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Welding consumables — Shielding gases for arc welding and cutting

Produits consommables pour le soudage — Gaz de protection pour le soudage et le coupage à l'arc

INTERNATIONAL ISO

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 14175 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Sub-Committee SC 3, *Welding consumables*.

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet central@iso.ch
X.400 c=ch; a=400net; p=iso; o=isocs; s=central

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Welding consumables — Shielding gases for arc welding and cutting

1 Scope

This International Standard is applicable to gas shielded arc welding and cutting processes with gases and gas mixtures defined within. Applications include, but are not limited to:

— tungsten inert gas (TIG) welding;
— metal active gas (MAG) welding;
— metal inert gas (MIG) welding;
— plasma arc welding;
— plasma arc cutting;
— back shielding.

The purpose of this International Standard is to classify shielding gases according to their chemical properties as a base for the approval of shielding gas and filler wire combinations.

Gas purities and mixing tolerances are also specified.

2 Properties of gases

The physical and chemical properties are listed in table 1.

Table 1 — Properties of gases

Type of gas	Chemical symbol	Specified at 0°C and 1,013 bar (0,101 MPa)		Boiling point at 1,013 bar °C	Reaction behaviour during welding
		Density (air = 1,293) kg/m³	Relative density to air		
Argon	Ar	1,784	1,380	- 185,9	Inert
Helium	He	0,178	0,138	- 268,9	Inert
Carbon dioxide	CO_2	1,977	1,529	- 78,5[1)]	Oxidizing
Oxygen	O_2	1,429	1,105	- 183,0	Oxidizing
Nitrogen	N_2	1,251	0,968	- 195,8	Unreactive[2)]
Hydrogen	H_2	0,090	0,070	- 252,8	Reducing

1) Sublimation temperature (solid to gas transition temperature).

2) The behaviour of nitrogen varies with different materials. Possible negative influences shall be considered.

3 Classification of shielding gases

Table 2 classifies into groups the various component/composition combinations of shielding gases according to their reaction behaviour.

The symbols used for classification groups are:

— R: reducing gas mixtures;
— I: inert gases and inert mixtures;
— M: oxidizing mixtures containing oxygen, carbon dioxide or both;
— C: highly oxidizing gas and highly oxidizing mixtures;
— F: unreactive gas or reducing gas mixtures.

Where components not listed in table 2 are added to one of these classifications it is designated as a special gas mixture and carries the prefix S. Details of the S designation are given in clause 4.

Table 2 — Classification of shielding gases for arc welding and cutting

Symbol [1]		Components, % (*V*/*V*)						Typical applications	Remarks
Group	Identification	Oxidizing		Inert		Reducing	Unreactive		
		CO_2	O_2	Ar	He	H_2	N_2		
R	1 2			Balance [2] Balance [2]		> 0 to 15 > 15 to 35		TIG, plasma arc welding, plasma arc cutting, back shielding	Reducing
I	1 2 3			100 Balance	100 > 0 to 95			MIG, TIG, plasma arc welding, back shielding	Inert
M1	1 2 3 4	> 0 to 5 > 0 to 5 > 0 to 5	 > 0 to 3 > 0 to 3	Balance [2] Balance [2] Balance [2] Balance [2]		> 0 to 5		MAG	Sligthly oxidizing
M2	1 2 3 4	> 5 to 25 > 0 to 5 > 5 to 25	 > 3 to 10 > 3 to 10 > 0 to 8	Balance [2] Balance [2] Balance [2] Balance [2]					More pronounced oxidation
M3	1 2 3	> 25 to 50 > 5 to 50	 > 10 to 15 > 8 to 15	Balance [2] Balance [2] Balance [2]					
C	1 2	100 Balance	 > 0 to 30						
F	1 2					 > 0 to 50	100 Balance	Plasma arc cutting, back shielding	Unreactive Reducing

1) Where components not listed are added to one of the groups in this table, the gas mixture is designated as a special gas mixture and carries the prefix S. Details of the S designation are given in clause 4.

2) Argon may be replaced by up to 95 % helium. The helium content is designated by an additional identification number, see clause 4, and is given in table 3.

