MATERIAL SAFETY DATA SHEET
FOR
ALUMINIUM ALLOYED
WELDING WIRES AND RODS

1. PRODUCT

1.1 Product identification: Aluminium alloyed welding wire and rods for MIG and TIG procedures (see EN573-3).
Trade designation: ML1050, ML1450, ML4043, ML4047, ML5087, ML5183, ML5356, ML5554, ML5754, ML2319

1.2 Relevant identified use of the substance or mixture and use advised against:
Gas metal arc welding, gas tungsten arc welding, MIG and TIG brazing, laser welding, arc spraying ONLY. Do not use for anything else than what stated.

1.3 Producer / Supplier:
Mig Weld S.A.S.U
20 rue Colbert
F-21600 LONGVIC - FRANCE
Phone: +33 (0)3 80 68 07 50 / E-Mail: sales@mig-weld.fr

1.4 Emergency telephone number: European emergency phone number = 112.

2. HAZARDS IDENTIFICATION

2.1 Classification of the substance or mixture:
The product is not considered to be dangerous following dispositions relative to directives 67/548/CEE and 1999/45/CE and/or regulation (CE) 1272/2008 (CLP) (with subsequent modifications and amendments).
CAS: not applicable to alloys. EINECS: not applicable to alloys.
The product doesn't contain substances classified as dangerous for health or environment following directive 67/548/EEC and/or Regulation 1272/2008 (CE) and following modifications or amendments since, out from its foreseen uses, the single elements cannot be separated using mechanical methods.

2.2 Label elements:

Pictograms	- not applicable
Precautions	- not applicable
Risk phrases R	- not applicable
Precautionary statements	- the following precautionary statements apply to the product as-is:

- Keep out of reach of children (P102)
- Read label before use (P103).

The product doesn't need dangerous goods labelling following point 1.3.4, regulation 1272/2008 (CE) and successive modifications and amendments.

2.3 **Not welded**, the products are dense materials and even small cartons are relatively heavy. Therefore, they should not be left in a position where physical injury or accident could be caused. If not welded, skin contact does not normally present any hazard though it is always possible that occasionally individuals may be found allergic to substances usually regarded as inert. Non-flammable as supplied.

Other hazards: **When welded**, dust and fume from welding can cause eye, skin or upper respiratory tract irritation. Ultraviolet radiation from welding can cause flash burns.

Explosion/fire hazards may be present when molten aluminium is in contact with water/moisture or other metal oxides; dust or fines are dispersed in the air; Chips, fines or dust are in contact with water; Fines or dust are in contact with other metal oxides (e.g. rust).

Most important symptoms and effects, both acute and delayed:

- Aluminium is welded in a protective, inert atmosphere such as argon or helium using the MIG or TIG process. Welding processes generate welding fumes and an intense ultraviolet radiation that results in the formation of ozone, oxides and nitrogen. Ultraviolet radiation from welding can also cause flash burns to the eyes and skin.
- Exposure to low levels of ozone can cause irritation of the eyes, nose and throat. Inhalation can cause chest tightness, headache and shortness of breath, cough, wheeze, nausea and narrowing of airways. Symptoms disappear when removed from exposure.

- Exposure to high levels of ozone may cause acute respiratory distress with shortness of breath, pulmonary changes, haemorrhage, and pulmonary oedema (fluid in the lungs). Symptoms of pulmonary oedema may be delayed for one or more hours. Exposure of test animals and human tissue to high concentrations has shown chromosomal changes, reproductive effects, blood changes and death from lung congestion.

- Oxides of nitrogen can cause irritation of the eyes, skin (when moist), and respiratory tract. Exposure to high levels of nitrogen oxides can cause delayed pulmonary oedema (fluid in the lungs) which may be fatal. Nitric oxide can cause formation of methaemoglobin, which decreases the blood's ability to carry oxygen. Chronic overexposure can cause pulmonary fibrosis (scarring of the lungs).

- Overexposure to Aluminium dust/fines and fumes can cause reduced lung function and may be associated with neurological effects.

- Overexposure to magnesium oxide fumes can cause respiratory tract irritation and fever, chills, shortness of breath and malaise (metal fume fever). Temporary symptoms can include fever, chills nausea, vomiting, and muscular pains.

