NATO STANDARD

ADivP-04

DIVING GAS QUALITY

Edition A Version 1

DECEMBER 2013

NORTH ATLANTIC TREATY ORGANIZATION

ALLIED DIVING OPERATIONS PUBLICATION

Published by the
NATO STANDARDIZATION AGENCY (NSA)

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NORTH ATLANTIC TREATY ORGANIZATION (NATO)

NATO STANDARDIZATION AGENCY (NSA)

NATO LETTER OF PROMULGATION

18 December 2013

1. The enclosed Allied Diving Operations Publication, ADivP-04, Edition A, Version 1, DIVING GAS QUALITY, which has been approved by the nations in the Military Committee Maritime Standardization Board, is promulgated herewith. The agreement of nations to use this publication is recorded in STANAG 1458.

2. ADivP-04, Edition A, Version 1, is effective upon receipt.

3.

4. This publication shall be handled in accordance with C-M(2002)60.

Dr. Cihangir Aksit, TUR Civ
Director NATO Standardization Agency

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RESERVED FOR NATIONAL LETTER OF PROMULGATION

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RECORD OF RESERVATIONS

CHAPTER	RECORD OF RESERVATION BY NATIONS
General	ITA
2	ITA
Annex B	CZE, FRA, ITA, POL
Annex C	CZE, ITA, POL
Annex D	FRA, ITA, POL
Annex E	CZE, FRA, ITA, POL
Annex F	CZE, ITA, POL
Annex G	CZE, FRA, ITA, POL
Note: The reservations listed on this page include only those that were recorded at the time of promulgation and may not be complete. Refer to the NATO Standardization Document Database for the complete list of existing reservations.	

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RECORD OF SPECIFIC RESERVATIONS

[nation]	[detail of reservation]
CZE	CZE armed forces will not implement Annex B due to the difference from national standard, - CZE armed forces will not implement Annexes C, E, F, G because they do not use these mixtures.
FRA	France complies with the following requirements as far as the levels of contaminants for compressed air and gas mixtures are concerned: Annex B - Compressed air - Water : 100 mg/m3 instead of 35 mg/m3 in ADivP-04(A); - Carbon monoxide (CO): 5 ppm (instead of 10); - Volatile hydrocarbons: 6.6 ppm (instead of 30); - Oxygen (O_2): 21% ±0,5% (instead of 21 ±1%). Annex D - Oxygen - Water: 20 mg/m3 (instead of 5); - Carbon dioxide (CO_2): 10 ppm (instead of 5); - Oil: 0.5 mg/m3 (instead of 0.1); - Volatiles hydrocarbons: 25 ppm (instead of 30); - Chlorofluorocarbons + halogenated hydrocarbons: 5 ppm (instead of 2). Annex E - Nitrogen gas mixtures - Water: 20 mg/m3 (instead of 5); - CO_2: 10 ppm (instead of 5); - Oil: 0.5 mg/m3 (instead of 0.1); - Volatile hydrocarbons: 25 ppm (instead of 30); - O_2: ±1% (instead of ±0.5%). Annex G - Oxygen in helium and nitrogen gas mixtures - Water: 20 mg/m3 (instead of 5); - CO_2: 10 ppm (instead of 5); - Oil: 0.5 mg/m3 (instead of 0.1); - O_2 for gas with more than 20% O_2: ±0.5% (instead of ±1%); - Helium (He) for gas with more than 20% O_2: ±2% (instead of ±1%).

