An Introduction to Respiratory Protection
This handbook offers general advice for users. However, each individual application must be specifically checked. All details have been compiled to the best of our knowledge. This does not imply any liability, however. Dräger assumes no responsibility for the content of this handbook.

The information and data in this handbook are subject to technical modifications and cannot always be up to date. Always use the instructions for use supplied with Dräger products.

The reproduction of usage names, trade names, product identifications, etc., even without specific designation, does not authorise the assumption that such names may be free in the sense of trademark protection and thereby available for use by any person.

Technical data: Subject to modifications
1st edition

Dräger Safety AG & Co. KGaA
Lübeck, 2016
An Introduction to Respiratory Protection

4 Introduction
   1. Air is life, you can’t survive without it

5 Our atmosphere
   2. When does air become dangerous?

7 Contaminants
   3. What are contaminants?

9 Impact categories of contaminants
   4. How do contaminants get into the body?

11 Hazardous substances in the workplace
   5. How can I protect myself from unclean air?

13 Device types
   6. What types of respiratory protection devices are there?
1. AIR IS LIFE, YOU CAN’T SURVIVE WITHOUT IT

By the age of 68, you will have inhaled approximately 300,000 m³ of air — an enormous amount. For this volume, it is vital that the air flowing through your lungs is clean. This applies equally to ambient air as well as to air that is supplied to you externally (via a device or filter). Externally supplied air is necessary if the ambient air is contaminated or oxygen deficient. Types of external air supply include, for example, air from compressed-air cylinders that are filled with breathing air, or air from external breathing-air pipes.

When breathing air becomes dangerous

Is the concentration of hazardous substances at your workplace too high and/or the oxygen content in ambient air too low? If so, you need respiratory protection. Wearing respiratory protection is always an additional burden, this is why the following principle applies: as much protection as necessary, as little a burden as possible. But how much protection is necessary? The answer to this question depends on your area of application.
2. WHEN DOES AIR BECOME DANGEROUS?

The normal atmosphere is only made up of about 21% $O_2$. If the breathing air contains too little oxygen, it can be life threatening. Particularly dangerous is the fact that you cannot detect a lack of oxygen with your nose.

### OUR ATMOSPHERE IS MADE UP AS FOLLOWS (IN PPM):

<table>
<thead>
<tr>
<th>Gas</th>
<th>Composition</th>
<th>Dry</th>
<th>Humid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main gases</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$N_2$ – Nitrogen</td>
<td>780,840</td>
<td>768,543</td>
<td></td>
</tr>
<tr>
<td>$O_2$ – Oxygen</td>
<td>209,450</td>
<td>206,152</td>
<td></td>
</tr>
<tr>
<td>$H_2O$ – Water vapour</td>
<td>0</td>
<td>15,748</td>
<td></td>
</tr>
<tr>
<td>Argon</td>
<td>9</td>
<td>9,193</td>
<td></td>
</tr>
<tr>
<td>$CO_2$ – Carbon dioxide</td>
<td>340</td>
<td>335</td>
<td></td>
</tr>
</tbody>
</table>

How does oxygen deficiency come about?
If inert gas flows into the atmosphere, it displaces the oxygen at the same time. Since only approximately one-fifth of the atmosphere is oxygen, the oxygen concentration is only reduced by one-fifth of the concentration of inert gas.
**Danger of inertisation**

Industrial firms regularly use liquid nitrogen (-196 °C). If it evaporates, this can quickly lead to a lack of oxygen. If nitrogen in the ambient air reaches 10%, the concentration of oxygen decreases by 2%.

<table>
<thead>
<tr>
<th>Oxygen concentration in Vol.-%</th>
<th>Oxygen partial pressure in hPa</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 17</td>
<td>&lt; 170</td>
<td>Tendency towards danger from lack of oxygen</td>
</tr>
<tr>
<td>11 to 14</td>
<td>110 to 140</td>
<td>Unnoticeable reduction in physical and mental capabilities</td>
</tr>
<tr>
<td>8 to 11</td>
<td>80 to 110</td>
<td>Possibility of loss of consciousness without warning after a certain period of time</td>
</tr>
<tr>
<td>6 to 8</td>
<td>60 to 80</td>
<td>Loss of consciousness in a few minutes (resuscitation possible if initiated immediately)</td>
</tr>
<tr>
<td>&lt; 6</td>
<td>&lt; 60</td>
<td>Immediately loss of consciousness</td>
</tr>
</tbody>
</table>
3. WHAT ARE CONTAMINANTS?

Generally speaking, ‘contaminants’ mean substances or mixtures that are harmful to people, animals, plants, organisms and entire ecosystems. According to the German Ordinance on Hazardous Substances, contaminants not only include pure substances but also mixtures, preparations or products.

