What are gases and what PPE to recommend against them?

What is a gas?

At regular room temperature and atmospheric pressure, chemical compounds can take different forms depending on their inner properties: they can be solid, liquid or gaseous. Those 3 aggregation states differ on several basic properties:

	Solid	Liquid	Gas
Possibility for the molecules to move freely	+	++	+++
Compressibility	+	++	+++

The aggregation state of a chemical can be determined by looking at the MSDS available for this specific compound – section 8 or 9 of the MSDS always states the aggregation state of the chemical in normal conditions, meaning at usual room temperature and atmospheric pressure. Watch out for:

- The boiling temperature
- The pressure

Boiling temperature

The temperature over which a chemical is no longer liquid but becomes gaseous. Each chemical possesses a different boiling temperature based on its properties.

Example: boiling temperature of acetone = 56-57°C
At a temperature lower than 56-57°C, acetone will be liquid.
At a temperature higher than 56-57°C, acetone will become a gas.

Pressure

The aggregation state of a chemical can also change due to the pressure: a high pressure might change a chemical from a gaseous state to a liquid when high enough. We then talk about a liquefied gas.

Aerosols

Often considered by many people as gaseous compounds, aerosols usually also contain liquid compounds. The gaseous compound is usually only present to facilitate the ejection other liquids from the can they are stored in.

What protection devices to use against gases?

One specific type of PPE cannot be recommended for every gaseous compounds. Indeed, the type of PPE to use against a gas will depend on the toxicity of the chemical and on the precise application of your customer.

Please however note that a glove in itself does usually not correspond to an appropriate mean of protection against a pure gaseous compound, since this glove will not avoid inhalation of the gas and will not completely avoid contact with it either.

More precisely, the recommendation will depend on:

	Solution
Whether toxic inhalation of the chemical is possible	A whole suit of protection with an isolating breathing device on it should be used.
Whether the chemical is used in its liquefied form	Cold burns correspond the main risk to avoid. Specific cold protective gloves should be used in this case (please refer to our FAQ about liquefied gases for more information).
Whether the gaseous chemical is diluted in water	If diluted, the product then becomes liquid – therefore, gloves should be used and an estimation of the permeation time can be done.

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If you are unsure about one of these parameters, please ask your customer or chemical provider for more information (example: ask for an MSDS, ask in what state the chemical is being used or if the gaseous chemical is kept under pressure). Also feel free to contact the Chemical Guardian team in case of doubt.

Examples:

1) Air is composed of different gases: oxygen, nitrogen, carbon dioxide, etc. Air is not toxic for human beings (they absolutely need oxygen to live), meaning that of course no PPE should be used in this case.

2) Mustard gas is a very toxic chemical that was used as a chemical weapon during World War I. Chemical burns are produced on the skin of a person exposed to this chemical. It is also toxic by inhalation. In this precise case, a glove does not correspond to an appropriate mean of protection when it is used alone. A whole suit of protection with an isolating breathing device on it should be used to protect the user from this chemical.

3) Hydrogen fluoride is a very toxic chemical. It can induce gangrene and even the death of the end-user if the person was exposed to this chemical. When pure (100% concentration), hydrogen fluoride corresponds to a gas. When diluted in water (99% concentration or lower), it corresponds to a liquid. If hydrogen fluoride is in a liquid diluted form, specific gloves should be used when manipulating this chemical. See our FAQ on the topic for more information. If gaseous hydrogen fluoride is used, then a whole suit of protection with an isolating breathing device on it should be used to completely avoid any contact and inhalation of this toxic chemical.

4) Propane corresponds to a gaseous compound often stored in pressurized bottles. This condition of storage, which increases the pressure, transforms propane into a liquid, which we call a "liquefied gas". When this liquefied gas comes out of the pressurized bottles, the main risk will be the possible cold burns produced to the end-user's hands. Specific cold protective gloves must be used in this case – please refer on our FAQ about liquefied gases for more information about this topic.

5) Chlorine corresponds to a gas in normal conditions – therefore, a glove doesn't represent a relevant way of protection against it when used alone. However, in the day-to-day life, many people use the term "chlorine" as a very generic word to describe the liquid solution usually used to disinfect swimming-pools. This solution is actually not made of the chemical chlorine, but is made of a chloride-derivative dissolved in water (example: chlorine dioxide dissolved in water or sodium hypochlorite dissolved in water). In conclusion: if your customer is using chlorine, it is important to know whether he refers well to the gaseous chlorine or the day-to-day disinfecting solution. Our recommendation is going to be different depending on that fact (a glove can indeed be recommended to handle the aqueous day-to-day chlorine).