Ministry of Defence

Defence Standard 68-284 Part 02

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Breathing Gases for Non-Medicinal Life-Support Applications

Part: 02 : Breathing Oxygen

Section 1

Foreword

Defence Standard Structure

Section 1 (Generated by the StanMIS toolset)

- Revision Note
- Historical Record
- Warning
- Standard Clauses

Section 2 (Technical information provided by Subject Matter Expert)

- Title
- Introduction (optional)
- Table of Contents
- Scope
- Technical Information to include Tables and Figures
- Annexes (as required)

Section 3 (Generated by StanMIS toolset)

- Normative References
- Definitions
- Abbreviation

REVISION NOTE

A long overdue revision to keep the Def Stan aligned with applicable civil / military standards to keep it up-to-date and relevant. Defence Standard 68-284 has been re-issued in 4 new Parts.

HISTORICAL RECORD

This standard supersedes the following:

Def Stan 68-284 Issue 3 Dated 03 April 2009;

Def Stan 68-284 Issue 2 Dated 8 November 2002;

Def Stan 68-284 Issue 1 Dated 12 October 2001;

Def Stan 68-75 Issue 3 Dated 30 June 1995;

Def Stan 68-75 Issue 2 Dated 23 April 1993;

Def Stan 16-8 Issue 4 Dated 19 February 1993;

Def Stan 16-1 Issue 3 Dated 16 October 1992;

Def Stan 68-75 Issue 1 Dated 31 March 1983;

Def Stan 16-8 Issue 3 Dated 31 May 1977;

Def Stan 16-1 Issue 2 Dated 18 July1972;

Def Stan 16-8 Issue 2 Dated 10 February 1972;

WARNING

The Ministry of Defence (MOD), like its contractors, is subject to both United Kingdom and European laws regarding Health and Safety at Work. Many Defence Standards set out processes and procedures that could be injurious to health if adequate precautions are not taken. Adherence to those processes and procedures in no way absolves users from complying with legal requirements relating to Health and Safety at Work.

STANDARD CLAUSES

a) This standard has been published on behalf of the Ministry of Defence (MOD) by UK Defence Standardization (DStan).

b) This standard has been reached following broad consensus amongst the authorities concerned with its use and is intended to be used whenever relevant in all future designs, contracts, orders etc. and whenever practicable by amendment to those already in existence. If any difficulty arises which prevents application of the Defence Standard, DStan shall be informed so that a remedy may be sought.

c) Please address any enquiries regarding the use of this standard in relation to an invitation to tender or to a contract in which it is incorporated, to the responsible technical or supervising authority named in the invitation to tender or contract.

d) Compliance with this Defence Standard shall not in itself relieve any person from any legal obligations imposed upon them.

e) This standard has been devised solely for the use of the MOD and its contractors in the execution of contracts for the MOD. To the extent permitted by law, the MOD hereby excludes all liability whatsoever and howsoever arising (including, but without limitation, liability resulting from negligence) for any loss or damage however caused when the standard is used for any other purpose.

Section 2

Breathing Gases for Non-Medicinal Life-Support Applications Part 02: Breathing Oxygen

Introduction

The Defence Standard (Def Stan) aims to provide a unified gas standard to encompass non-medicinal breathing gases procured or in-situ produced for use in Ministry of Defence (MOD) aircraft, diving and marine life-support applications. It provides specifications for, including purity requirements and contaminant limits, breathing gases procured or in-situ produced for aircraft, diving and marine non-medicinal life-support applications. It includes compressed natural breathing air (CNBA), oxygen / helium mixtures (Heliox), oxygen / nitrogen mixtures (Nitrox), oxygen / nitrogen / helium mixtures (Trimix), molecular sieve oxygen concentrating system (MSOCS) product gas, and breathing oxygen (in liquid and gaseous forms), for use by the MOD.

It is arranged in four parts as follows:

- Part 01: Supply Requirements
- Part 02: Breathing Oxygen
- Part 03: Compressed Natural Breathing Air
- Part 04: Breathing Gas Mixtures

The technical authority of the Def Stan is the Defence Strategic Fuels Authority, MOD Abbey Wood, Bristol BS34 8JH, United Kingdom. The Def Stan is produced on behalf of the MOD operating communities.

Scope

This part of the Def Stan specifies the requirements for non-medicinal breathing oxygen procured or in-situ produced for life-support applications and provides reference methods of test. It includes compressed gaseous breathing oxygen and liquid breathing oxygen procured / in-situ produced for aircraft and diving applications, breathing oxygen produced by MSOCS for aircraft oxygen systems, and breathing oxygen produced by low pressure electrolysers for marine applications on board HM ships and submarines.

- Medicinal breathing oxygen is excluded as it is covered by the European Pharmacopoeia monograph, however, where breathing oxygen is to be used for therapeutic purposes at pressure, ie. during recompression treatments and hyperbaric therapy, it should comply with the requirements of this part of the Def Stan.

- Reference methods of test are provided to give guidance on testing. They are not prescriptive, and alternative methods (AMs), which have been demonstrated in specific cases to DSFA's satisfaction to produce results adequate for the measurand, are acceptable.

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Technical Content

1. Gaseous Breathing Oxygen (Type I Oxygen)

1.1. Requirements

Requirements for gaseous breathing oxygen (Type I Oxygen) procured or in-situ produced for aviation and diving applications are aligned with the requirements specified in BS EN 12021, SAE AS8010, NATO STANAG 7106 and NATO STANAG 1458, and shall comply with the requirements of Table 1 in respect of purity.

1.2. Production Method

The standard method of production of Type I Oxygen shall be by fractional distillation of liquid air using cryogenic air separation units (ASUs).

1.3. Supply

Cylinders and manifolded cylinder packs (MCPs) for Type I Oxygen shall be supplied to the MOD in accordance with Part 01 of this Def Stan.

1.4. Label

1.4.1. Standard. Cylinders and MCPs are to be marked as conforming to the Def Stan shall have the marking “Def Stan 68-284 Type I Oxygen” suitably annotated on the cylinder shoulders for cylinders and on the frames for MCPs.

1.4.2. NATO Code Number & Product Description. Cylinders and MCPs for aviation applications are to be marked in accordance with NATO STANAG 7146 shall have the marking “ABO-2202, Oxygen, Gaseous, Aviator’s Breathing Oxygen” suitably annotated on the cylinder shoulders for cylinders and on the frames for MCPs.

1.5. Quality Assurance – Procured

1.5.1. Certification. Suppliers shall provide a Certificate of Conformity (CoC) to the requirements with each delivery of Type I Oxygen.

1.5.2. Receipt. If the Type I Oxygen being delivered does not have a valid CoC, or any damage to the cylinders and MCPs is evident, the whole delivery shall be rejected.