- Chronic exposure to inert dusts of silicon can cause increased airway resistance and contributes to chronic bronchitis. Intratracheal administration of silicon in rabbits produced significant pulmonary lesions.

- Exposure to zinc oxide fumes subsequent to burning, welding, and molten metal work can result in fever, chills, shortness of breath, and malaise (Metal fume fever), and upper respiratory tract irritation. Temporary symptoms can include fever, chills, nausea, vomiting and muscular pains. Exposure to dust or fines presents a low health risk by inhalation.

- Hexavalent Chromium (Chrome VI) can cause asthma, kidney damage, primary irritant dermatitis, sensitization dermatitis, skin ulceration, and pulmonary deem (Fluid in the lungs). Chronic inhalation or overexposure has been associated with lung, nasal, and gastrointestinal cancer. Hexavalent chromium is listed as carcinogenic to humans by IARC (Group 1) = the agent is carcinogenic to humans. Chromium and some of its compounds are listed as carcinogenic by the NTP. Hexavalent chromium compounds may be generated during welding operations, with alloys containing chromium. A significant amount of the chromium in the fumes can be hexavalent chromium, which has a very low exposure limit, 0,005 mg/m^3 (5µg/m^3).

- The potential from overexposure to copper fume may exist when welding, flame, cutting, etc. Overexposure to copper dust/mists can cause irritation of the eyes, skin, and upper respiratory tract. Chronic overexposure may result in blood disorders (anaemia), and skin and hair discolorations. Overexposure to copper fume can result in respiratory tract irritation, nausea, and fever, chills, shortness of breath and malaise (metal fume fever).

- Nickel dust and fume can cause skin sensitization, allergic contact dermatitis, and conjunctivitis. Chronic inhalation of high levels of nickel can cause irritation of airways and lungs, lung fibrosis (scarring of the lungs), nasal septum perforation, nasal sinusitis, respiratory sensitization and asthma. Nickel compounds have been associated with cancer of lungs, larynx and paranasal sinuses in humans. Nickel compounds are listed on the NTP and are listed as carcinogenic to humans by IARC (Group 1) = the agent is carcinogenic to humans. Nickel metal is possibly carcinogenic to humans as defined by IARC (Group 2B) = the agent is possibly carcinogenic to humans.

- Beryllium can cause irritant dermatitis, allergic contact dermatitis and skin granulomas. Inhalation of excessive levels of beryllium can result in acute pneumonitis (inflammation of the lung tissues). Beryllium can cause lung sensitization in susceptible individuals. Chronic inhalation of dust and fumes by these sensitized individuals can result in a serious, progressive disease called Chronic Beryllium Disease (CBD). This disease is often misdiagnosed as sarcoidosis, is an allergic condition in which the lung tissues become inflamed. This inflammation, sometimes accompanied with fibrosis (Lung scarring), restricts the uptake of oxygen into the blood stream. CBD can, over time, be fatal. Inhalation of Beryllium has produced lung tumours in animals. Beryllium is listed on the NTP and is known to be carcinogenic to humans by IARC (Group 1) = the agent is carcinogenic to humans.

- Lead inorganic dust and fume is listed as a possibly carcinogenic to humans by IARC Group 2B = the agent is possibly carcinogenic to humans. Overexposure to lead dust or fume can cause weakness of extremities (peripheral neuropathy), stomach disturbances, harm to the kidneys, liver, central nervous system, blood and blood forming tissues, and reproductive organs. Overexposure to lead has been associated with human reproductive effects (e.g. reduced fertility and damage to the foetus of exposed pregnant women). Lead is a cumulative toxic metal by inhalation or ingestion.