4 Designation

Shielding gases shall be designated by the term "shielding gases", reference to this International Standard, group and identification number according to table 2.

EXAMPLE 1: A gas mixture containing 30 % helium, and balance of argon is designated:

Shielding gas ISO 14175 - I3

EXAMPLE 2: A gas mixture containing 10 % carbon dioxide, 3 % oxygen and balance of argon is designated:

Shielding gas ISO 14175 - M24

If argon is partly replaced by helium, the helium content is designated by an additional identification number, see table 3. This identification number is added in parentheses as a suffix.

EXAMPLE 3: A gas mixture M21 containing 25 % helium is designated:

Shielding gas ISO 14175 - M21 (1)

Special gases shall be designated by the prefix S followed by the base gas or mixture symbol as in table 2, followed by the percent concentration by volume and chemical formula of the additional gases.

S (designation) + % chemical symbol

EXAMPLE 4: A special gas mixture containing 10 % carbon dioxide, 3 % oxygen and balance of argon, designation M24, but also containing 2,5 % neon is designated:

Shielding gas ISO 14175 - S M24 + 2,5 Ne

Table 3 — Identification numbers for gases in groups R and M containing helium

Identification	Helium content, % (*V*/*V*)
(1)	> 0 to 33
(2)	> 33 to 66
(3)	> 66 to 95

5 Tolerances of mixtures

For component concentrations up to 5 % (*V/V*) the permissible deviation shall not exceed ± 0,5 % (*V/V*) from the specified value. For component concentrations of between 5 % (*V/V*) and 50 % (*V/V*) the concentration shall not vary by more than ± 10 % of the specified value.

6 Purities and dew points

The minimum purities and maximum dewpoints of gases as delivered in cylinders or insulated tanks, are specified in table 4 according to their classifications in table 2. Purities and dewpoints for special gas mixtures shall correspond to the base gases or gas mixtures used, as specified in table 4.

For some materials, e.g. titanium and tantalum, gases of higher purities may be required and specifications can be agreed between the user and the supplier. The users gas supply system should be designed and maintained such that the purity as delivered is maintained up to the point of use.

Table 4 — Purities and dewpoints of gases and gas mixtures

Group[1)]	Minimum purity % (*V/V*)	Dewpoint at 1,013 Bar °C max.	Maximum humidity ppm
R	99,95	- 50	40
I	99,99	- 50	40
M1	99,70	- 50	40
M2	99,70	- 44	80
M3	99,70	- 40	120
C	99,70	- 35	200
F	99,50	- 50	40
Oxygen	99,50	- 35	200
Hydrogen	99,50	- 50	40
1) Data for oxygen and hydrogen have been included in this table.			

7 Forms of supply

Shielding gases are supplied in the gaseous or liquid state either as single gas or gas mixture.

Where gas mixtures are prepared on site from individual gases, the mixing system shall be designed and maintained such that the tolerance and the purity specified in clauses 5 and 6 can be achieved and maintained.

7.1 Gas cylinders

With the exception of carbon dioxide, all the gases and gas mixtures listed in table 2 are fully in the gaseous state when supplied in gas cylinders.

The gas cylinders for the gases listed in table 2 are filled to a stated volume and pressure as indicated by the supplier. The actual pressure will vary with the ambient temperature, e.g. the pressure of argon (I1) will vary as in figure 1.

Suitable regulators shall be fitted to the gas cylinder before use.

7.2 Liquid

Liquified gases will be supplied as low temperature (cryogenic) liquids in insulated tanks or, in the case of carbon dioxide, as a liquid at ambient temperature in gas cylinders. Before use liquified gases supplies have to be converted into the gaseous state.

In order to produce gas mixtures from liquified gases, the liquids have to be converted to the gaseous state prior to mixing. Argon-oxygen mixtures can also be stored pre-mixed as a liquid without using a mixer for the supply.

NOTE — In plasma arc cutting, gas mixing can take place inside the machine from individual gases or gas mixtures.

8 Shielding gas identification

The designation of the shielding gas according to clause 4 has to be provided with or without the term "shielding gas".