1.6. Quality Assurance – In-Situ Produced

1.6.1. Production / Maintenance Records. System operators shall keep a record for each batch production of Type I Oxygen produced in-situ by oxygen production and charging systems. Records shall also be kept of commissioning, testing, operation, maintenance, and results of analysis of Type I Oxygen production and charging systems.

1.6.2. Receipt. If the Type I Oxygen being delivered comes from a system that does not have a valid production / maintenance record, or any damage to the cylinders and MCPs is evident, the whole delivery shall be rejected.

1.7. Pre-Use Testing

Users shall carry out odour and moisture tests on a representative selection of Type I Oxygen cylinders and MCPs before they are put into service. Cylinders and MCPs that fail to meet the odour, or the moisture requirement specified in Table 1 shall be declared unserviceable and returned in accordance with Defence Logistic Framework (DLF). Refer to JSP 319 Pt 2 Vol 1 for details.

1.8. In-Use Filtering

Particulate matter can arise from the internal surface of storage containers and supply hoses. It is essential that particulate matter size is limited. Type I Oxygen must be filtered through an absolute micron rated (AMR) filter in the feed line as close as possible to the point of delivery. For aviation applications, the filter shall be 10µm maximum; and for diving applications, the filter shall be 5µm maximum.

2. Liquid Breathing Oxygen (Type II Oxygen)

2.1. Requirements

Requirements for liquid breathing oxygen (Type II Oxygen) procured or in-situ produced for aviation applications are aimed to align with the requirements specified in BS EN 12021, SAE AS8010 and NATO STANAG 7106 as far as possible, and shall comply with the requirements of Table 2 in respect of purity.

2.2. Production Method

The standard method of production of Type II Oxygen shall be by fractional distillation of liquid air using cryogenic air separation units (ASUs).

2.3. Label

2.3.1. Standard. MOD and contractor owned bulk liquid oxygen (LOx) storage vessels on MOD sites are to be marked as conforming to the Def Stan shall have the marking “Def Stan 68-284 Type II Oxygen” suitably annotated on the vessel bodies.

2.3.2. NATO Code Number & Product Description. NATO STANAG 7146 does not apply. There are no requirements for NATO code number and product description markings, since Def Stan 68-284 Type II Oxygen does not fully conform to NATO SATNAG 7106.

2.4. Quality Assurance – Procured

2.4.1. Certification. Suppliers shall provide a Certificate of Conformity (CoC) to the requirements with each delivery of Type II Oxygen to MOD owned bulk LOx storage vessels.

2.4.2. Receipt. Receipt shall be carried out at the time of delivery and prior to transfer into MOD owned bulk LOx storage vessels. If the Type II Oxygen being delivered does not have a valid CoC, or any contamination is evident from the odour and visual tests, the whole delivery shall be rejected.

2.5. Quality Assurance – In-Situ Produced

2.5.1. Production / Maintenance Records. System operators shall keep a record for each batch production of Type II Oxygen produced in-situ by oxygen production systems. Records shall also be kept of commissioning, testing, operation, maintenance, and results of analysis of the Type II Oxygen production and storage systems.

2.5.2. Receipt. If the Type II Oxygen being delivered comes from a system that does not have a valid production / maintenance record, or any contamination is evident from the odour and visual tests, the whole delivery shall be rejected.

2.6. Quality Assurance – In-Use

2.6.1. MOD Owned Bulk LOx Storage Vessels. These bulk storage vessels are maintained by the MOD in accordance with the relevant publication. Samples of product shall be taken on a 6-monthly basis aligned with storage vessel maintenance activities or as when contamination is suspected. Please refer to JSP 319 Pt 2 Vol 1 Chap 6 & Chap 11 for details. Samples shall be tested for compliance with the requirements of Table 2 in respect of purity.

2.6.2. Contractor Owned Bulk LOx Storage Vessels. These bulk storage vessels have different maintenance and operating regimes (eg, sampling regimes and demarcation of maintenance responsibilities) to the MOD owned bulk LOx storage vessels. Contractor shall sample on a monthly basis and provide a CoC after each sample. Please refer to JSP 319 Pt 2 Vol 1 Chap 6 & Chap 11 for details. Samples shall be tested for compliance with the requirements of Table 2 in respect of purity.

2.7. Pre-Use Testing

Users shall carry out odour test and visual check on Type II Oxygen before it is put into service. Type II Oxygen should be free from unacceptable odour. When examined in a clear glass beaker, Type II Oxygen shall be free from suspended matter and visible impurities. Refer to JSP 319 Pt 2 Vol 1 Chap 6 Annex A for olfactory assessment and Annex B for visual assessment of Type II Oxygen.

2.8. In-Use Filtering

Particulate matter can arise from the internal surface of storage containers and supply hoses. It is essential that particulate matter size is limited. Type II Oxygen must be filtered through an absolute micron rating (AMR) filter of 10µm located in the fill line as close as possible to the point of delivery.

3. Breathing Oxygen Produced by Molecular Sieve Oxygen Concentration System (Type V Oxygen)

3.1. Requirements

3.1.1. Purity. Requirements for Molecular Sieve Oxygen Concentrating System (MSOCS) product gas (Type V Oxygen) are aligned with the requirements specified in SAE AS8010 and NATO STANAG 7187, and shall comply with the requirements of Table 3 in respect of purity.

3.1.2. Particulate Matter. Type V Oxygen shall either comply with the particulate requirements in Table 6 or have particulate filtering at use by passing the oxygen through an absolute micron rating (AMR) filter of 10µm as close as possible to the point of delivery. The filtering option provides a backstop to legacy systems. New systems shall comply with the particulate requirements in Table 6.

3.2. Production Method

The standard method of production of Type V Oxygen shall be air separation by molecular sieve using a MSOCS. MSOCS is typically installed in-situ on board certain RAF aircraft, and may be referred to as on-board oxygen generating system (OBOGS). It uses a molecular sieve to produce oxygen enriched breathing gas from conditioned engine bleed air by a pressure swing adsorption (PSA) technique.

3.3. Quality Assurance

3.3.1. Certification. After inspection, sampling and testing have been carried out following operational maintenance and refit of MSOCS, a certificate of acceptance, signed and dated by the inspecting authority shall be issued if the MSOCS is fit for purpose. The product gas should meet the requirements in Clause 3.1.

3.3.2. Engine Bleed Air. Following ASIC ADV PUB ASMG 4060 and MIL-STD-3050, the engine bleed air supplied to the aircraft MSOCS shall meet the requirements of Table 4 to assure the quality of the product gas.

3.4. Design & Airworthiness

Type V Oxygen supplied by MSOCS is required to meet certain technical and physiological design requirements, including flow rates and oxygen partial pressures, which are outside the scope of the Def Stan. Refer to NATO STANAG 7187, NATO STANAG 3198, AIR STD ACS (ASMG) 4039, and Def Stan 00-970 Part 13 for details.