3. COMPOSITION/INFORMATION ON INGREDIENTS.

3.1 Substances: information not relevant.

3.2 Mixtures:

MIG WELD	CAS	S-AL.99,7	S-AL.99,5Ti	S-AL.SI.5	S-AL.SI.12	S-AlSi10Cu4	S-5554	S-AlMg3	S-AL-MG-5	S-ALMG4,5MN	S-ALMg4,5MNZR	S-5556A
AWS/ASTM		ER1070	ER1450	ER 4043	ER 4047	ER4145	ER 5554	ER5754	ER 5356	ER 5183	ER5087	ER5556A
Si	7440-21-3	0,20≤	0,30≤	4,50 - 5,50	11,0-13,0	9,3 – 10,7	0,25≤	0,40≤	0,25≤	0,25≤	0,25≤	0,25≤
Fe	7439-89-6	0,25≤	0,40≤	0,40≤	0,50≤	0,8≤	0,40≤	0,40≤	0,40≤	0,40≤	0,40≤	0,40≤
Cu	7440-50-8	0,04≤	0,05≤	0,05≤	0,05≤	3,3 – 4,7	0,10≤	0,10≤	0,05≤	0,05≤	0,05≤	0,10≤
Mn	7439-96-5	0,03≤	---	0,05≤	0,15≤	0,15≤	0,50-1,0	0,50≤	0,10- 0,20	0,60-1,0	0,60-1,0	0,60-1,0
Mg	7439-95-4	0,03≤	---	0,05≤	0,05≤	0,15≤	2,40-3,0	2,60-3,60	4,50-5,60	4,30-5,20	4,30-5,20	5,0-5,50
Ga, V	7440-62-2	V0,05≤	---	---	---	---	---	---	---	---	---	---
Cr	7440-47-3	---	---	---	---	0,15≤	0,05-0,20	0,30≤	0,10-0,30	0,05-0,25	0,05-0,25	0,05-0,20
Zn	7440-66-6	0,04≤	0,07≤	0,10≤	0,10≤	0,20≤	0,25≤	0,20≤	0,10≤	0,25≤	0,25≤	0,25≤
Ti	7440-32-6	0,03≤	0,10 - 0,20	0,15≤	0,15≤	---	0,05-0,20	0,15≤	0,07-0,15	0,10-0,15	0,15≤	0,05-0,20
Zr	7440-67-7	---	---	---	---	---	---	---	---	---	0,08-0,20	---
Be	7440-41-7	0,0003≤	0,0003≤	0,0003≤	0,0003≤	0,0003≤	0,0003≤	0,0003≤	0,0003≤	0,0003≤	0,0003≤	0,0003≤
Others - each	---	0,03≤	0,03≤	0,05≤	0,05≤	0,05≤	0,05≤	0,05≤	0,05≤	0,05≤	0,05≤	0,05≤
Others - total	---	---	---	0,15≤	0,15≤	0,15≤	0,15≤	0,15≤	0,15≤	0,15≤	0,15≤	0,15≤
ALUMINIUM	7429-90-5	≥99,70	≥99,5	RIM.	RIM.	RIM.	RIM.	RIM.	RIM.	RIM.	RIM.	RIM.

4. FIRST AID MEASURES

Measures hereinafter reported are referred to problems that can incur during the welding procedures, whenever the minimal prescriptions referenced to health and safety are not fulfilled, and do **not relate to the product as is.** In case of necessity, contact your local health emergency office or any available public health office.

4.1 Description of first aid measures:

Inhalation: signs and symptoms of inhalation can be: dizziness, distress, sickness, dehydration and/or throat irritation. In these cases, remove patient from exposition area to fresh air and breathe deeply. In case of significant inhalation, call a doctor.

Skin/eye contact:
Skin: wash carefully with soap.
Eyes: rinse deeply with fresh water. In more serious cases, call a doctor.

Ingestion: Not normally a hazard due to the physical form of product. The material is a physical irritant to the gastro-intestinal tract. If required, call a doctor.

4.2 Indication of any immediate medical attention and special treatment needed: None.

5. FIREFIGHTING MEASURES

5.1 Extinguishing media.
Suitable extinguishing media: powder or foam.
Not suitable extinguishing media: do not use water on molten aluminium or halogenated products on small chips/fines.

5.2 Special hazards arising from the substance or mixture: the product may be a potential hazard under the following conditions:
- Dusts or fines dispersed in the air can be explosive.
- Chips, fines and dust in contact with water can generate flammable/explosive hydrogen gas. These gases could present an explosion hazard in confined or poorly ventilated spaces.
- Fines and dust in contact with certain metal oxides (e.g., rust). A thermite reaction, with considerable heat generation, can be initiated by a weak ignition source.
- Molten aluminium in contact with water/moisture or other metal oxides (e.g., rust). Moisture entrapped by molten aluminium can be explosive. Contact of molten aluminium with other metal oxides can initiate a thermite reaction.
Dangerous combustion products: packaging is made of carton. It can be ignited and, thus, normal fire prevention precautions must be followed.

