TECHNICAL REPORT

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Health and safety in welding — Guidelines for risk assessment of welding fabrication activities

Hygiène et sécurité en soudage - Lignes directrices pour l'évaluation des risques des activités de fabrication de soudage

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is IIW, *International Institute of Welding*, Commission VIII.

Introduction

This Technical Report was prepared by the International Institute of Welding (IIW), Commission VIII: Health, Safety, and Environment.

It constitutes the concerns of this expert group on the possible hazards and risks to be considered during arc welding and allied processes in order to help welding fabricators to identify countermeasures in order to minimize exposures to risk. The experts have drawn on views expressed in previous IIW Commission VIII documents on this topic and information published in papers in the scientific literature. The latter are listed in the Bibliography.

This Technical Report provides tables of possible risks associated with welding and allied activities, focusing on possible consequent harm and damages. The lists contain the most common health and safety aspects related to welding, but do not purport to be exhaustive.

In addition, Annex A reports information on possible actions to be implemented to reduce the risk, and Annex B suggests relations among processes typically allied activities. Annex C gives information about the use of this risk assessment procedure as part of a health and safety management system for welding fabrication.

This Technical Report is not intended to replace or supersede national, regional, or local legislation.

Health and safety in welding — Guidelines for risk assessment of welding fabrication activities

1 Scope

This Technical Report provides guidance for the assessment of the health and safety aspects of welding fabrication of metallic materials, including on-site and repair work. This Technical Report applies to welding and allied processes which are covered by the following processes in accordance with ISO 4063:

— arc welding (process number 1);

— gas welding (process number 3);

— cutting and gouging [process number 8 (excluding 84 laser cutting)].

For the purpose of this Technical Report, allied processes includes joint preparation and grinding.

Other processes, such as the following, might have similar health and safety aspects but are not directly addressed by this Technical Report:

— soldering and brazing;

— thermal spraying;

— pre-heating and post weld heat treatments;

— flame straightening and mechanical straightening.

This Technical Report includes list of hazards, harms, and damages with reference to assessment procedures and a guide for possible preventive actions.

2 Normative references

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

ISO 4063, *Welding and allied processes — Nomenclature of processes and reference numbers*

ISO 14731, *Welding coordination — Tasks and responsibilities*

ISO 31000, *Risk management — Principles and guidelines*

ISO/TR 25901, *Welding and related processes — Vocabulary*

ISO/IEC Guide 2, *Standardization and related activities — General vocabulary*

ISO/IEC Guide 51, *Safety aspects — Guidelines for their inclusion in standards*

ISO/IEC Guide 73, *Risk management — Vocabulary — Guidelines for use in standards*

IEC 31010, *Risk management — Risk assessment techniques*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TR 25901, ISO/IEC Guide 2, ISO/IEC Guide 51, ISO/IEC Guide 73, and the following apply.

3.1
hazard
source or situation with a potential for harm, which in this Technical Report comprises injury, occupational disease, death, material damage, and/or other loss

3.2
risk
combination of the likelihood and consequence(s) of a specified hazardous event, typically quantified by means of a risk assessment

4 Use of this document

This Technical Report provides lists for the assessment of health and safety aspects of welding fabrication of metallic materials, including on-site and repair work. In order to perform such assessments, an understanding of the following topics is required:

— occupational health and safety;

— welding fabrication;

— management systems.

For the intended use of this Technical Report, the support of welding coordination personnel is needed. Tasks and responsibilities of welding coordination personnel are defined in ISO 14731.

5 Procedures

It is in the employer's interest that personnel are able to work in a healthy and safe environment as this has a direct influence on productivity and motivation. Common sense should dictate measures to maintain the health and safety of operators in manufacturing environments. Beyond this, other requirements that ensure the health and safety of welding personnel during welding and allied activities can originate from a number of sources such as

— legal requirements, often at the national and/or regional level,

— customer requirements,

— insurance requirements, and

— certification requirements.

NOTE This Technical Report does not replace or supersede legal requirements.

6 Risk assessment principles

Accidents and occupational diseases can ruin lives and affect business if output is lost, machinery or property is damaged, and can lead to an increase in insurance costs. Risk assessments and risk assessment techniques are described in various national and international guidelines and International Standards (e.g. ISO 31000 and IEC 31010), which generally follow the same principal sequence.

A risk assessment is a systematic examination of hazards in a specific activity, in order to consider precautions to prevent harm as depicted in Figure 1.

This Technical Report can help in identifying possible hazards related to, and harm arising from, welding and allied activities (steps 2 and 3 in Figure 1) as well as in reducing or even preventing the associated risks (step 6 in Figure 1).