ITA	1. CHAPTER 2 - 2.1 GENERAL - (Page 2.1): The subject publication is applied only military services or organizations. The military Standardization process in Italy does not automatically applies civilian/commercial organizations. It's a proper ITA Navy responsibility to specify and require gas quality levels i.a.w. STANAG/AP when purchasing gases from industry. 2. ANNEX B - COMPRESSED AIR (Page B-1); ANNEX C - OXYGEN COMPATIBLE COMPRESSED AIR (Page C-1): a. Water: ITA will apply a requirement equal to 50 (fifty) mg/m3. According to available through years data records ITA Navy consider the 35mg/m3 level as not achievable under any climate and weather conditions (hot and humid environments) with all the currently in-service air compressor (200 bar) and filtering system. Some uncertainty is also added by water measurement system accuracy and procedures. In addition ITA Navy applies a cylinders periodical inspection and testing regime to prevent any water damage to equipment. Any effort will be done to maintain water content as low as possible in particular for cold water diving. b. ITA Navy will not apply the item "Chlorofluorocarbons and halogenated hydrocarbons". Under some circumstances ITA Navy wants to keep the possibility to analyze air by means of portable equipment which does not detect CFC. 3. ANNEX D - OXYGEN (Page D-1): a. ITA Navy will not apply the item "Chlorofluorocarbons and halogenated hydrocarbons". Under some circumstances ITA Navy wants to keep the possibility to analyze air by means of portable equipment which does not detect CFC. b. ITA Navy will not apply the item "Other non-toxic gases". Too wide and generic range of nontoxic gases. 4. ANNEX E - OXYGEN IN NITROGEN GAS MIXTURES (Page E-1); ANNEX F - OXYGEN IN HELIUM MIXTURES (Page F-1); ANNEX G - OXYGEN IN HELIUM AND NITROGEN GAS MIXTURES (Page G-1): ITA Navy will not apply the item "Other non-toxic gases". Too wide and generic range of non-toxic gases. 5. NOTE B.2.1/C.2.1/D.2.2/E.2.2/F.2.2/G.2.2: Delivery point's particulate filters can be avoided if same function filters are directly placed at the apparatus gas connectors (*i.e.* regulators, first stage pressure reducers', gas inlet connectors).

POL	1. ANNEX B, Table B-1 - harmful admixtures: - Oil (Carbon content greater than or equal to C6) - not denoted according to national regulations; - Chlorofluorocarbons and halogenated hydrocarbons - not denoted according to national regulations. 2. ANNEX C, Table C-1 - harmful admixtures: - Oil (Carbon content greater than or equal to C6) - not denoted according to national regulations; - Chlorofluorocarbons and halogenated hydrocarbons - not denoted according to national regulations. 3. ANNEX D, Table D-1 - harmful admixtures: - Oil (Carbon content greater than or equal to C6) - not denoted according to national regulations; - Chlorofluorocarbons and halogenated hydrocarbons - not denoted according to national regulations. 4. ANNEX E, Table 1 - harmful admixtures: - Oil (Carbon content greater than or equal to C6) - not denoted according to national regulations; - Other nontoxic gases - not denoted according to national regulations. 5. ANNEX F, Table F-1 - harmful admixtures: - Oil (Carbon content greater than or equal to C6) - not denoted according to national regulations; - Other nontoxic gases - not denoted according to national regulations. 6. ANNEX G, Table G-1 - harmful admixtures: - Oil (Carbon content greater than or equal to C6) - not denoted according to national regulations; - Other non-toxic gases - not denoted according to national regulations.

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CHAPTER 1 INTRODUCTION

1.1. AIM

The aim of this standard is to enhance the effectiveness of NATO forces when conducting joint diving operations, through the adoption of a uniform and safe level of gas quality for diving and hyperbaric applications.

1.2. OBJECTIVES

1. To specify safe levels of contaminants of breathing gases for diving and hyperbaric applications.

2. To provide guidance to ensure the quality of breathing gases.

3. To allow the exchange of diving gases between member nations.

1.3. AGREEMENT

Participating nations agree to adopt the gas quality levels defined by this standard.

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CHAPTER 2 DETAILS OF AGREEMENT

2.1. GENERAL

1. This standard will help ensure that diving gases have a uniform and safe level of contaminants. Such gases could then be easily exchanged between member nations. It would also allow diving teams to exchange diving gases when playing host to another member nation.

2. It is intended that this standard will apply to any member nation, service or organisation that employs diving gases. It is also proposed that this standard be applicable to any military test house or research body concerned with the testing or development of diving equipment and using diving gases.