5.3 Advice for firefighters:
Special protection equipment: in case of fire, use auto breather and suitable protective clothing.
Specific measures: none.

6. ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures: not applicable, since the product is solid and not dangerous. However, during its use, welders must use suitable protective clothing and, for eyes, certified protective devices used for electric arc welding.

6.2 Environmental precautions: not applicable, since the product is solid and not dangerous.

6.3 Methods and material for containment and cleaning up: not applicable, since the product is solid and not dangerous.

6.4 Reference to other sections: see section 8.

7. HANDLING AND STORAGE

7.1 Precautions for safe handling: solid, high density product. Use with precaution.

7.2 Conditions for safe storage, including any incompatibilities: store the product in original packaging in dry areas, protected from atmospheric agents. Avoid thermal shock. Storage in unsuitable environments can lead to surface oxidation phenomena, harmful for material quality.

7.3 Specific end use: not established.

8 EXPOSURE CONTROL / PERSONAL PROTECTION

8.1 Control parameters:
Threshold limit values TLV-TWA: not applicable. It is suggested to make reference to TLVs of each single element inside the welding fumes (see point 11.1.1).

8.2 Exposure controls:

8.2.1 *Appropriate engineering controls*: while using the product, protect body and eyes from light and fumes emissions, since they can be source of danger.

8.2.2 *Individual protection measures*:
Respiratory protection: depending upon welding and environmental conditions, use a suitable respiratory protection related to welding activity. Use proper ventilation and/or suitable fume extraction unit.
Hand protection: use suitable UV and heat protective welding gloves.
Eyes protection: use suitable lens or helmets provided with UV, IR and light protective filters.
Skin protection: use suitable body, hand and head clothing. Use protective shoes that block radiations, sparks and electric shocks. Avoid using dirty, greasy or oily clothing, as they could ignite during welding.

8.2.3 *Environmental exposure controls*: use suitable ventilation and/or gas/fumes extraction unit.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Appearance: aluminium alloys solid wires and rods, of silvery colour, diameter between 0,8mm and 5,0mm.

9.2 Odour: none.

9.3 pH: not applicable.

9.4 Melting point: from 570° to 660° c.

9.5 Boiling point: around 2500°C (depends on alloy).

9,6 Flash point: not applicable.

9.7 Evaporation rate: not applicable.
9.8 Flammability: none.
9.9 Upper/Lower flammability or explosive limits: not applicable.
9.10 Vapour pressure: $2.4 \cdot 10^{-5}$ Pa.
9.11 Vapour density: not applicable.
9.12 Relative density: 2.7g/cm^3
9.13 Solubility: none.
9.14 Partition coefficient: not applicable.
9.15 Auto-ignition temperature: not applicable.
9.16 Decomposition temperature: not applicable.
9.17 Viscosity: none.
9.18 Explosive properties: none.
9.19 Oxidising properties: none.
9.20 Other information: not available.

10. STABILITY AND REACTIVITY

10.1 Reactivity: avoid contact of the product with acids or bases that can generate dangerous fumes.
10.2 Chemical stability: aluminium alloys wires and rods are stable in normal environment.
10.3 Possibility of hazardous reactions: with acids or bases that can react and emit dangerous fumes.
10.4 Conditions to avoid: do not touch wires or rods during welding, since burnings or electric shock is possible.
10.5 Incompatible materials: acids or bases that can react and emit dangerous fumes.
10.6 Hazardous decomposition products: none.

11. TOXICOLOGICAL INFORMATION

11.1 Information on toxicological effects:
11.1.1 *Substances*: the product as is has no toxicity. During welding, grinding, machining, fumes, dust, fines and gases are produced whose composition depends upon many factors: base material, process and welding procedures, etc. Other conditions that can influence the fumes composition are: substances found on base metal surface, number of welders and volume of welding environment, quality and quantity of ventilation.