Occupational Exposure Limits (OEL) or other reference levels may apply, but protection of the health and safety conditions is, as a general rule, a continuous process for which gradual improvements are targeted (see Annex C).

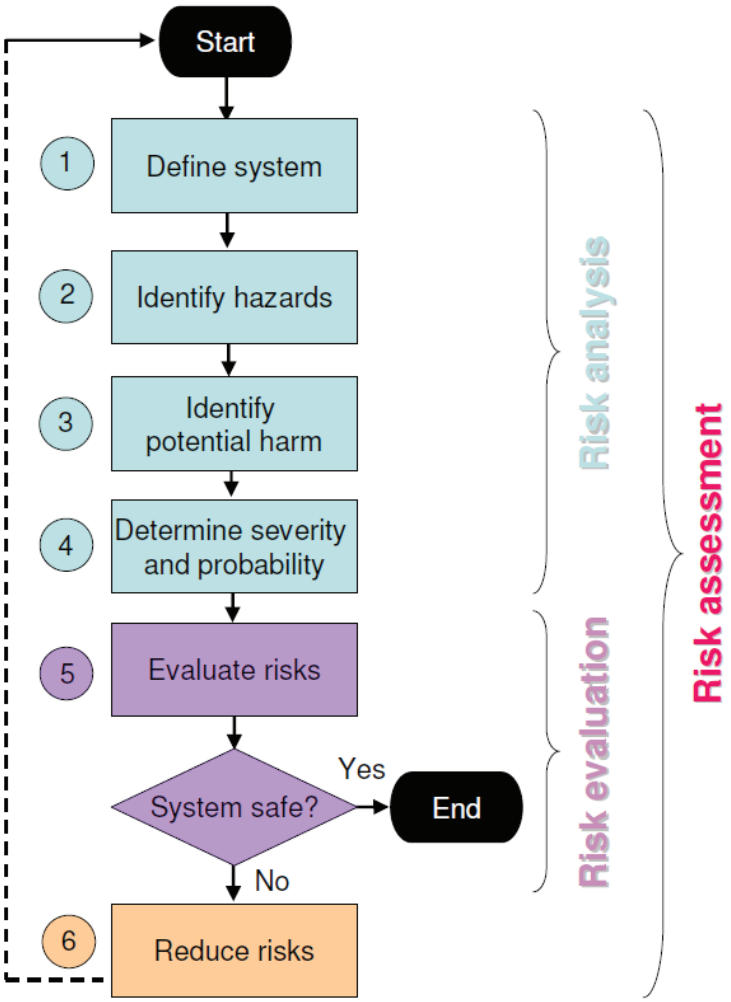

Figure 1 — Principle of risk assessment

7 Risk assessment for welding and allied activities

The lists in this Technical Report can be used as a tool for health and safety analysis and for the identification of possible problem areas. In general, this applies to the following situations:

— when planning a fabrication, the implementation of new fabrication methods or equipment;

— the identification of procedures that might require specific monitoring or checks of health and safety aspects;

— the specification of safety procedures for welding and for handling, storing, and disposing of welding-related substances that might be hazardous to health and safety.

This assessment is based on the following steps:

a) Identify the hazards arising from the activity (as referred to in Table 1).

b) Identify the potential harm arising from the hazard (as referred to in Table 2).

c) Based on that, preventive measures (substitute with a safer process, reduce, or protect) can be implemented in order to minimize the probability and/or the severity of the harm. Annex A lists possible preventive and corrective measures which can be typically applied.

8 List for welding and allied activities

Table 1 — Hazard identification

A-No.	Activity	Hazard	H-No.
Welding processes (W)			
W1	Fusion welding in general	Ergonomic aspects (body work, body posture, climate etc.)	H1
		Fumes, gases, vapours, and/or dust (explosive, inflammable, toxic, suffocating etc.)	H2.2
W2	Arc welding, cutting, and joint preparation using an electrical arc	Optical radiation	H3
		Hot (incl. liquid) metal, spatter, and/or slag	H4
		Hot surfaces	H5
		Electrical currents	H6
		Electromagnetic fields	H6.1
W3	Gas welding, cutting, and joint preparation using a gas flame	Optical radiation	H3
		Hot (incl. liquid) metal, spatter, and/or slag	H4
		Hot surfaces	H5
		Flame	H7
General activities (G)			
G1	Grinding/mechanical cutting and joint preparation	Projectiles	H8
		Sparks	H9
		Noise	H10
		Dust and fumes	H2.1
		Sharp edges	H11
		Vibration	H12
		Hot surfaces	H5
		Rotating parts	H13
G2	Cleaning	Hazardous materials (acids, solvents, gases, etc.)	H14
		Sharp edges	H11
G3	Operating electrical tools	Electrical currents	H6
G4	Using compressed air	Projectiles	H8
G5	Cutting in general	Released parts or stresses	H15

