

Air Supply Systems for Breathing Apparatus

Introduction

Air supplied breathing apparatus (BA) are a form of Respiratory Protective Equipment (RPE) used in various hazardous atmosphere environments. They need a supply of breathing quality air from an independent source (air cylinder or air compressor) and may be used to provide high levels of protection to allow working in atmospheres with atmospheric contaminants that far exceed respiratory exposure limits and in oxygen deficient atmospheres. If used correctly, they can be relied on to protect personnel from both acute and chronic effects.

However the integrity of the RPE depends on the quantity, reliability and quality of the air supplied to it, and this Safety Information provides guidance on this aspect in the context of industrial gases operations.

Further, this Safety Information specifically considers line fed systems. Self-contained BA (SCBA) systems (which are more likely to be used in emergency situations), supply systems for medical applications or diving activities and applications where the entire working space is ventilated (i.e. BA is not used) are outside the scope of this advice.



Recent Incidents

There have been a number of very serious incidents in recent times, including a fatality, where operators using line fed BA systems have sustained severe ill effects due to a lack of control over the air supply system.

- An operator was using a permanently installed air supplied BA connected via a hose to the instrument gas system as RPE for working in an acetylene generator carbide loading area. The air compressor supply system failed, and a back-up system using a nitrogen dewar was used resulting in the asphyxiation and death of the operator.
- A contractor was sandblasting equipment while using BA connected to a pressurised instrument air system. The contractor felt ill and removed the mask, then lost consciousness for a short period of time. The supplied air was measured at 11% oxygen concentration. Following investigation it was found that the instrument air system was backed up by a compressed nitrogen supply.

Risks associated with line-fed BA systems

The quantity, reliability and quality of air supplied to line-fed BA systems is critical. Systems which have the potential to supply air with parameters outside recommended limits (see below) represent a serious hazard, which can lead to intoxication, permanent injuries (e.g. brain damage), or even death.

Recommendations for Safe Operations

In many jurisdictions the use of respiratory breathing protection is subject to legal requirements. These requirements typically cover medical pre-checks of users, information on risks, use, rescue and response as well as organising work involving this equipment. Operators shall ensure compliance with those requirements as a minimum.

Air supply for BA systems requires robust controls to be in place to meet applicable minimum compressed breathing air quality requirements.

As an example, the requirements for the UK are as follows:

Parameter	Composition
Oxygen (O ₂)	20.9 % by volume +/- 1%
Nitrogen (N ₂)	Balance
Water vapour	< 25 ml/m ³
Liquid water	None present
Carbon dioxide (CO ₂)	< 500 ml/m ³ (< 500 ppm by volume)
Carbon monoxide (CO)	< 5 ml/m ³ (< 5 ppm by volume)
Oil mist	< 0.5 mg/m ³
Other contaminants	None present at > 10% of the relevant exposure limit
Odour/taste	No significant odour or taste

There may be other standards of relevance, including:

- EN 12021:1999 Respiratory protective devices. Compressed air for breathing apparatus; and
- EN 14593 -1:2005 Respiratory protective devices. Compressed air line breathing apparatus with demand valve. Apparatus with a full mask. Requirements, testing, marking.
- EN 124594:2005 Respiratory protective devices. Continuous flow compressed air line breathing apparatus. Requirements, testing, marking.

Therefore care shall be taken to select the standard more applicable to the application and prevailing jurisdiction.

Other recommendations for safe operation include the following:

- As with all other personnel Protective equipment (PPE) applications, RPE usage should be considered after higher order protection within the risk control hierarchy (e.g. elimination, substitution etc) has been considered.
- All RPE equipment shall be procured to a recognised standard (e.g. EN 14594:2005 Respiratory protective devices. Continuous flow compressed air line breathing apparatus. Requirements, testing, marking).
- Breathing air shall be supplied via systems designed specifically for that purpose.
- The design, installation (including location of inlet for atmospheric air sources), inspection and maintenance process (including cleaning and disinfection) shall ensure the composition limits are maintained, e.g. as in the table above..
- Breathing air systems shall be marked and labelled as breathing air systems. Other air systems shall be clearly labelled for the service they provide.
- The design of air supply systems should be risk assessed and any modification to these systems submitted to a management of change process, see EIGA Doc 51. For example, the risk of interconnection of other gas systems and the risk of supply shortages due to power failure needs to be addressed and eliminated.
- Breathing air supply systems shall be maintained in accordance with the requirements of the manufacturer, and the quality of air shall be periodically tested.
- Competent supervision shall be available, commensurate with the risk associated with the activity (e.g. confined

space entry)

- Those who are responsible for the operation of BA systems shall be trained in order to understand the risk associated with an air supply which fails to meet reliability, quantity and quality criteria during operation.
- When in use, a line fed breathing air system should never be connected to any gas supply source other than breathing air or other certified breathing gas mixture. RPE systems should not supply oxygen only.
- When nitrogen (or other gas) is used as a backup supply to a compressed air system the source of the nitrogen shall be disconnected from the air system prior to it being used for breathing purposes. Furthermore, as part of the air supply re-establishment process the gas contents of buffer cylinders and vessels shall be tested to verify the presence of required oxygen levels.
- Before connecting the RPE to the air supply system check that there is a flow of air.
- Check that the RPE ensures evacuation of exhaled air.
- Regularly clean and disinfect RPE in accordance with manufacturers' guidance.
- Other factors, such as the fitness of operators to use this equipment, the face fit testing of RPE, and the training of users in RPE shall be included in the risk assessment and procedures shall be in place.

References

United Kingdom Health and Safety Executive. UK, HSG 53: Respiratory protective equipment at work

Other references as listed above

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