Breathing Air

The provision of breathable air to be used by a person in the execution of a work related task is controlled by certain legal requirements.

Legal Requirements

These requirements are contained variously in the following non-exhaustive listing;

The Personal Protective Equipment Regulations 2002 (SI 2002/1144) - these regulations include provisions for respiratory protective equipment.

Control of Substances Hazardous to Health (COSHH) Regulations 2002 (6th edition 2013) – these regulations identify the maximum exposure limits for a defined list of contaminants which may be present in a workplace atmosphere. The exposure limits are now identified by the single term 'workplace exposure limit' (WEL) which encompasses both long and short term exposure. Related to COSHH is a reference listing published annually under the identity EH40/2005 (2nd edition 2011) 'Occupational Exposure Limits'. The listings are in addition to those in COSHH. Where any doubt exists as to the limits for any contaminant then this should be used as a starting point.

Standards

Suitable equipment and arrangements are detailed in BS EN529:2005 Respiratory protective devices recommendations for selection, use, care and maintenance.
The specified standard for breathable air is BS EN12021: 2014 'Respiratory protective devices Compressed gasses for breathing apparatus' is now the only standard to indicate maximum permitted contaminant levels for breathing air both in the UK and in the EU.

Extract from BS EN12021 – Clause 6

Compressed gas for breathing shall not contain contaminants at a concentration which can cause toxic or harmful effects. In any event, all contaminants shall be kept as low as possible and shall be less than one tenth of a national 8h exposure limit. For breathing air only the limit shall be less than one sixth of a national 8h exposure limit. For breathing at hyperbaric pressures greater than 10 bar or exposure times greater than 8h levels shall be revised to take into account the effects of pressure and exposure times.

<table>
<tr><td>Oxygen</td><td>(21 ± 1) % by volume</td><td>Carbon dioxide</td><td>≤ 500ml/m³ (ppm)</td></tr>
<tr><td>Carbon monoxide</td><td>≤ 5ml/m³ (ppm)</td><td>Oil</td><td>≤ 0.5 mg/m³</td></tr>
<tr><td>Water (vapour)</td><td colspan="3">Compressed breathing air shall have a dew point sufficiently low to prevent condensation and freezing. Where the apparatus is used and stored at a known temperature the pressure dew point shall be at least 5 °C below the likely lowest temperature. Where the conditions of usage and storage of any compressed air supply is not known the pressure dew point shall not exceed -11 °C</td></tr>
<tr><td rowspan="4">Water (vapour) content of high pressure breathing air</td><td>Nominal maximum supply pressure Bar</td><td colspan="2">Maximum water content of air at atmospheric pressure and 20 °C mg/m³</td></tr>
<tr><td>40 to 200</td><td colspan="2">≤ 50</td></tr>
<tr><td>>200</td><td colspan="2">≤ 35</td></tr>
<tr><td colspan="3">The water content of the air supplied by the compressor for filling 200 bar or 300 bar cylinders should not exceed 25 mg/m³</td></tr>
<tr><td>Odour /Taste</td><td colspan="3">The gas shall be free from unsatisfactory odour or taste</td></tr>
</table>

BS EN 12021:2014 the UK National Annex NA.4.2 states: "Samples should be taken and analysed at least every three months or more frequently if there has been a change in, or concerns relating to, the production process."

Health and Safety Executive - Respiratory Protective Equipment at Work, HSG53 (Fourth Edition) Appendix 3 - States you should keep air quality test results for five years.

BRITISH COMPRESSED AIR SOCIETY

Guidance Notes

Compressed air for breathing normally originates from a compressor system installed or operating at the place of use and there are various factors that can affect the quality and safety of this air.

Only competent personnel should be involved in designing breathing-air systems and preparing risk assessments. Standard compressed-air filtration is probably not sufficient to ensure air quality continuously meets the requirements of BS EN12021. A few of the key issues to consider are listed below:

- Breathing-air should be without significant odour or taste. Adequate filtration with an activated carbon stage to remove odour is imperative.
- The air intake to the compressor can ingest airborne contamination from local processes and vehicle exhaust fumes which are not removed by standard breathing air filtration. Such air born contamination may not be continuous but the pollution of the air supply may persist for hours or days. Where this risk cannot be completely eliminated the need for CO and CO_2 suppression equipment and intake monitoring may need to be considered.
- Malfunctioning compressors, especially reciprocating type, can produce unsafe levels of both carbon monoxide and carbon dioxide.
- Breathing air filtration has a finite life and can fail, causing high levels of oil and water contamination to be present in the air.
- The performance of desiccant filters is dramatically affected by operating temperature. Infrequent validation may result in poor quality air being supplied for an extended period
- Failure of the compressed air aftercooling will result in air entering the filtration at too high a temperature. This will cause the filtration to prematurely fail and pass excess levels of oil and water.
- Malfunctioning dryers can disturb the oxygen concentration to outside safe levels within the breathing air.
- High levels of water in breathing air can freeze within RPD demand valves causing the air supply to fail.
- Insufficient air flow or pressure to the RPD will reduce the protection factor of the RPE and potentially expose the user to ingress of external contaminants.
- The effects of contaminants when breathed at elevated pressure can have a much greater effect on users than it would at normal pressure.
- Changes in the performance of compressor and filtration equipment are usually rapid in nature. Any failure affecting outlet air quality may injure users for an extended period if quality validation is infrequent.
- Odour alone is a poor indicator of air quality, toxic as asphyxiant gasses are often odourless, and the limits for oil pollution can be lower than the threshold detection level that most people will notice.
- For breathing air systems supporting life in IDLH (Immediately Dangerous to Life and Health) areas the operators must wear an EBF (Emergency Breathing Facility) that has sufficient capacity to allow all the users to withdraw to a place of safety.
- Any situation where an EBF is activated is required to be reported as a RIDDOR to the HSE. Therefore, in the design of any breathing air system supporting life in IDLH areas an automatic failsafe reserve air supply system should be considered to prevent a RIDDOR reportable incident occurring in the event of a primary air supply failure.
- With any failsafe reserve air system an adequate secure method of communicating a failure mode to the breathing air users should be considered.
- When considering an air quality testing regime 3 months should be considered as a maximum interval and all outside factors that could potentially impact on air quality should be considered.
- When considering a testing regime for a centralised breathing air system, representative sample points can be considered at each test interval, however the HSE have recommended that a suitable testing regime would include the testing of all points over a 12 month period.
- When considering a testing regime for high pressure cylinder filling systems there are other factors that may need to be considered as well as the maximum time interval of three months. Most HP filtration systems are simple absorption type filters that have a finite life based on compressor running hours which will be significantly reduced as ambient temperatures increase above a 20°C ambient base. A regime that considers these risks would normally include an air quality test when a new filter cartridge is fitted and subsequent tests commencing after 50% of the 20°C filter design life based on compressor running hours.