Contaminants can be divided into two main groups:
- natural (e.g. mineral dust and hydrogen cyanide in bitter almonds)
- synthetic and created by man (e.g. vehicle exhaust gases and industrial fumes)
When do contaminants become dangerous?
If contaminants get into your body, they can cause illness. Their impact depends on their respective characteristics and their interaction with the human body.

Dräger gas detection and warning devices
In order to detect dangers from flammable and toxic gases simply and quickly, Dräger offers a wide range of gas-measurement and warning devices for the widest range of uses.

Additional information about gas detection is available on the Dräger website. Or you can simply ask your local Dräger representative.

CHECK OUT: www.draeger.com
4. HOW DO CONTAMINANTS GET INTO THE BODY?

Contaminants can enter the body in three different ways:
- Inhalation: via the respiratory tracts
- Oral: via the mouth (mostly when swallowing)
- Dermal: via the skin

How can a risk be recognised?
The Globally Harmonized System of Classification and Labelling of Chemicals (GHS) internationally prescribes uniform labelling of hazardous substances, mixtures and products using pictograms for physical, health and environmental dangers.
HOW DO CONTAMINANTS WORK?

Roughly speaking, there are three chronological impact categories:

- **Hyperacute**: leads to death in a relatively short space of time
- **Acute**: rapid impact (e.g. poisoning, cauterisation, irritation and burns (for example after explosions))
- **Chronic**: longer impact duration leading to chronic genetic changes (tumours, deformities) or to long-term poisoning with organ damage (e.g. to the liver, lungs or kidneys)
5. HOW CAN I PROTECT MYSELF FROM UNECLEAN AIR?

Are you uncertain whether the air in a certain workplace or working area is free of hazardous substances? Before starting work, you should carry out a risk analysis to identify risks and stresses for you and your employees. You can only protect yourself from hazardous substances effectively when you know which substances you’re dealing with.

Can I protect myself from hazardous substances in the workplace without respiratory protection equipment? In order to limit the risk from hazardous substances, you can take the following precautions:

- Replace hazardous substances with less dangerous substances (substitution)
- Avoid hazardous substances being released by exhaust air, ventilation technology or encapsulation
- Eliminate intake of hazardous substances via organisational measures
What if these measures are ineffective or can't be implemented? Or what if you're not entirely sure that there's no danger left in the air? In any of these cases, you should definitely take extra safety precautions, such as respiratory or body protection.

**EMPLOYEE SAFETY IS MANDATORY**

Employers are duty-bound to ensure that the ambient air in which employees work contains sufficient oxygen. They must also ensure that employee health is not damaged by contaminants. The occupational exposure limits (OELs) provided by the Committee on Hazardous Substances apply. Additional national and local regulations must be followed.
6. WHAT TYPES OF RESPIRATORY PROTECTION DEVICES ARE THERE?

Respiratory protection devices are divided into different types, depending on whether the device acts independently of the ambient air conditions or not.

An overview of respiratory protection devices:
When should I use respiratory protection?
Wearing a respiratory protection device is an additional burden. Therefore, you should only consider respiratory protection if the limits in your workplace cannot be met with any other protective measures.

You can avoid wearing respiratory protection with the following protective measures:
- Substitution of the hazardous substance
- Technical solutions, such as exhausts, ventilation measures or encapsulation
- Organisational measures

How do I select the right respiratory protection for my field of work?
The guide EN 529 “Respiratory protection devices – Recommendations for use, care and maintenance” provides important information at the European level. In Germany, the professional association regulation 190 (BGR 190) “Use of respiratory protection” applies. This regulation includes information about selecting and using respiratory protection as well as any relevant prerequisites.
CORPORATE HEADQUARTERS
Drägerwerk AG & Co. KGaA
Moislinger Allee 53–55
23558 Lübeck, Germany
www.draeger.com

REGION DACH
Dräger Safety AG & Co. KGaA
Revalstraße 1
23560 Lübeck, Germany
Tel +49 451 882 0
Fax +49 451 882 2080
info@draeger.com

REGION EUROPE
Dräger Safety AG & Co. KGaA
Revalstraße 1
23560 Lübeck, Germany
Tel +49 451 882 0
Fax +49 451 882 2080
info@draeger.com

REGION MIDDLE EAST, AFRICA
Dräger Safety AG & Co. KGaA
Branch Office
P.O. Box 505108
Dubai, United Arab Emirates
Tel +971 4 4294 600
Fax +971 4 4294 699
contactuae@draeger.com

REGION ASIA PACIFIC
Draeger Safety Asia Pte Ltd
25 International Business Park
#04-20/21 German Centre
Singapore 609916
Tel +65 6308 9400
Fax +65 6308 9401
asia.pacific@draeger.com

REGION CENTRAL AND SOUTH AMERICA
Dräger Panama S. de R.L.
Complejo Business Park,
V tower, 10th floor
Panama City
Tel +507 377-9100
Fax +507 377-9130
contactcsa@draeger.com

Locate your Regional Sales Representative at:
www.draeger.com/contact