

BS 5N 100-5:2006+A1:2018



BSI Standards Publication

Aircraft oxygen systems and equipment

Part 5: Guide to fire and explosion hazards associated with oxygen, including handling, storage and replenishment

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Summary of pages

This document comprises a front cover, and inside front cover, pages i to ii, pages 1 to 14, an inside back cover and a back cover.

Foreword

Publishing information

This part of BS 5N 100 is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 October 2006. It was prepared by Technical Committee ACE/38, *Aircraft oxygen equipment*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

BS 5N 100-5:2006+A1:2008 supersedes BS 5N 100-5-2006, which is withdrawn.

Hazard warnings

WARNING. This British Standard calls for the use of substances and/or procedures that can be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

Information about this document

This new edition of BS 5N 100-5 incorporates technical changes only. It does not represent a full review or revision of the standard, which will be undertaken in due course.

BS N 100 consists of the following parts:

- *Part 1: Design and installation;*
- *Part 2: Tests for the compatibility of materials in the presence of oxygen;*
- *Part 3: Testing of equipment and systems;*
- *Part 4: Guide to the physiological factors;*
- *Part 5: Guide to fire and explosion hazards associated with oxygen, including handling, storage and replenishment;*
- *Part 6: Guidance and recommendations on the selection of materials for use with oxygen;*
- *Part 7: Guide to cleaning, labelling and packaging.*

Text introduced or altered by Amendment No. 1 is indicated in the text by the tags A1 A1. Minor editorial changes are not tagged.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is “shall”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

1 Scope

This part of BS 5N 100 provides guidance on the dangers, and avoidance of, fire and explosion hazards associated with oxygen.

[Annex A](#) provides additional guidance and recommendations on liquid and gaseous oxygen handling, storage and aircraft replenishment.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS N 100-1, *Aircraft oxygen systems and equipment – Part 1: Design and installation*

BS N 100-2, *Aircraft oxygen systems and equipment – Part 2: Tests for the compatibility of materials in the presence of oxygen*

BS N 100-6, *Aircraft oxygen systems and equipment – Part 6: Guidance and recommendations on the selection of materials for use with oxygen*

BS N 100-7, *Aircraft oxygen systems and equipment – Part 7: Guide to cleaning, labelling and packaging*

3 General

- 3.1** With few exceptions, metallic and non-metallic materials continue to burn in oxygen-rich atmospheres when once ignited. The resulting release of energy can cause very high local pressures and temperature and weakening of the surrounding materials, with resultant explosive failure of the pressure-containing envelope.
- 3.2** Ignition conditions can result from the internal or external application of sufficient heat energy and spontaneous combustion can be caused by the adiabatic compression of oxygen in the vicinity of certain non-metallic materials. Friction rubbing, certain gas flow phenomena (e.g. gas and material resonance), impact of particles (e.g. contamination) and electrostatic discharge are also possible causes of oxygen fires.
- A1** **3.3** In any oxygen system, all non-metallic materials and metals should be selected to withstand the maximum temperature and pressure to be experienced under the most adverse operating conditions. The tests described in BS N 100-2 should be used for the selection and quality control of all non-metallic materials. Refer to BS N 100-6 for guidance and recommendations on the selection of metals and metals in combination with non-metallic materials. Additionally, consideration should be given to the possible interaction between two relatively safe materials, for example the reaction between aluminium and fluorinated greases. **A1**
- 3.4** Despite the most careful attention given to the selection of the materials, and of the construction of components, there remains a potential risk that combustion will occur. The possibility of sustained combustion can be greatly reduced by selecting materials in accordance with BS N 100-6 and employing designs in accordance with BS N 100-1.
- 3.5** The effects of combustion can be minimized by ensuring that it is contained, and heat generated is rapidly dissipated, before the adjacent metals reach ignition temperature.

- 3.6** From data reported to HSE under the *Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995* [1] (RIDDOR) over a five year period (1990 to 1994), 95 incidents involved gaseous oxygen (see 5.4).

4 Factors affecting an incident

NOTE See ASTM Standard Guide for Studying Fire Incidents in Oxygen Systems [2] for further information.

4.1 Local area enrichment

Oxygen is not a flammable gas but supports combustion. Most materials, including those normally regarded as fire resistant, burn vigorously in an oxygen enriched atmosphere. They are also more easily ignited. These effects are evident even if the enrichment is only a few per cent. Oxygen enrichment of the atmosphere is generally the result of leakage from damaged pipes, hoses, valves, connections, etc.

4.2 Contamination

4.2.1 Low level contamination

When contamination is present in an oxygen system, the contaminant might serve to start the incident. Then, the ensuing fire involving the polymers, metals, non-metals and contaminant can consume the contaminant fully, leaving no indication of its original presence.

4.2.2 High level contamination

When the contamination level is high, it can produce so large and explosive an event that the system integrity can be breached, and the fire extinguished without complete combustion of the contaminant, thus leaving evidence of its presence.

In these instances, the flammability of the contaminant can be so much greater than that of the metals and non-metals that there might be only scant damage to the system materials.

4.2.3 “Carbon” or black dust

In many incidents, a black powder is present on many surfaces. The powder could be unreacted carbon from incomplete combustion of organic materials either inside or outside the components. However, some powders that look like carbon are not. For example, fires involving aluminium in gaseous or liquid oxygen produce a black (and in some cases grey) powder that is largely unreacted aluminium. Indeed, such dust might be present as a result of a fire involving aluminium or because of fabrication processes. In metal inert gas (MIG) welding, aluminium is vaporized and condenses as a black dust in the region of the bead.

If this powder is present in an oxygen system, it could be the cause of ignition, because it is very flammable and has even been observed burning in air.

4.2.4 Oil

Oil in oxygen systems can be a severe hazard. Many oils, hydrocarbons in particular, are relatively volatile in comparison to metals and polymers, especially in aerosol form. Their spontaneous ignition temperatures are much lower than those of most other materials (metals and non-metals) used to fabricate oxygen systems, including many materials not generally regarded as oxygen compatible. Therefore, heat of compression can ignite oils much more easily. Furthermore, many oils burn very rapidly, even explosively, and they are often the likely cause of an oxygen incident. Obvious presence of oil near an oxygen incident is a strong indicator of probable contamination.