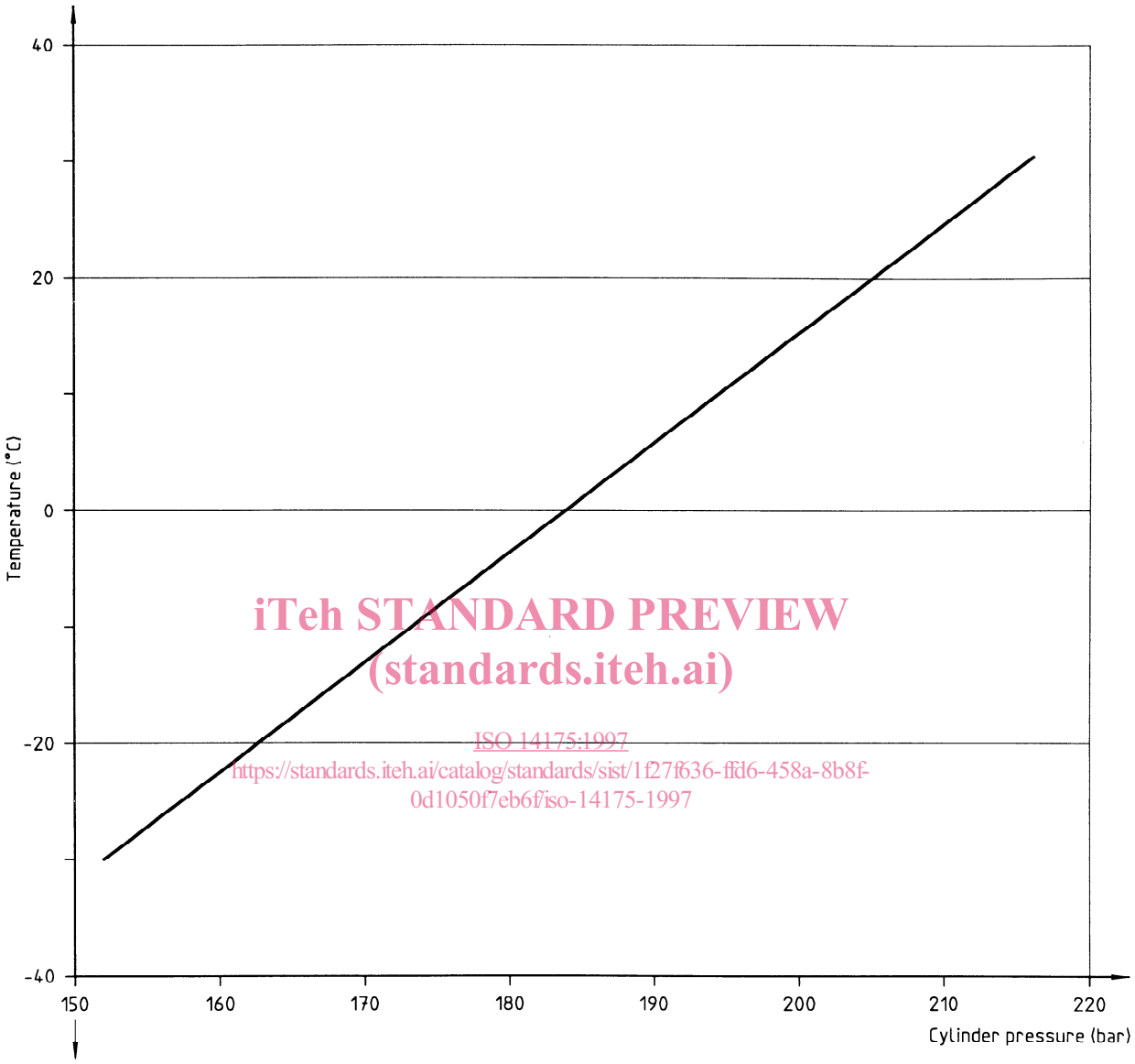

Figure 1 — Cylinder pressure - temperature diagram for argon (I1) at constant cylinder content