3. This standard specifies the requirements, including essential purity and dryness, for compressed gases produced for use with diving and hyperbaric applications. It encompasses compressed breathing air, oxygen compatible compressed air, oxygen, oxygen in nitrogen, oxygen in helium and oxygen in helium and nitrogen mixtures.

4. The list of potential contaminants specified by this standard is by no means comprehensive. It includes likely contaminants generated by standard gas production and compression techniques.

2.2. DEFINITIONS

1. Compressed air – air taken directly from the atmosphere without additional gaseous additives. Some purification may be necessary.

2. Oxygen compatible compressed air – air taken directly from the atmosphere that has been purified to a level where it may be using in oxygen clean systems or mixed with other gases to make diving gases with an oxygen content greater than 22 %.

3. Oxygen in nitrogen gas mixture (may also be known as Nitrox) – a diving gas comprising a mixture of oxygen and nitrogen capable of supporting human life under appropriate diving conditions.

4. Oxygen in helium gas mixture (may also be known as Heliox) – a diving gas comprising a mixture of oxygen and helium capable of supporting human life under appropriate diving conditions.

5. Oxygen in helium and nitrogen gas mixture (may also be known as Trimix) – a diving gas comprising a mixture of oxygen, helium and nitrogen capable of supporting human life under appropriate diving conditions.

2.3. REQUIREMENTS

1. The technical requirements for analysis and sampling are contained in:

- Annex A: Analysis techniques and sampling regime.

2. The technical requirements for gas quality are contained in the following Annexes:

- Annex B: Compressed air
- Annex C: Oxygen compatible compressed air
- Annex D: Oxygen
- Annex E: Oxygen in nitrogen gas mixtures
- Annex F: Oxygen in helium gas mixtures
- Annex G: Oxygen in helium and nitrogen gas mixtures.

2.4. SUPPORTING INFORMATION

Supporting information is presented in the following Annexes:

- Annex H: Comparison matrix with other standards
- Annex I: Bibliography of source documents.

ANNEX A ANALYSIS TECHNIQUES AND SAMPLING REGIME

A.1. ANALYSIS TECHNIQUES

1. All analysis of gases should take place under laboratory conditions and be corrected to 20 °C, 101.3 kPa (1013 mbar). The exact analysis techniques used are not specified by this standard, however all techniques must be carried out by suitably qualified operators and be capable of resolution of results to the levels required by this standard. Laboratories should have reached an approved standard and maintain assurance of quality through an audit sample programme. All equipment shall have traceable calibration standards.

2. As odour is a subjective measurement, the odour of any gas should be assessed by a number of operators. This may include the final user at time of use. Gas mixtures containing less than 12 % oxygen should not be assessed in volumes or conditions that could result in hypoxia of the technician.

A.2. SAMPLING REGIME

Gas sampling may be at bulk source, compressor plant or from cylinders supplied to or for use by the diver. Gases procured from main gas suppliers should be tested prior to use. Air from diving compressors should be sampled at a maximum interval of six months or more frequently dependent on period of compressor operation. Evidence of correct sampling and analysis should be available at the time of gas usage.

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ANNEX B LEVELS OF CONTAMINANTS FOR COMPRESSED AIR

B.1. REQUIREMENT

At 20 °C, 101.3 kPa (1013 mbar)

Property	Unit	Requirement
Odour	Subjective	Free from adverse odours
Water	$mg.m^{-3}$	35
Carbon monoxide	ppm (v)	10
Carbon dioxide	ppm (v)	500
Oil (Carbon content ≥ C6)	$mg.m^{-3}$	0.5
Total volatile non-substituted hydrocarbons (vapour or gas) as methane equivalent (Carbon content < C6)	ppm (v)	30
Chlorofluorocarbons and halogenated hydrocarbons	ppm (v)	2.0
Oxygen	%	21 $\pm$1.0
Nitrogen	%	Remainder

Table B-1: Compressed air

B.2. NOTE

1. Particulate matter can arise from the internal surface of storage containers and/or supply hoses. It is essential, therefore, that in addition to the filtration of the supply from the compressing plant the particulate matter size is limited by passing the gas through a filter as close as possible to the point of delivery.