			Limit values (mg/m^3) following	
	CAS No.	Form	**ACGIH TLV-TWA**	**OSHA PEL**
Aluminium	7429-90-5	Total dust, fume Respirable	1	15 5
Beryllium and Beryllium compounds	7440-41-7	All compound as Be	0,00005	0,002, 0,005 ceiling, 0,025 for 30 minutes
Chromium	7440-47-3	Metals Cr II Compounds CR III Compounds CR VI Compounds, water soluble CR VI Compounds, water insoluble	0,5 --- 0,5 as Cr 0,05 as Cr 0,01 as Cr	1 0,5 as Cr 0,5 as Cr 0,005 as Cr VI 0,005 as Cr VI
Copper	7440-50-8	Fume Dust/mist	0,2 1	0,1 1
Iron	7439-89-6	Oxide dust and fume (as Fe)	5 (respirable)	10
Lead	7439-92-1	Elemental and inorganic compounds	0,05 as Pb	0,05 as Pb
Magnesium	7439-95-4	Oxide fume	10 (inhalable)	15 (total particulate)
Manganese	7439-96-5	Fume	0,2	5 (ceiling)
Nickel	7440-02-0	Metal Soluble inorganic compounds Insoluble inorganic compounds	1,5 as Ni 0,1 as Ni 0,2 as Ni	1 as Ni 1 as Ni 1 as Ni
Silicon	7440-21-3	Total dust Respirable	TLV Withdrawn ---	15 5
Vanadium	7440-62-2	Respirable dust Fume	0,05 as V_2O_5 (inhalable)	0,5 (ceiling) as V_2O_5 0,1 (ceiling) as V_2O_5
Zinc	7440-66-6	Oxide fume Total Oxide dust Respirable oxide dust	--- --- 2, 10 (STEL)	5 15 5

			Limit values (mg/m³) following	
	CAS No.	Form	**ACGIH TLV-TWA**	**OSHA PEL**
Zirconium	7440-67-7	Elemental	5, 10 (STEL)	5 (compounds only)

Higher levels may arise when wires and rods are used to weld contaminated base materials, coated or plated materials, other metals and alloys, or when incorrect welding conditions are used.
The only accurate way of determining the composition and quantity of fumes, gases, particulates, dust, mist, or any other compound obtained during working with the product, to which workers are exposed is to take air samples from inside the welders' helmets, if worn, or in the worker's breathing zones.
Individual measurements should be made in these cases using recognized sampling and analysis standards. Based on the results of these measurements, additional fume controls may be required to ensure that all the fume constituents are controlled below their exposure limits.

CARCINOGEN CLASSIFICATION

Ingredient	**OSHA**	**NTP**	**IARC**	**TARGET ORGAN**
Chromium	N	Y	3	Lung
Hexavalent Cr	N	Y	1	Lung
Lead	N	N	2B	Lung, Stomach
Nickel	N	Y	1	Lung, Stomach

Legend:
N = Not listed as a human carcinogen
Y = Listed as a human carcinogen
Code for IARC evidence of human carcinogenicity: 1 = Positive; 2A = Probable; 2B = Possible; 3 = Not classified; 4 = Probably Negative.

11.1.7 Information on likely routes of exposure:
Inhalation: small over exposition to welding fumes can provoke metal fumes fever, dizziness, sickness, dehydration or nose/throat/eyes irritation; they can also worsen pre-existent respiratory diseases such as asthma and emphysema. Aluminium welding and arc-spraying can generate ozone gas. Over exposition to ozone may result irritant on mucous membranes and can be cause of irritations, congestions and oedemas. Welding fumes are defined as possibly carcinogenic to people by IARC (group 2B): carcinogenic suspect agent.
Ingestion: there are no specific information available for toxicological effects due to product ingestion.
Eyes or skin contact: eventual effects deriving from UV rays exposition from welding arc can be conjunctivitis or skin burns.

12. ECOLOGICAL INFORMATION

12.1 Toxicity: use the products following good working practices, avoiding dispersion of product in the environment. The product does not contain inhibiting effects on microorganism activity.

12.2 Persistence and degradability: the product does not contain substances for which information has been given about their degradation capacity in determined environmental circumstances following biodegradation or other processes such as oxidation and hydrolysis.

12.3 Bio accumulative potential: not established.

12.4 Mobility in soil: the product doesn't contain substances for which indications regarding their distribution in environmental compartments have been provided, or data concerning their absorption/de absorption.

12.5 Results of PBT and vPvB assessment: not established.

12.6 Other adverse effects: not established.

13. DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods: dispose of residues and waste following local laws.
CER code on waste disposal:
120113: welding residues
120103: filings and shavings of non-ferrous materials.

14. TRANSPORT INFORMATION

Transport: the product is not classified as goods dangerous for transport by sea, truck, rail or air.

