mass spectrometer (<i>recommended</i>)</li> </ul>	0.3 ppm (0.42 mg/m <sup>3</sup> ) averaged over 8 hours*

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<b>Hydrogen cyanide</b>	<ul style="list-style-type: none"> <li>- It's a colourless gas</li> <li>- It may smell like almonds. However some people can't smell it at all</li> <li>- It's extremely toxic if you breathe in the gas, or ingest it or absorb it through the skin</li> <li>- It can affect all organs because it stops the supply of oxygen to them</li> </ul>	<ul style="list-style-type: none"> <li>- Irritation to eyes, nose, throat and skin (at low doses)</li> <li>- Flushing of the face, headaches, nausea, vomiting and breathing problems. Convulsions and death can follow (at high doses)</li> <li>- Nervous system, thyroid, heart and lung damage (with long term exposure)</li> </ul>	<ul style="list-style-type: none"> <li>- Colorimetric gas detection tubes</li> <li>- Hydrogen cyanide-specific gas detectors (electrochemical sensor) - this may give the most accurate results (<i>recommended</i>)</li> <li>- Portable mass spectrometer (<i>recommended</i>)</li> </ul> <p><i>PIDs cannot be used to detect the presence or levels of hydrogen cyanide</i></p>	<ul style="list-style-type: none"> <li>- Colorimetric gas detection tubes</li> <li>- Hydrogen cyanide-specific electrochemical sensor</li> <li>- Portable mass spectrometer</li> </ul> <p><i>PIDs cannot be used to detect the presence or levels of hydrogen cyanide</i></p>	10 ppm (11 mg/m <sup>3</sup> ) (ceiling)*
<b>Chloropicrin (tear gas)</b>	<ul style="list-style-type: none"> <li>- It has a pungent smell at even very low levels</li> <li>- It's extremely toxic</li> <li>- It's not approved for use with other fumigants in New Zealand</li> </ul>	<ul style="list-style-type: none"> <li>- Severe irritation to eyes, lungs and skin</li> <li>- Blindness (with long term exposure)</li> </ul>	<ul style="list-style-type: none"> <li>- Colorimetric gas detection tubes</li> <li>- Chloropicrin-specific gas detectors (electrochemical sensor) - this may give the most accurate results (<i>recommended</i>)</li> <li>- Portable mass spectrometer (<i>recommended</i>)</li> </ul> <p><i>PIDs should not be used to detect the presence or levels of chloropicrin as they don't provide good accuracy</i></p>	<ul style="list-style-type: none"> <li>- Colorimetric gas detection tubes</li> <li>- Chloropicrin-specific electrochemical sensor</li> <li>- Portable mass spectrometer</li> </ul> <p><i>PIDs should not be used to detect the presence or levels of chloropicrin as they don't provide good accuracy</i></p>	0.1 ppm (0.67 mg/m <sup>3</sup> ) averaged over 8 hours*

**TABLE 1:** Commonly used fumigants

\* For short term activities such as inspections and unpacking, ceiling WES values should be used for comparison. However for those substances that do not have ceiling values, the eight hour values should be used instead as a guide for risk assessment.

<sup>1</sup> Check that these WES values are the most up-to-date values at the WorkSafe website. Search using the phrase 'Workplace Exposure Standards and Biological Exposure Indices'.