4. Breathing Oxygen Produced by In-Situ Electrolysis (Type VI Oxygen)

4.1. Requirements

Requirements for breathing oxygen produced by in-situ electrolysis (Type VI Oxygen) are aligned with the requirements specified in SAE AS8010, and shall comply with the requirements of Table 5 in respect of purity.

4.2. Production Method

The standard method of production of Type VI Oxygen shall be water decomposition by electrolysis using a low-pressure electrolyser (LPE). LPE is typically installed in-situ on board certain HM ships and submarines. Electrolysis of water splits the water into oxygen and hydrogen gas due to an electric current passed through the water.

4.3. Quality Assurance

After inspection, sampling and testing have been carried out following operational maintenance and refit of LPE, a certificate of acceptance, signed and dated by the inspecting authority shall be issued if the LPE is fit for purpose. The product gas should meet the requirements in Clause 4.1.

4.4. Design & Seaworthiness

Type VI Oxygen supplied by LPE is required to meet certain technical and physiological design requirements, including flow rates and oxygen partial pressures, which are outside the scope of the Def Stan. Refer to BR 3049(2), BR 3049(3), BR 5020(7)9B1, and BRF 6555(200) for details.

4.5. In-Use Filtering

Particulate matter can arise from the internal surface of storage containers and supply hoses. It is essential that particulate matter size is limited. Type VI Oxygen must be filtered through an absolute micron rated (AMR) filter in the feed line as close as possible to the point of delivery. For aviation applications, the filter shall be 10µm maximum; and for diving applications, the filter shall be 5µm maximum.

Table 1 Purity requirements for gaseous breathing oxygen (Type I Oxygen).

Contaminant / Constituent / Property		Limit	Test Method	Note
Oxygen (O_2)		99.5%(v) min	BS EN 12021 NA.11	1a
Moisture (dew point)		-64°C max	BS ISO 8573-3 Table 2, 4 or 6	1b
Odour		Free from unacceptable odour	BS EN 12021 NA.5	1a, & 2
Carbon Dioxide (CO_2)		5 ppm(v) max	BS EN 12021 NA.7 or 8	1c
Carbon Monoxide (CO)		1 ppm(v) max	BS EN 12021 NA.7 or 8	1c
Nitrous Oxide (N_2O)		4 ppm(v) max	BS EN 12021 NA.7 or 9	4
Total volatile non-substituted hydrocarbons (vapour or gas) as Methane (CH_4) equivalent		30 ppm(v) max	BS EN 12021 NA.7 or 8	9
Of the total volatile non-substituted hydrocarbons (vapour or gas):	Ethane (C_2H_6) and heavier hydrocarbons (as ethane (C_2H_6) equivalent)	6 ppm(v) max	BS EN 12021 NA.7 or 8	4, & 5
	Ethylene (C_2H_4)	0.4 ppm(v) max	BS EN 12021 NA.7 or 8	4, & 5
	Acetylene (C_2H_2)	0.1 ppm(v) max	BS EN 12021 NA.7 or 8	4, & 5
Total chlorofluorocarbons and halogenated hydrocarbons		2 ppm(v) max	BS EN 12021 NA.7 or 9	10
Of the total chlorofluorocarbons & halogenated hydrocarbons:	Halogenated hydrocarbons	0.2 ppm(v) max	BS EN 12021 NA.7 or 9	4, & 12
Oil		0.1 mg/m^3 max	BS EN 12021 NA.15	3, & 8
Other toxic / irritating substance (each substance)		TBA	BS EN 12021 NA.7	6, 7, & 11

Note:

1. No change from Def Stan 68-284 Issue 3.
   a. The limit is the same as that specified in BS EN 12021, SAE AS8010, NATO STANAG 7106 and NATO STANAG 1458.
   b. The limit is essentially the same as that specified in SAE AS8010, NATO STANAG 7106 and NATO STANAG 1458. It is rounded off to the next lower integer value in degree Celsius. It is more restrictive than that specified in BS EN 12021.
   c. The limit is the same as that specified in BS EN 12021 and NATO STANAG 1458, but is more restrictive than that specified in SAE AS8010 and NATO STANAG 7106.
2. Free from unacceptable odour that may have an adverse effect on the user or breathing apparatus.
3. Any production / manufacturing process which uses an oil lubricated compressor is to be analysed for oil content. It is accepted that oil will not be presented in other processes and therefore need not be measured if that is applicable.
4. Inherited a less restrictive limit from SAE AS8010 and NATO STANAG 7106 for interoperability after considering the potential detrimental effects on health and concluded that the risk is minimum. It is not specified in BS EN 12021 and NATO STANAG 1458.

5. Although “total volatile non-substituted hydrocarbons (vapour or gas)” is limited, specific hydrocarbons are further limited to meet the requirements as that specified in SAE AS8010 and NATO STANAG 7106.
6. Where infra-red active trace contaminants other than those listed are found, the contaminants shall be identified and reported to the applicable authority for determination of maximum limits and appropriate test methods based on the sensitivity and specificity of the methods.
7. The limit should not be greater than one tenth (1/10) of the 8-hour time weighted average Workplace Exposure Limit (WEL) given in the Health & Safety Executive publication, Workplace Exposure Limits (EH40), or that specified in BS EN 12021, SAE AS8010, NATO STANAG 7106 and NATO STANAG 1458, whichever is more restrictive.
8. The limit 0.01 mg/m^3 specified in Def Stan 68-284 Issue 3 is believed to be a typo error. This is corrected to 0.1 mg/m^3 aligning it to the same as that specified in BS EN 12021 and NATO STANAG 1458. No limit is specified in SAE AS8010 and NATO STANAG 7106.
9. Volatile hydrocarbons are grouped together as “total volatile non-substituted hydrocarbons (vapour or gas)” in BS EN 12021 and NATO STANAG 1458 with a limit of 30 ppm(v). It is a more restrictive limit compared to the same suggested by summing the limits for Acetylene – 0.1 ppm(v), Methane – 50 ppm(v), Ethylene – 0.4 ppm(v), Ethane and heavier hydrocarbons – 6 ppm(v) as that specified in SAE AS8010 and NATO STANAG 7106.
10. Refrigerants and solvents as named in Def Stan 68-284 Issue 3 are grouped together as “total chlorofluorocarbons and halogenated hydrocarbons” in BS EN 12021 and NATO STANAG 1458 with a limit of 2 ppm(v). This is a more restrictive limit compared to the same suggested by summing the limits for refrigerants – 2 ppm(v) and solvents – 0.2 ppm(v) as that specified in SAE AS8010 and NATO STANAG 7106.
11. Where infra-red active trace contaminants are detected by FTIR analysis but cannot fully identified, they shall be quantified using gas chromatography - mass spectrometry (GC-MS) or other alternative methods (AMs). This approach is the same as that given in Def Stan 68-284 Issue 3 A.6 Method for the Determination of Other Trace Contaminants.
12. Although “total chlorofluorocarbons and halogenated hydrocarbons” is limited, halogenated hydrocarbons are further limited to meet the requirements as that specified in SAE AS8010 and NATO STANAG 7107.