14.1 UN number: not applicable.
14.2 UN proper shipping name: not applicable.
14.3 Transport hazard class(es): not applicable.
14.4 Packing group: not applicable.
14.5 Environmental hazard: none.
14.6 Special precautions for user: none.
14.7 Transport in bulk: not applicable.

15. REGULATORY INFORMATION

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture.
Classification following Directive 1272/2008/CEE: not classified.
15.2 Chemical safety assessment: not applicable.

16. OTHER INFORMATION

Prior to using this product in any new process or experiment, a deep study upon security and product compatibility with materials must be undergone. The supplying company cannot be held responsible for eventual damages arising from the use of the product in incorrect applications and/or in conditions differing from the expected ones. This safety data sheet has been compiled in conformity with current valid European Directives and is applicable to all countries that have implemented these Directives in their national legislations. The data reported is the data reported in technical specialized literature; whatever reported in this sheet is only for information purpose and doesn't substitute standards or dispositions issued by public organizations. The information has been supplied in order to protect health and safety in workplace. No responsibility will be accepted if damages arise from use of the product other than the mentioned ones. This safety sheet cancels and replaces all previous revisions.

GENERAL BIBLIOGRAPHY

1. Directive 1999/45/CE and subsequent modifications.
2. Directive 67/548/CEE and subsequent modifications and amendments (annulled).
3. Regulation CE 1907/2006 of European Parliament (REACH).
4. Regulation CE 1272/2008 of European Parliament (CLP).
5. Regulation CE 790/2009 of European Parliament (I Atp. CLP).
6. Regulation CE 453/2010 of European Parliament (Safety Data Sheets).
7. ACGIH: American Conference of Government Industrial Hygienists.
8. TLV: Threshold Limit Value.
9. TWA: Time-Weighted Average.
10. CAS: Chemical Abstract Service.
11. PBT: Persistent, bioaccumulative and toxic.
12. vPvB: very persistent and very bioaccumulative.

Note for user:

The information contained in this safety sheet is based upon available knowledge up until revision date. The user must ensure suitability and completeness of information relative to the specific product use.
This document must not be interpreted as a warranty of any specific property of the product.
Since the use of the product does not fall upon MIG WELD direct control, it is the user's obligation to follow, under his own responsibility, the valid laws and regulations concerning hygiene and security. MIG WELD won't assume any liability whatsoever for the accuracy or completeness of the information contained herein.
Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, MIG WELD cannot guarantee that these are the only hazards that exist.

APPENDIX nr 1

EXPOSURE SCENARIO

Welding/Brazing produces fumes which can affect human health and the environment. Fumes are a varying mixture of airborne gases and fine particles which, if inhaled or swallowed, constitute a health hazard. The degree of risk will depend on the composition of the fume, concentration of the fume and duration of exposure. The fume composition is dependent upon the material being worked, the process and consumables being used, coatings on the work such as paint, galvanizing or plating, oil or contaminants from cleaning and degreasing activities. A systematic approach to the assessment of exposure is necessary, taking into account the particular circumstances for the operator and ancillary worker that can be exposed.

Considering the emission of fumes when welding, brazing or cutting of metals, it is recommended to (1) arrange risk management measures through applying general information and guidelines provided by this exposure scenario and (2) using the information provided by MIG WELD's MSDS, issued in accordance with REACH, by MIG WELD S.A.S.
The employer shall ensure that the risk from welding fumes to the safety and health of workers is eliminated or reduced to a minimum. The following principle shall be applied:

1) Select the applicable process/material combinations with the lowest class, whenever possible.
2) Set welding process with the lowest emission parameter.
3) Apply the relevant collective protective measure in accordance with class number. In general, the use of PPE is taken into account after all other measures is applied.
4) Wear the relevant personal protective equipment in accordance with the duty cycle.

In addition, compliance with the National Regulations regarding the exposure to welding fumes of welders and related personnel shall be verified.