2. Percent (%) and percent tolerances are absolute, *i.e.* percent of the total gas not of individual component.

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ANNEX C LEVELS OF CONTAMINANTS FOR OXYGEN COMPATIBLE COMPRESSED AIR

C.1. REQUIREMENT

At 20 °C, 101.3 kPa (1013 mbar)

Property	Unit	Requirement
Odour	Subjective	Free from adverse odours
Water	$mg.m^{-3}$	35
Carbon monoxide	ppm (v)	10
Carbon dioxide	ppm (v)	500
Oil (Carbon content ≥ C6)	$mg.m^{-3}$	0.1
Total volatile non-substituted hydrocarbons (vapour or gas) as methane equivalent (Carbon content < C6)	ppm (v)	30
Chlorofluorocarbons and halogenated hydrocarbons	ppm (v)	2.0
Oxygen	%	21 $\pm$1.0
Nitrogen	%	Remainder

Table C-1: Oxygen compatible compressed air

C.2. NOTE

1. Particulate matter can arise from the internal surface of storage containers and/or supply hoses. It is essential, therefore, that in addition to the filtration of the supply from the compressing plant the particulate matter size is limited by passing the gas through a filter as close as possible to the point of delivery.

2. Percent (%) and percent tolerances are absolute, *i.e.* percent of the total gas not of individual component.

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ANNEX D LEVELS FOR OXYGEN

D.1. REQUIREMENT

At 20 °C, 101.3 kPa (1013 mbar)

Property	Units	Requirement
Oxygen	%	>99.5
Odour	Subjective	Free from adverse odours
Water	$mg.m^{-3}$	5
Carbon monoxide	ppm (v)	1
Carbon dioxide	ppm (v)	5
Oil	$mg.m^{-3}$	0.1
Total volatile non-substituted hydrocarbons (vapour or gas) as methane equivalent	ppm (v)	30
Chlorofluorocarbons and halogenated hydrocarbons	ppm (v)	2.0
Other non-toxic gases	%	Remainder

Table D-1: Oxygen

D.2. NOTE

1. Other non-toxic gases to include asphyxiants such as nitrogen, argon and other Group 18 Noble gases.

2. Particulate matter can arise from the internal surface of storage containers and/or supply hoses. It is essential, therefore, that in addition to the filtration of the supply from the compressing plant the particulate matter size is limited by passing the gas through a filter as close as possible to the point of delivery.

3. Percent (%) and percent tolerances are absolute, *i.e.* percent of the total gas not of individual component.

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ANNEX E LEVELS OF CONTAMINANTS FOR OXYGEN IN NITROGEN GAS MIXTURES

E.1. REQUIREMENT

At 20 °C, 101.3 kPa (1013 mbar)

Property	Units	Requirements
Odour	Subjective	Free from adverse odours
Water	$mg.m^{-3}$	5
Carbon monoxide	ppm (v)	1
Carbon dioxide	ppm (v)	5
Oil	$mg.m^{-3}$	0.1
Total volatile non-substituted hydrocarbons (vapour or gas) as methane equivalent	ppm (v)	30
Oxygen	%	Specified $\pm$0.5
Nitrogen	%	Remainder
Other non-toxic gases	%	0.5

Table E-1: Oxygen in nitrogen (nitrox) gas mixtures

E.2. NOTE

1. Other non-toxic gases to include asphyxiants such as argon and other Group 18 Noble gases.

2. Particulate matter can arise from the internal surface of storage containers and/or supply hoses. It is essential, therefore, that in addition to the filtration of the supply from the compressing plant the particulate matter size is limited by passing the gas through a filter as close as possible to the point of delivery.