Table 2 Purity requirements for liquid breathing oxygen (Type II Oxygen).

Contaminant / Constituent / Property	Limit	Test Method	Note
Oxygen (O_2)	99.5%(v) min	BS EN 12021 NA.11	1a
Moisture (dew point)	-64°C max	BS ISO 8573-3 Table 2, 4 or 6	1b
Odour	Free from unacceptable odour	BS EN 12021 NA.5	1a, & 2
Acetylene (C_2H_2)	0.05 ppm(v) max	BS EN 12021 NA.7 or 8	1c, & 6
Carbon Dioxide (CO_2)	5 ppm(v) max	BS EN 12021 NA.7 or 8	1a, & 6
Ethane (C_2H_6) and heavier hydrocarbons (as ethane (C_2H_6) equivalent)	3 ppm(v) max	BS EN 12021 NA.7 or 8	1c, & 6
Ethylene (C_2H_4)	0.2 ppm(v) max	BS EN 12021 NA.7 or 8	1c, & 6
Methane (CH_4)	50 ppm(v) max	BS EN 12021 NA.7 or 8	1d
Nitrous Oxide (N_2O)	2 ppm(v) max	BS EN 12021 NA.7 or 9	1c, & 6
Refrigerants (ie CFCs, HCFCs)	1 ppm(v) max	BS EN 12021 NA.7 or 9	1c, & 6
Solvents (ie trichloroethylene (C_2HCl_3), carbon tetrachloride (CCl_4))	0.1 ppm(v) max	BS EN 12021 NA.7 or 9	1c, & 6
Oil	0.1 mg/m^3 max	BS EN 12021 NA.15	3, & 7
Other toxic / irritating substance (each substance)	TBA	BS EN 12021 NA.7	4, 5, 8 & 9

Note:

1. No change from Def Stan 68-284 Issue 3.
   a. The limit is the same as that specified in BS EN 12021, SAE AS8010 and NATO STANAG 7106.
   b. The limit is essentially the same as that specified in SAE AS8010 and NATO STANAG 7106. It is rounded off to the next lower integer value in degree Celsius. It is more restrictive than that specified in BS EN 12021.
   c. The limit is the same as that specified in SAE AS8010 and NATO STANAG 7106. It is not specified in BS EN 12021.
   d. Less restrictive limit specified in Def Stan 68-284 Issue 3 is inherited to preserve the status quo, since UK suppliers cannot guarantee to meet the more restrictive limit specified in BS EN 12021, SAE AS8010 and NATO STANAG 7106 on a consistent basis.
2. Free from unacceptable odour that may have an adverse effect on the user or breathing apparatus.
3. Any production / manufacturing process which uses an oil lubricated compressor is to be analysed for oil content. It is accepted that oil will not be presented in other processes and therefore need not be measured if that is applicable.
4. Where infra-red active trace contaminants other than those listed are found, the contaminants shall be identified and reported to the applicable authority for determination of maximum limits and appropriate test methods based on the sensitivity and specificity of the methods.
5. The limit should not be greater than one tenth (1/10) of the 8-hour time weighted average Workplace Exposure Limit (WEL) given in the Health & Safety Executive publication, Workplace Exposure Limits (EH40), or that specified in SAE AS8010 and NATO STANAG 7106, whichever is more restrictive.

6. Contaminant limits for Type II Oxygen are generally one half (1/2) of the same for Type I Oxygen (Table 1). This is because contaminants tend to concentrate in the remaining bulk material as Type II Oxygen evaporates off in storage. The limits used allow some margins for deterioration before contaminant concentrations become unacceptable.
7. The limit 0.01 mg/m^3 specified in Def Stan 68-284 Issue 3 is believed to be a typo error. This is corrected to 0.1 mg/m^3 aligning it to the same as that specified in BS EN 12021. No limit is specified in SAE AS8010 and NATO STANAG 7106.
8. Where infra-red active trace contaminants are detected by FTIR analysis but cannot fully identified, they shall be quantified using gas chromatography - mass spectrometry (GC-MS) or other alternative methods (AMs). This approach is the same as that given in Def Stan 68-284 Issue 3 A.6 Method for the Determination of Other Trace Contaminants.
9. Carbon Monoxide is a listed contaminant in Def Stan 68-284 Issue 3. It is no longer listed in this Def Stan to align with SAE AS8010 and NATO STANAG 7106, and is now covered in “Other Toxic / Irritating Substance”. The production method specified assures the risk of Carbon Monoxide contamination is low.

Table 3 MSOCS product gas maximum allowable contaminant concentration (Type V Oxygen).

Contaminant / Constituent / Property	Limit	Test Method	Note
Oxygen (O_2)	N/A	BS EN 12021 NA.11	1
Moisture (dew point)	-30°C max	BS ISO 8573-3 Table 2, 4 or 6	2f
Odour	Free from unacceptable odour	BS EN 12021 NA.5	2a, & 3
Acrolein (C_3H_4O)	0.05 ppm(v) max	BS EN 12021 NA.7 or 8	4b, & 10
Aldehydes (R-CHO)	0.2 ppm(v) max	BS EN 12021 NA.7 or 8	4b
Argon (Ar)	5%(v) max	BS EN 12021 NA.10	4a
Aromatics (R-C_6H_5)	0.1 ppm(v) max	BS EN 12021 NA.7 or 8	5a
Carbon Dioxide (CO_2)	250 ppm(v) max	BS EN 12021 NA.7 or 8	2b, & 10
Carbon Monoxide (CO)	10 ppm(v) max	BS EN 12021 NA.7 or 8	6
Ethanol (C_2H_6O)	500 ppm(v) max	BS EN 12021 NA.7 or 8	5b
Fluorine (as hydrogen fluoride (HF))	0.05 ppm(v) max	BS EN 12021 NA.7 or 9	5c
Hydrogen Peroxide (H_2O_2)	0.5 ppm(v) max	BS EN 12021 NA.7 or 9	5c
Methyl Alcohol (CH_3OH)	100 ppm(v) max	BS EN 12021 NA.7 or 8	5c
Methyl Bromide (CH_3Br)	1 ppm(v) max	BS EN 12021 NA.7 or 9	5c, & 10
Nitrogen Oxides (NOx)	0.1 ppm(v) max	BS EN 12021 NA.7 or 9	4c
Nitrous Oxide (N_2O)	25 ppm(v) max	BS EN 12021 NA.7 or 9	5d
Ozone (O_3)	0.05 ppm(v) max	BS EN 12021 NA.7 or 9	4c
Refrigerants (ie CFCs, HCFCs)	2 ppm(v) max	BS EN 12021 NA.7 or 9	2c
Solvents (ie trichloroethylene (C_2HCl_3), carbon tetrachloride (CCl_4))	0.2 ppm(v) max	BS EN 12021 NA.7 or 9	2a
Total remaining volatile hydrocarbons (as methane (CH_4))	25 ppm(v) max	BS EN 12021 NA.7 or 8	2d
Unsaturated hydrocarbons (ie alkenes, alkynes)	0.2 ppm(v) max	BS EN 12021 NA.7 or 8	2e
Nickel (Ni)	0.125 mg/m^3 max	BS EN 12021 NA.9	2e
Cobalt (Co)	0.025 mg/m^3 max	BS EN 12021 NA.9	2e
Oil	0.2 mg/m^3 max	BS EN 12021 NA.15	2e