Risk Management Measures for individual process / base material combinations

Class[1]	Welding process (according to ISO4063)	Base Materials	Remarks	Ventilation / Extraction / Filtration[2]	PPE[3] DC<15%	PPE[3] DC>15%
Non-confined space [10]						
I	GTAW (141)	All	Except Aluminium	GV low[4]	n.r.	n.r.
	SAW (12)					
	Autogenous (3)					
	PAW (15)					
	ESW/EGW (72-73)					
	Resistance (2)					
	Stud welding (78)					
	Solid state (521)					
	Gases brazing (9)					
II	GTAW (141)	Aluminium	Except Cd- alloys.	GV low[4]	n.a.	FFP2[5]
III	GMAW (131 – 135)	All	Except Cu-Be- V-alloys	GV low[4] LEV low[6]	Improved helmet	FFP2[5]
IV	All processes class I	Painted / primed / oiled	No Pb containing primer	GV low[4]		
	All processes class III	Painted / primed / oiled	No Pb containing primer	GV low[4] LEV low[6]	FFP2[5]	FFP3, TH2/P2 o LDH2[11]
V	MMAW (111)	Stainless, Ni, Be- and V- alloys.	n.a.	LEV low[6]	TH3/P3, LDH3[9]	TH3/P3, LDH3[9]
	FCAW (136/137)	Stainless, Mn- and Ni- alloys.				
	GMAW (131)	Cu- alloys.				
	Powder Plasma Arc (152)	Stainless, Mn-, Ni- and Cu- alloys.				
Closed system or confined space [10]						
I	Laser (52)	All	Closed System	GV medium[7]	n.a.	n.a.
	Electron beam (51)					
VIII	All	All	Confined Space	LEV high[8] – External air supply	LDH3[9]	LDH3[9]

LEGEND:

[1] Class: approximate ranking to mitigate risk by selecting process/material combinations with the lowest value. Identified collective and individual risk management measures shall be applied.
[2] Recommended measures to comply with national maximum allowable limits. Extracted fumes, for all materials except unalloyed steel and aluminium, shall be filtered before release in the outside environment.
[3] Personal Protective Equipment (PPE) required avoiding exceeding the National Exposure Limit Value (DC: Duty Cycle, expressed in 8 hours).
[4] General Ventilation (GV) low. With additional Local Exhaust Ventilation (LEV) and extracted air to the outside, the GV or LEV capacity may be reduced to 1/5 of the original requirement.
[5] Filtrating half Mask (FFP2)
[6] When an alloyed consumable is used, measures from "Class V" are required.
[7] General Ventilation (GV) Medium (double compared to Low).
[8] Local Exhaust Ventilation (LEV) high, extraction at source (includes table, hood, arm or torch extraction).
[9] Helmet with powered filters (TH3/P3), or helmet with external air supply (LDH3).
[10] A confined space, despite its name, is not necessarily small. Examples of confined spaces include ship, silos, vats, utility vaults, tanks, etc.
[11] Filtrating Half Mask (FFP3), helmet with powered filters (TH2/P2), or helmet with external air supply (LDH2).

In the above table "Risk Management Measures for individual process / base material combinations", reference is made to the below standards for personal and collective protection measures:

ISO 4063	Welding process Reference Numbers according to ISO 4063.
EN ISO 15012-1:2006	Health and safety in welding and allied processes - Requirements testing and marking of equipment or air filtration - Part 1: Testing of the separation efficiency for welding fume.
EN ISO 15012-2:2008	Health and safety in welding and allied processes - Requirements, testing and marking of equipment for air filtration - Part 2: Determination of the minimum air volume flow rate of captor hoods and nozzles.
EN 149:2009	Respiratory protective devices - Filtering half masks to protect against particles - Requirements, testing, marking (FFP1 - FFP2 - FFP3).
EN 1835:2001	Respiratory protective devices. Light duty construction compressed air line breathing apparatus incorporating a helmet or a hood. Requirements, testing, marking (LDH1 - LDH2 - LDH3).
EN 12941:2009	Respiratory protective devices. Powered filtering devices incorporating a helmet or a hood. Requirements, testing, marking (TH1 - TH2 - TH3).
EN 143:2007	Respiratory protective devices - Particle filters - Requirements, testing, marking (P1, P2, P3).
Directive 1998/24/EC	Article 6.2 on the protection of the health and safety of workers from the risks related to chemical agents at work.
BGR 190	Benutzung von Atemschutzgeräten (Berufsgenossenschaftliche Regel für Sicherheit und Gesundheit bei der Arbeit).
TRGS 528	Schweißtechnische Arbeiten (Technische Regeln für Gefahrstoffe).