Table 1 *(continued)*

A-No.	Activity	Hazard	H-No.
G6	Mechanized, semi-automated and fully automated processes	Moving machinery	H16
Activities associated with specific welding processes (A)			
A1	Slag removal	Hot (incl. liquid) metal, spatter, and/or slag	H4
		Projectiles	H8
		Noise	H10
A2	Gas handling	Hazardous materials (acids, solvents, gases etc.)	H14
		Pressurized gas	H17
A3	Drying of electrodes and flux/powder	Hot surfaces	H5
A4	Flux/powder handling	Dust	H2
		Ergonomic aspects (body work, body posture, climate, etc.)	H1
A5	Disposal of electrode stubs	Hot surfaces	H5
		Slipping	H18
A6	Regrinding of thoriated tungsten electrodes	Radioactive dust	H19
Surroundings/welding environment (S)			
S1	Welding in dangerous or sensitive environments	Explosive atmosphere	H20
		Combustible materials	H21
S2	Welding in confined spaces	Ergonomic aspects (body work, body posture, climate, etc.)	H1
		Fumes, gases, vapours, and/or dust (explosive, inflammable, toxic, suffocating, etc.)	H2.2
		Exposure	H22
S3	Welding in electrically conducting surroundings	Electrical currents, elevated hazard	H6.2
S4	Welding under water	Ergonomic aspects (body work, body posture, climate, etc.)	H1
		Electrical currents	H6
		Diving related hazards	H23

Table 2 — Identification of potential harm and damage

H-No.	Hazard	Harm	Material damage
H1	Ergonomic aspects (body work, body posture, climate, etc.)	Musculoskeletal diseases	
		Fatigue	
H2	Dust	Lung diseases	Sooting
		Eye irritation	
H2.1	Dust and fumes	Lung diseases	Sooting
		Poisoning	
		Eye irritation	
H2.2	Fumes, gases, vapours, and/or dust (explosive, inflammable, toxic, suffocating, etc.)	Lung diseases	Sooting
		Poisoning	
		Burns and scalds	
		Eye irritation	
H3	Optical radiation	Radiation burns	Embrittlement of sensitive components
		Blinding	
		Arc eye	
H4	Hot (incl. liquid) metal, spatter, and/or slag	Burns	Fire
		Eye injuries	Melting of and adhesion to low-melting components
H5	Hot surfaces	Burns	Fire
			Melting of and adhesion to low-melting components
H6	Electrical currents	Electrical burns	Current spikes in electrical devices
		Shock	Tripping mains
		Muscle paralysis (suffocation)	
		Heart fibrillations	
H6.1	Electromagnetic fields	Interference with pace makers	Interference with electronic control systems
		Heating and induced currents in body	
H6.2	Electrical currents, elevated hazard	see H6	
H7	Flame	Burns	Fire
H8	Projectiles	Puncture wounds	
		Eye injuries	
H9	Sparks	Burns	Fire
		Eye injuries	
H10	Noise	Hearing damage	
H11	Sharp edges	Lacerations	

Table 2 *(continued)*

H-No.	Hazard	Harm	Material damage
H12	Vibration	Occupational diseases	Material fatigue
		Muscular diseases	Moving of loose objects
H13	Rotating parts	Lacerations	
		Crushing injuries	
H14	Hazardous materials (acids, solvents, gases, etc.)	Poisoning	Corrosion
		Chemical burns	
		Occupational diseases	
		Suffocation	
H15	Released parts or stresses	Crushing injuries	Structural collapse
		Broken bones	
		Hearing damage	
		Concussion	
H16	Moving machinery	Crushing injuries	
		Lacerations	
		Broken bones	
		Concussion	
H17	Pressurized gas	Eye injuries	Explosion
		Suffocation	
		Bruises	
H18	Slipping	Concussion	
		Broken bones	
		Bruises	
H19	Radioactive dust	Cancer	
		Poisoning	
H20	Explosive atmosphere	Burns	Fire
		Hearing damage	Melting
		Suffocation	Structural damage
H21	Combustible materials	Burns	Fire
		Poisoning	Melting
		Suffocation	
H22	Exposure	Occupational diseases	
		Shock	
H23	Diving related hazards	Occupational diseases	

Annex A
(informative)

Preventive measures

Below are the general preventive measures associated with welding:

— a welding permit and fire sentry (regular patrols) are recommended for all welding activities outside of a dedicated welding workplace (see activity no. 8 to 10);

— basic long sleeved protective clothing and closed safety shoes;

— marking of all hazardous areas and using signs for compulsory protective measures.