Other toxic / irritating substance (each substance)	TBA	BS EN 12021 NA.7	7, 8, & 9

Note:

1. The oxygen purity supplied varies inversely with supply demand flow and oxygen concentration control mechanism. It typically varies depending on temperature, pressure and cycle time, concentrators can produce oxygen concentrations between 40%(v) and 95%(v). Generally, higher bleed air supply pressures and lower vent ambient pressure promote better MSOCS performance.
2. No change from Def Stan 68-284 Issue 3.
   a. The limit is the same as that specified in SAE AS8010, ASIC ADV PUB ASMG 4060 and MIL-STD-3050.
   b. Since there is a wide discrepancy for the limit specified in SAE AS8010, ASIC ADV PUB ASMG 4060 and MIL-STD-3050, after some consideration, it is decided to continue to use the limit specified in Def Stan 68-284 Issue 3.
   c. The limit is the same as that specified in ASIC ADV PUB ASMG 4060. It is not specified in SAE AS8010 and MIL-STD-3050.
   d. The limit is the same as that specified in MIL-STD-3050. It is more restrictive than that specified in ASIC ADV PUB ASMG 4060 and SAE AS8010.
   e. The limit is the same as that specified in MIL-STD-3050. It is not specified in SAE AS8010 and ASIC ADV PUB ASMG 4060.
   f. The limit is more restrictive than that specified in SAE AS8010. It is not specified in ASIC ADV PUB ASMG 4060 and MIL-STD-3050.
3. Free from unacceptable odour that may have an adverse effect on the user or breathing apparatus.
4. Inherited a more restrictive limit than that specified in Def Stan 68-284 Issue 3.
   a. The limit specified in ASIC ADV PUB ASMG 4060 is applied. Both SAE AS8010 and MIL-STD-3050 have not specified a limit.
   b. The limit specified in ASIC ADV PUB ASMG 4060 and MIL-STD-3050 is applied. SAE AS8010 has not specified a limit.
   c. The more restrictive limit specified in ASIC ADV PUB ASMG 4060 and MIL-STD-3050 is applied. The less restrictive limit specified in SAE AS8010 is disregarded.
5. A new named contaminant is added further to those listed in Def Stan 68-284 Issue 3.
   a. Following SAE AS8010 and MIL-STD-3050, the contaminant is added to the list and the more restrictive limit specified in MIL-STD-3050 is applied. The less restrictive limit specified in SAE AS8010 is disregarded. The contaminant is not listed in ASIC ADV PUB ASMG 4060.
   b. Following SAE AS8010, ASIC ADV PUB ASMG 4060 and MIL-STD-3050, the contaminant is added to the list and the more restrictive limit specified in ASIC ADV PUB ASMG 4060 and MIL-STD-3050 is applied. The less restrictive limit specified in SAE AS8010 is disregarded.
   c. Following ASIC ADV PUB ASMG 4060 and MIL-STD-3050, the contaminant is added to the list and the limit specified in ASIC ADV PUB ASMG 4060 and MIL-STD-3050 is applied. The contaminant is not listed in SAE AS8010.
   d. Following SAE AS8010, the contaminant is added to the list and the limit specified in SAE AS8010 is applied. The contaminant is not listed in ASIC ADV PUB ASMG 4060 and MIL-STD-3050.
6. Inherited a less restrictive limit specified in ASIC ADV PUB ASMG 4060 and MIL-STD-3050 after considering the potential detrimental effects on health and concluded that the risk is minimum. The least restrictive limit specified in SAE AS8010 is disregarded.
7. Where infra-red active trace contaminants other than those listed are found, the contaminants shall be identified and reported to the applicable authority for determination of maximum limits and appropriate test methods based on the sensitivity and specificity of the methods.
8. The limit should not be greater than one tenth (1/10) of the 8-hour time weighted average Workplace Exposure Limit (WEL) given in the Health & Safety Executive publication, Workplace Exposure Limits (EH40).

9. Where infra-red active trace contaminants are detected by FTIR analysis but cannot fully identified, they shall be quantified using gas chromatography - mass spectrometry (GC-MS) or other alternative methods (AMs). This approach is the same as that given in Def Stan 68-284 Issue 3 A.6 Method for the Determination of Other Trace Contaminants.
10. Certain contaminant limits for Type V Oxygen are one twentieth (1/20) of the same for engine bleed air listed in Table 4 of this Def Stan. This assumes MSOCS have the capability to reduce the contaminants in the product gas stream by a factor of twenty or better.

Table 4 Engine bleed air maximum allowable contaminant concentrations.

Contaminant / Constituent / Property	Limit	Test Method	Note
Acrolein (C_3H_4O)	0.1 ppm(v) max	BS EN 12021 NA.7 or 8	1a, & 8
Aldehydes (R-CHO)	1 ppm(v) max	BS EN 12021 NA.7 or 8	1a
Carbon Dioxide (CO_2)	5000 ppm(v) max	BS EN 12021 NA.7 or 8	1a, & 8
Carbon Monoxide (CO)	50 ppm(v) max	BS EN 12021 NA.7 or 8	2
Ethanol (C_2H_6O)	1000 ppm(v) max	BS EN 12021 NA7 or NA8	3
Fluorine (as hydrogen fluoride (HF))	0.1 ppm(v) max	BS EN 12021 NA.7 or 9	1a
Hydrogen Peroxide (H_2O_2)	1 ppm(v) max	BS EN 12021 NA7 or NA9	3
Methyl Alcohol (CH_3OH)	200 ppm(v) max	BS EN 12021 NA.7 or 8	3
Methyl Bromide (CH_3Br)	20 ppm(v) max	BS EN 12021 NA.7 or 9	3, & 8
Nitrogen Oxides (NOx)	5 ppm(v) max	BS EN 12021 NA.7 or 9	1a
Ozone (O_3)	0.1 ppm(v) max	BS EN 12021 NA7 or NA9	4
Oil breakdown products	1 ppm(v) max	BS EN 12021 NA.7	1b, & 5
Total remaining hydrocarbons (as methane (CH_4))	250 ppm(v) max	BS EN 12021 NA.7 or 8	1a, & 6
Moisture (dew Point)	24°C max	BS ISO 8573-3 Table 2, 4 or 6	1b
Nickel (Ni)	0.5 mg/m^3 max	BS EN 12021 NA.9	1b
Cobalt (Co)	0.1 mg/m^3 max	BS EN 12021 NA.9	1b
Remaining solid (sub-micron) particles	0.5 mg/m^3 max	BS ISO 8573-8	1b
Other toxic / irritating substance (each substance)	TBA	BS EN 12021 NA.7	7, & 9