3. Percent (%) and percent tolerances are absolute, *i.e.* percent of the total gas not of individual component.

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ANNEX F LEVELS OF CONTAMINANTS FOR OXYGEN IN HELIUM GAS MIXTURES

F.1. REQUIREMENT

At 20 °C, 101.3 kPa (1013 mbar)

Property		Units	Requirements
Odour		Subjective	Free from adverse odours
Water		$mg.m^{-3}$	5
Carbon monoxide		ppm (v)	1
Carbon dioxide		ppm (v)	5
Oil		$mg.m^{-3}$	0.1
Total volatile non-substituted hydrocarbons (vapour or gas) as methane equivalent		ppm (v)	30
Hydrogen		ppm (v)	10
Oxygen	$\leq$10 %	%	Specified $\pm$0.25
Oxygen	>10% $\leq$20%	%	Specified $\pm$0.5
Oxygen	>20 %	%	Specified $\pm$1.0
Helium		%	Remainder
Other non-toxic gases	Oxygen $\leq$10 %	%	0.1
Other non-toxic gases	Oxygen >10% $\leq$20%	%	0.2
Other non-toxic gases	Oxygen >20%	%	0.5

Table F-1: Oxygen in helium (heliox) gas mixtures

F.2. NOTE

1. Other non-toxic gases to include asphyxiants such as argon and other Group 18 Noble gases.

2. Particulate matter can arise from the internal surface of storage containers and/or supply hoses. It is essential, therefore, that in addition to the filtration of the supply from the compressing plant the particulate matter size is limited by passing the gas through a filter as close as possible to the point of delivery.

3. Percent (%) and percent tolerances are absolute, *i.e.* percent of the total gas not of individual component.

ANNEX G LEVELS OF CONTAMINANTS FOR OXYGEN IN HELIUM AND NITROGEN GAS MIXTURES

G.1. REQUIREMENT

At 20 °C, 101.3 kPa (1013 mbar)

Property		Units	Requirements
Odour		Subjective	Free from adverse odours
Water		$mg.m^{-3}$	5
Carbon monoxide		ppm (v)	1
Carbon dioxide		ppm (v)	5
Oil		$mg.m^{-3}$	0.1
Total volatile non-substituted hydrocarbons (vapour or gas) in methane equivalent		ppm (v)	25
Hydrogen		ppm (v)	10
Oxygen	≤10 %	%	Specified ±0.25
Oxygen	>10% ≤20%	%	Specified ±0.5
Oxygen	>20 %	%	Specified ±1.0
Helium	≤20%	%	Specified ±0.5
Helium	>20 %	%	Specified ±1.0
Nitrogen		%	Remainder
Other non-toxic gases	Oxygen ≤10 %	%	0.1
Other non-toxic gases	Oxygen >10% ≤20%	%	0.2
Other non-toxic gases	Oxygen >20%	%	0.5

Table G-1: Oxygen in helium and nitrogen (trimix) mixtures

G.2. NOTE

1. Other non-toxic gases to include asphyxiants such as argon and other Group 18 Noble gases.

2. Particulate matter can arise from the internal surface of storage containers and/or supply hoses. It is essential, therefore, that in addition to the filtration of the supply from the compressing plant the particulate matter size is limited by passing the gas through a filter as close as possible to the point of delivery.

3. Percent (%) and percent tolerances are absolute, *i.e.* percent of the total gas not of individual component.

ANNEX H COMPARISON OF ADivP-04 / STANAG 1458 AND MEDICAL PHARMACOPOEIA REQUIREMENTS FOR OXYGEN

Property	STANAG 1458 Oxygen	European Pharmacopoeia Monograph 0417 Medical oxygen	US Pharmacopoeia 7782-44-7 Medical oxygen
Oxygen	> 99.5 %	> 99.5 %	> 99.0 %
Carbon Dioxide	5 ppm	300 ppm	300 ppm
Carbon Monoxide	1 ppm	5 ppm	10 ppm
Water	5 $mg.m^{-3}$ (6.6 ppm)	51 $mg.m^{-3}$ (67 ppm)	No requirement
Oil, Hydrocarbons, Freons, Other non-toxic	Specified	Not addressed	Not addressed

Table H-1: Comparison matrix

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ANNEX I BIBLIOGRAPHY

NATO (NSA): ADivP-1(B)
Allied Guide To Diving Operations
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