## Appendix 2: Common off-gases that may be present inside containers

SUBSTANCE	WHAT IS IT?	EXPOSURE SYMPTOMS INCLUDE:	EQUIPMENT TO DETERMINE IF IT IS PRESENT INSIDE CONTAINERS	EQUIPMENT TO MEASURE HOW MUCH IS INSIDE CONTAINERS	WHAT IS THE WES VALUE <sup>2</sup> ?
<b>Formaldehyde</b>	<ul style="list-style-type: none"> <li>- It has a pungent distinctive smell</li> <li>- It's toxic if you breathe in high levels</li> <li>- It may be released from foam insulation, MDF products, plastics, fabrics, glues and resins used on products, building materials, carpets and upholstery</li> </ul>	<ul style="list-style-type: none"> <li>- Irritation to eyes, nose and throat</li> <li>- Headaches, nosebleeds, dizziness and tiredness</li> <li>- Wheezing and chest pains (at high doses)</li> </ul>	<ul style="list-style-type: none"> <li>- Colorimetric gas detection tubes</li> <li>- Formaldehyde-specific gas detectors (electrochemical sensor) – <i>this may give the most accurate results (recommended)</i></li> <li>- Portable mass spectrometer (<i>recommended</i>)</li> </ul> <p><i>Commonly used photoionisation detectors (PIDs) (with a 10.6eV lamp) cannot be used to detect the presence or levels of formaldehyde</i></p>	<ul style="list-style-type: none"> <li>- Colorimetric gas detection tubes</li> <li>- Portable mass spectrometer</li> <li>- Formaldehyde-specific electrochemical sensor</li> </ul> <p><i>Commonly used PIDs (with a 10.6eV lamp) cannot be used to detect the presence or levels of formaldehyde</i></p>	<p>0.5 ppm (averaged over 8 hours)*</p> <p>Ceiling 1 ppm*</p>
<b>Toluene</b>	<ul style="list-style-type: none"> <li>- It has a sweet pungent smell</li> <li>- It's toxic if you breathe in high levels</li> <li>- It may be released from shoes, electronics, wood, toys, consumables, textiles, food, polyresin, rubber, packaging plastics, fabrics, building materials, carpets and upholstery</li> </ul>	<ul style="list-style-type: none"> <li>- Irritation to eyes, nose and throat</li> <li>- Headaches, nausea, sleepiness, dizziness and tiredness</li> <li>- Central nervous system effects at high doses</li> <li>- Death</li> </ul>	<ul style="list-style-type: none"> <li>- Colorimetric gas detection tubes</li> <li>- Portable mass spectrometer (<i>recommended</i>)</li> <li>- Toluene-specific electrochemical sensor</li> </ul>	<ul style="list-style-type: none"> <li>- Colorimetric gas detection tubes</li> <li>- PIDs</li> <li>- Portable mass spectrometer</li> <li>- Toluene-specific electrochemical sensor</li> </ul>	<p>50 ppm (188 mg/m<sup>3</sup>) averaged over 8 hours*</p>
<b>Benzene</b>	<ul style="list-style-type: none"> <li>- It's toxic if you breathe in high levels</li> <li>- It may be released from shoes, electronics, wood, toys, consumables, textiles, food, polyresin, rubber, packaging plastics, fabrics, building materials, carpets and upholstery</li> </ul>	<ul style="list-style-type: none"> <li>- Sleepiness, dizziness, irregular heartbeat, headaches and tremors</li> <li>- Bone marrow or the immune system effects at high doses</li> </ul>	<ul style="list-style-type: none"> <li>- Colorimetric gas detection tubes</li> <li>- Portable mass spectrometer (<i>recommended</i>)</li> <li>- Benzene-specific electrochemical sensor</li> </ul>	<ul style="list-style-type: none"> <li>- Colorimetric gas detection tubes</li> <li>- PIDs</li> <li>- Portable mass spectrometer</li> <li>- Benzene-specific electrochemical sensor</li> </ul>	<p>1 ppm (3.19 mg/m<sup>3</sup>) averaged over 8 hours*</p>

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<b>Xylene</b>	<ul style="list-style-type: none"> <li>- It's toxic if you breathe in high levels</li> <li>- It may be released from shoes, electronics, wood, toys, consumables, textiles, food, polyresin, rubber, packaging plastics, fabrics, building materials, carpets and upholstery</li> </ul>	<ul style="list-style-type: none"> <li>- Irritation to eyes, nose and throat</li> <li>- Dizziness, headaches irregular heartbeat, nausea and vomiting.</li> <li>- Central nervous system effects at high doses</li> </ul>	<ul style="list-style-type: none"> <li>- Colorimetric gas detection tubes</li> <li>- Portable mass spectrometer (<i>recommended</i>)</li> <li>- Xylene-specific electrochemical sensor</li> </ul>	<ul style="list-style-type: none"> <li>- Colorimetric gas detection tubes</li> <li>- PIDs</li> <li>- Portable mass spectrometer</li> <li>- Xylene-specific electrochemical sensor</li> </ul>	50 ppm (217 mg/m <sup>3</sup> ) averaged over 8 hours*
<b>Carbon monoxide</b>	<ul style="list-style-type: none"> <li>- It's a colourless, odourless gas</li> <li>- It's toxic if you breathe in high levels</li> <li>- It blocks the ability of red blood cells to deliver oxygen throughout the body</li> <li>- It may come from unloading a container with a petrol-, diesel- or LPG-powered fork hoist. This can cause carbon monoxide to build up inside the container</li> </ul>	<ul style="list-style-type: none"> <li>- Headaches, dizziness, nausea, vomiting and confusion</li> <li>- Death</li> </ul>	<ul style="list-style-type: none"> <li>- Colorimetric gas detection tubes</li> <li>- Carbon monoxide-specific gas detectors (electrochemical sensor) <ul style="list-style-type: none"> <li>- <i>this may give the most accurate results (recommended)</i></li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>- Colorimetric gas detection tubes</li> <li>- Carbon monoxide-specific electrochemical sensor</li> </ul>	25 ppm averaged over 8 hours 400 ppm (ceiling)*

\* For short term activities such as inspections and unpacking, ceiling WES values should be used for comparison. However for those substances that do not have ceiling values, the eight hour values should be used instead as a guide for risk assessment.

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