Note:

1. No change from Def Stan 68-284 Issue 3.
   a. The limit is the same as that specified in ASIC ADV PUB ASMG 4060 and MIL-STD-3050.
   b. The limit is the same as that specified in MIL-STD-3050. It is not specified in ASIC ADV PUB ASMG 4060.
2. Inherited a less restrictive limit specified in ASIC ADV PUB ASMG 4060 and MIL-STD-3050 after considering the potential detrimental effects on health and concluded that the risk is minimum.
3. A new named contaminant is added further to those listed in Def Stan 68-284 Issue 3. The limit specified in ASIC ADV PUB ASMG 4060 and MIL-STD-3050 is applied.
4. Inherited a more restrictive limit specified in ASIC ADV PUB ASMG 4060 and MIL-STD-3050.
5. It is necessary to know the type (and brand) of oil used and its breakdown products.

6. A named contaminant, “aviation fuels”, is specified in addition to the named contaminant, “total hydrocarbons”, in Def Stan 68-284 Issue 3. It seems that the named contaminant, “aviation fuels”, is redundant since aviation fuels are primarily hydrocarbons. Furthermore, it is not always practical to separate hydrocarbons from aviation fuels and hydrocarbons from other sources. After some consideration, aviation fuels limit specified in Def Stan 68-284 Issue 3 is disregarded.
7. Where infra-red active trace contaminants other than those listed are found, the contaminants shall be identified and reported to the applicable authority for determination of maximum limits and appropriate test methods based on the sensitivity and specificity of the methods.
8. Certain contaminant limits for Type V Oxygen (Table 3) are generally one twentieth (1/20) of the same for engine bleed air. This assumes MSOCS have the capability to reduce the contaminants in the product gas stream by a factor of twenty or better.
9. Where infra-red active trace contaminants are detected by FTIR analysis but cannot fully identified, they shall be quantified using gas chromatography - mass spectrometry (GC-MS) or other alternative methods (AMs). This approach is the same as that given in Def Stan 68-284 Issue 3 A.6 Method for the Determination of Other Trace Contaminants.

Table 5 Purity requirements for breathing oxygen by in-situ electrolysis (Type VI oxygen).

Contaminant / Constituent / Property	Limit	Test Method	Note
Oxygen (O_2)	99.5%(v) min	BS EN 12021 NA.11	1a
Moisture (dew point)	25°C max	BS ISO 8573-3 Table 2, 4 or 6	2
Odour	Free from unacceptable odour	BS EN 12021 NA.5	1a, & 3
Carbon Dioxide (CO_2)	10 ppm(v) max	BS EN 12021 NA.7 or 8	5
Carbon Monoxide (CO)	10 ppm(v) max	BS EN 12021 NA.7 or 8	5
Hydrogen (H_2)	500 ppm(v) max	BS EN 12021 NA.12	1a
Nitrous Oxide (N_2O)	4 ppm(v) max	BS EN 12021 NA.7 or 9	5
Ozone (O_3)	0.1 ppm(v) max	BS EN 12021 NA.7 or 9	6, & 7
Solvents (ie trichloroethylene (C_2HCl_3), carbon tetrachloride (CCl_4))	0.2 ppm(v) max	BS EN 12021 NA.7 or 9	5
Total volatile hydrocarbons (as methane (CH_4) equivalent)	50 ppm(v) max	BS EN 12021 NA.7 or 8	6, & 8
Oil	0.1 mg/m^3 max	BS EN 12021 NA.15	4, & 12
Other toxic / irritating substance (each substance)	TBA	BS EN 12021 NA.7	1b, 9 10, & 11

Note:

1. No change from Def Stan 68-284 Issue 3.
   a. The limit is the same as that specified in SAE AS8010.
   b. SAE AS8010 has not specified a limit.
2. Inherited a practical limit specified in SAE AS8010. When Type VI oxygen is to be stored under pressure prior to use, the required moisture limit shall be determined by the actual application.
3. Free from unacceptable odour that may have an adverse effect on the user or breathing apparatus.
4. Any production / manufacturing process which uses an oil lubricated compressor is to be analysed for oil content. It is accepted that oil will not be presented in other processes and therefore need not be measured if that is applicable.
5. Inherited a less restrictive limit specified in SAE AS8010 after considering the potential detrimental effects on health and concluded that the risk is minimum.
6. A new named contaminant is added further to those listed in Def Stan 68-284 Issue 3.
7. Small amount of ozone (O_3) may be produced during the electrolysis process. The amount of O_3 produced relative to oxygen (O_2) depends on the over-potential, pH, radials present and anode material. The limit specified in SAE AS8010 is applied
8. Acetylene (C_2H_2), Ethane (C_2H_6), Ethylene (C_2H_4) and Methane (CH_4) are slightly soluble in water, and each gas does not pose a contamination risk in the product gas that would require special attention to them individually. However, they do pose a risk collectively. Following SAE AS8010, these gases are grouped together under a generic constituent group “total hydrocarbons” and the limit specified in SAE AS8010 is applied. It superseded the named contaminants, Acetylene (C_2H_2), Ethane (C_2H_6), Ethylene (C_2H_4) and Methane (CH_4), specified in Def Stan 68-284 Issue 3.

9. Where infra-red active trace contaminants other than those listed are found, the contaminants shall be identified and reported to the applicable authority for determination of maximum limits and appropriate test methods based on the sensitivity and specificity of the methods.
10. The limit should not be greater than one tenth (1/10) of the 8-hour time weighted average Workplace Exposure Limit (WEL) given in the Health & Safety Executive publication, Workplace Exposure Limits (EH40).
11. Where infra-red active trace contaminants are detected by FTIR analysis but cannot fully identified, they shall be quantified using gas chromatography - mass spectrometry (GC-MS) or other alternative methods (AMs). This approach is the same as that given in Def Stan 68-284 Issue 3 A.6 Method for the Determination of Other Trace Contaminants.
12. The limit 0.01 mg/m^3 specified in Def Stan 68-284 Issue 3 is believed to be a typo error. This is corrected to 0.1 mg/m^3 aligning it to the same as that specified in BS EN 12021. No limit is specified in SAE AS8010.

Table 6 Particulate matter requirements for Type V Oxygen.

Solid Matter	Limit	Test Method	Note
Particles	100 µm max	BS ISO 13320	1
Fibres	40 µm x 600 µm max	HSE MDHS59	1
PM_{10}	0.15 mg/m^3 max	BS ISO 25597	1
$PM_{2.5}$	0.035 mg/m^3 max	BS ISO 25597	1
Total Solids	1.0 mg/m^3 max	BS ISO 8573-8	1

Note:

1. Inherited a more restrictive limit specified in SAE AS8010.

Section 3

Normative References

1 The publications shown below are referred to in the text of this standard. Publications are grouped and listed in alpha-numeric order.

Note: Def Stan's can be downloaded free of charge from the DStan web site by visiting **<http://dstan.uwh.diif.r.mil.uk/>** for those with RLI access or **<https://www.dstan.mod.uk>** for all other users. All referenced standards were correct at the time of publication of this standard (see 2, 3 & 4 below for further guidance), if you are having difficulty obtaining any referenced standard please contact the DStan Helpdesk in the first instance.

Def Stans

Number	Title
68-284, Pt 01, Iss 01	Breathing Gases for Non-Medicinal Life-Support Applications - Supply Requirements
00-970, Pt 13, Iss 14	Certification Specifications for Airworthiness - MILITARY COMMON FIT EQUIPMENT
01-005, Iss 19	Fuels, Lubricants and Associated Products

STANAGs

Number	Title
3198 Edition 5	FUNCTIONAL REQUIREMENTS OF AIRCRAFT OXYGEN EQUIPMENT AND PRESSURE SUITS - AAMedP-1.3 EDITION A
7106 Edition 3	CHARACTERISTICS OF GASEOUS BREATHING OXYGEN, LIQUID BREATHING OXYGEN AND SUPPLY PRESSURES, HOSES AND REPLENISHMENT COUPLINGS - AAGSP-02 EDITION A
7146 Edition 4	ASSIGNMENT OF NATO CODE NUMBERS TO GASES USED IN AIRCRAFT CROSS-SERVICING - AAGSP-10 EDITION A
7187 Edition 2	ON BOARD OXYGEN GENERATING SYSTEMS (OBOGS) PERFORMANCE STANDARDS - AAGSP-06 EDITION A
1458 Edition 2	DIVING GAS QUALITY - ADivP-04 EDITION A

Allied Publications

Number	Title
AAMedP-1.3 Edition A Version 1	FUNCTIONAL REQUIREMENTS OF AIRCRAFT OXYGEN EQUIPMENT AND PRESSURE SUITS
AAGSP-02 Edition A Version 1	CHARACTERISTICS OF GASEOUS BREATHING OXYGEN, LIQUID BREATHING OXYGEN AND SUPPLYPRESSURES, HOSES AND REPLENISHMENT COUPLINGS
AAGSP-10 Edition A Version 1	ASSIGNMENT OF NATO CODE NUMBERS TO GASES USED IN AIRCRAFT CROSS-SERVICING
AAGSP-06 Edition A Version 1	ON BOARD OXYGEN GENERATING SYSTEMS (OBOGS) PERFORMANCE STANDARDS
ADivP-04 Edition A Version 1	DIVING GAS QUALITY

Other References

Standard Type	Standard Name
BS / BS EN / BS ISO Standards	BS EN 12021, Respiratory Equipment – Compressed Gases for Breathing Apparatus
BS / BS EN / BS ISO Standards	BS ISO 13320, Particle Size Analysis – Laser Diffraction Methods
BS / BS EN / BS ISO Standards	BS ISO 25597, Stationary Source Emissions – Test Method for Determining PM2.5 and PM10 Mass in Stack Gases Using Cyclone Samplers and Sample Dilution
BS / BS EN / BS ISO Standards	BS ISO 8573-3, Compressed Air – Part 3: Test Methods for Measurement of Humidity
BS / BS EN / BS ISO Standards	BS ISO 8573-8, Compressed Air – Part 8 Test Methods for Solid Particle Content by Mass Concentration
Other Civilian/Industry Standards	SAE AS8010, Aviator’s Breathing Oxygen Purity Standard
Other Civilian/Industry Standards	MIL-STD-3050, Aircraft Crew Breathing Systems Using On-Board Oxygen Generating System (OBOGS)

Other Civilian/Industry Standards	JSP 319, Ministry of Defence, Joint Service Safety Regulations for the Storage & Handling of Gases
Other Civilian/Industry Standards	HSE MDHS59, Health & Safety Executive, Machine-made fibres: Airborne number concentration and classification by phase contrast light microscopy
Other Civilian/Industry Standards	HSE EH40, Health & Safety Executive, Workplace Exposure Limits – Containing the List of Workplace Exposure Limits for Use with the Control of Substances Hazardous to Health Regulations (as amended)
Other Civilian/Industry Standards	AIR STD ACS (ASMG) 4039, Minimum Physiological Requirements for Aircrew Demand Breathing Systems
Other Civilian/Industry Standards	ASIC ADV PUB ASMG 4060, The Minimum Quality Criteria for On-Board Generated Oxygen
Other Civilian/Industry Standards	BR 3049(2), Low Pressure Electrolyser Mk1T & Mk1HT (Fitted with PMES TRU)
Other Civilian/Industry Standards	BR 3049(3), Low Pressure Electrolyser Mk1 & Mk1H (Fitted with PMES TRU)
Other Civilian/Industry Standards	BR 5020(7)9B1, Gas Management & LP Electrolyser Service System – Vanguard Class
Other Civilian/Industry Standards	BRF 6555(200), Low Pressure Electrolyser Mk1HC GOX Plant

2 Reference in this Standard to any normative references means in any Invitation to Tender or contract the edition and all amendments current at the date of such tender or contract unless a specific edition is indicated. Care should be taken when referring out to specific portions of other standards to ensure that they remain easily identifiable where subsequent amendments and supersession's might be made. For some standards the most recent editions shall always apply due to safety and regulatory requirements.

3 In consideration of clause 2 above, users shall be fully aware of the issue, amendment status and application of all normative references, particularly when forming part of an Invitation to Tender or contract. Correct identification of standards is as defined in the ITT or contract.

4 DStan can advise regarding where to obtain normative referenced documents. Requests for such information can be made to the DStan Helpdesk. Details of how to contact the helpdesk are shown on the outside rear cover of Defence Standards.

Definitions

For the purpose of this standard, ISO/IEC Guide 2 ‘Standardization and Related Activities – General Vocabulary’ and the definitions shown below apply.

Definition	Description
Absolute Micron Rating	It expresses the ability of the filter to remove at least 98.7% of a specific size particle. For instance, an absolute rating of 10µm simply means that filter captures at least 98.7% of contaminants 10µm in size.
Alternative Method	Measurement method which is not a reference method but has been demonstrated in specific cases to applicable authority’s satisfaction to produce results adequate for the measurand.
Compressed Natural Breathing Air	Compressed air that meets breathing air quality criteria, and the air is taken directly from the atmosphere without additional gaseous additives however some filtering / processing may be necessary.
Contaminant	Refer to impurity.
Could	The verb describes an activity that is a good practice but recognises that there are other methods available to the practitioner that provide an equally satisfactory good outcome.
Dew Point	Defined as the temperature at which dew or condensation, forms on cooling a gas. It is a measurement taken at normal atmospheric pressure (1,013mbar absolute, 20°C). NOTE: For temperatures below 0°C, the term Frost Point should strictly be used, but the term Dew Point is often used to include Frost Points (as does this Def Stan).
Heliox	Diving gas mixture, comprising a specified mixture of oxygen and helium, capable of supporting life under defined diving or hyperbaric conditions.
Impurity	Any constituent other than the main constituents.
In-Situ Produced	Commodity / product produced at MOD facility.
Must	The verb describes an activity that is mandatory, and descends directly from national legislation.
Nitrox	Diving gas mixture, comprising a specified mixture of oxygen and nitrogen, capable of supporting human life under defined diving or hyperbaric conditions. NOTE: Compressed breathing air made from a mixture of liquefied gases may be considered as Nitrox if it conforms to the Nitrox requirements.
Normal Atmospheric Pressure	1,013mbar absolute, 20°C.

Oil	Defined as a mixture of hydrocarbons and other organic compounds composed of six or more carbon atoms (C6+). NOTE 1: It may exist as oil aerosol (ie liquid oil suspended in a gaseous medium), oil liquid and as oil vapour. NOTE 2: Oil may arise from the use of an oil-lubricated compressor. NOTE 3: This definition mirrors that defined in BS EN 12021 and encompasses all types of oils. It includes synthetic oils based on silicone fluids, phosphate ester fluids, mineral oils and etc (refer to Def Stan 01-005).
Oil Breakdown Products	Defined as a gas, an aerosol (ie liquid suspended in a gaseous medium), liquid, or vapour present in the breathing gas and / or Molecular Sieve Oxygen Concentrating System (MSOCS) engine bleed air that is derived from breakdown of the lubricating oil in the compressor / aircraft engine, due to the action of heat (pyrolysis).
Procured	Commodity / product from manufacturer or value-added re-seller.
Purity	Concentrations of the main constituents, ie concentration of oxygen in a sample of breathing oxygen.
Reference Method	Measurement method taken as a reference by convention, which gives the accepted reference value of the measurand.
Shall	The verb describes an activity that is mandatory, but stems from defence regulations in the absence of national legislation.
Should	The verb describes an activity that is the best practice. If the activity is followed, then this will be considered sufficient to demonstrate compliance with a regulation. However, alternative approaches may be utilised where this produces an outcome as good as required by the Regulation.
Trimix	Diving gas mixture, comprising a specified mixture of oxygen, helium and nitrogen, capable of supporting human life under diving or hyperbaric conditions.
Type I Oxygen	Gaseous breathing oxygen (breathing GOx) for non-medicinal life-support applications.
Type II Oxygen	Liquid breathing oxygen (breathing LOx) for non-medicinal life-support applications.
Type V Oxygen	Breathing oxygen produced by MSOCS for non-medicinal life-support applications.
Type VI Oxygen	Breathing oxygen produced by in-situ electrolysis for non-medicinal life-support applications.

Abbreviations

Abbreviation	Description
%(v)	Percent by volume (dry gas) at normal atmospheric pressure (1,013mbar absolute, 20°C)
µm	Micrometre
ABO	Aviator Breathing Oxygen
ACS	Agile Combat Support
ADV	Advisory
AM	Alternative Method
AMR	Absolute Micron Rating
ASIC	Air & Space Interoperability Council
ASMG	Aerospace Medical Group
ASU	Air Separation Unit
BR	Book of Reference
BRF	Book of Reference (Fiche)
BS EN	British Standard European
BS ISO	British Standard International Standard Organisation
CFC	Chlorofluorocarbon
CNBA	Compressed Natural Breathing Air
CoC	Certificate of Conformity
Def Stan	Defence Standard
DLF	Defence Logistics Framework
DSFA	Defence Strategic Fuels Authority
DStan	UK Defence Standardization
EH	A numbered series of HSE publications: Guidance Notes, Environmental Hygiene
FTIR	Fourier Transform Infrared
GC-MS	Gas Chromatography – Mass Spectrometry

GOx	Gaseous Oxygen
HCFC	Hydrochlorofluorocarbon
Heliox	Helium and oxygen gas mixture (Refer to Definitions for details)
HM	Her Majesty's
HSE	Health and Safety Executive
JSP	Joint Services Publication
LOx	Liquid Oxygen
LP	Low Pressure
LPE	Low Pressure Electrolyser
MCP	Manifolded cylinder pack
MDHS	Methods for the Determination of Hazardous Substances
MIL-STD	Military Standard
MOD	Ministry of Defence
MSOCS	Molecular Sieve Oxygen Concentrating System
NATO	North Atlantic Treaty Organization
Nitrox	Nitrogen and oxygen gas mixture (Refer to Definitions for details)
NOx	Nitrogen Oxides
OBOGS	On-Board Oxygen Generating System
PM10	Particulate matter 10µm or less in diameter
PM2.5	Particulate matter 2.5µm or less in diameter
ppm(v)	Parts per million by volume (dry gas) at normal atmospheric pressure (1,013mbar absolute, 20°C)
PSA	Pressure Swing Adsorption
PUB	Publication
RAF	Royal Air Force
SAE	Society of Automotive Engineers
STANAG	Standardization Agreement
TBA	To Be Advised

Trimix	Oxygen, helium and nitrogen gas mixture (Refer to Definitions for details)
TWA	Time-Weighted Average
WEL	Workplace Exposure Limit

Defence Standards are published by and obtainable from:

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UK Defence Standardization

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Contract Requirements

When Defence Standards are incorporated into contracts, users are responsible for their correct application and for complying with contractual and statutory requirements. Compliance with a Defence Standard does not in itself confer immunity from legal obligations.

Revision of Defence Standards

Defence Standards are revised as necessary by an up-issue or amendment. It is important that users of Defence Standards ensure that they are in possession of the latest issue or amendment. Information on all Defence Standards can be found on the DStan Websites https://www.dstan.mod.uk and http://dstan.uwh.diif.r.mil.uk/, updated weekly. Any person who, when making use of a Defence Standard, encounters an inaccuracy or ambiguity is encouraged to notify UK Defence Standardization (DStan) without delay in order that the matter may be investigated and appropriate action taken.