Table A.1 — Preventive measures

H-No.	Hazard	Preventive measures
H1	Ergonomic hazards	Avoid excessive heat or cold, draughts, unergonomic positions
		Ergonomic gear and tools (welding helmet, welding torch, work bench, etc.)
H2	Dust	Ensure ventilation and dust/fume extraction
		Individual protection (welding helmet with ventilation/air supply, extraction at source or integrated into the welding torch, etc.) or general protection (work area ventilation, work outside, etc.)
		Working under water, if possible (e.g. cutting)
H2.1	Dust and fumes	Ensure adequate ventilation and extraction
		Individual protection (welding helmet with ventilation/air supply, extraction at source or integrated into the welding torch, etc.) or general protection (work area ventilation, work outside, etc.)
		Working under water, if possible (e.g. cutting)
H2.2	Fumes, gases, vapours, and/or dust (explosive, inflammable, toxic, suffocating, etc.)	Ensure adequate ventilation and extraction
		Individual protection (welding helmet with ventilation/air supply, extraction at source or integrated into the welding torch, etc.) or general protection (work area ventilation, work outside, etc.)
		Working under water, if possible (e.g. cutting)
		Ensure that all gas-containing parts are leak-free (bottles, valves, regulators, distribution systems, pipes, hoses, fittings, etc.)
		Prevent accumulation of gases in dangerous amounts (extraction, burning/flaring excess gas)
H3	Optical radiation	Welding helmet, welding goggles, welding shield
		Protective clothing covering the entire body
		Welding curtain, non-reflective surfaces

Table A.1 *(continued)*

H4	Hot liquid metal, spatter, and/or slag	Leather apron, leather gloves, closed safety shoes
		Remove, cover, or shield flammable and combustible materials
		Fire extinguishers, fire sentry
H5	Hot surfaces	Leather apron, leather gloves, closed safety shoes
		Cool down sensitive parts
H6	Electrical currents	Correctly maintained welding equipment (insulation, etc.)
		Correctly installed welding circuits
		Appropriate welding equipment (IP-protection codes…)
		Protective (insulating) clothing (shoes, gloves, etc.)
H6.1	Electromagnetic fields	Monitor exposure
		Pacemakers not allowed in vicinity
H6.2	Electrical currents, elevated hazard	see H6
		Appropriate welding equipment (“S”machines)
		insulating pad/layer
		Battery power and compressed air tools, insulating transformer
H7	Flame	Protective (flame resistant) clothing
		Remove, cover, or shield inflammable and combustible materials
		Fire extinguishers, fire sentry
H8	Projectiles	Protective clothing (protective goggles, closed safety shoes…)
H9	Sparks	Leather apron, leather gloves, closed safety shoes
		Remove, cover, or shield inflammable and combustible materials
		Fire extinguishers, fire sentry
H10	Noise	Noise-reduced machines, technical noise protection
		Hearing protection
H11	Sharp edges	Protective gloves
H12	Vibration	Uncoupling of vibrations
		Reduce exposure (operational hours)
H13	Rotating parts	Machine protection (screening, two-handed operation, access-protection, safety light barrier, etc.)
		Protective clothing (gloves, safety goggles, etc.)
H14	Hazardous materials	Follow labelled safety instructions/precautions
H15	Released parts or stresses	Fasten parts to be sectioned (both sides of the cut)
		Take into account weight, residual stresses, and stability of the sectioned parts
H16	Moving machinery	Machine protection (screening, two-handed operation, access protection, safety light barrier, etc.)
		Only use safety certified machinery (e.g. EU: EC machinery directive)

Table A.1 *(continued)*

H17	Pressurized gas	Follow labelled safety instructions/precautions
		Reduce gas pressure (use as little as possible, as much as necessary)
		Safety goggles
H18	Slipping	Cleanliness and tidiness
		Dispose of electrode stubs in a fireproof container
H19	Radioactive dust	Avoid the use of thoriated electrodes
		Wear appropriate dust protection
H20	Explosive atmosphere	Ensure that all gas-containing parts are leak-free (bottles, valves, regulators, distribution systems, pipes, hoses, fittings, etc.)
		Prevent accumulation of gases in dangerous amounts (extraction, burning/flaring excess gas); prevent secondary flames
		Place gas bottles in use outside small enclosures/rooms
		Only work with a welding permit; measure explosivity of atmosphere
H21	Combustible materials	Only work with a welding permit
		Remove, cover, or shield flammable and combustible materials
H22	Exposure	Only work with a welding permit; measure composition of atmosphere (oxygen content)
		Ensure ventilation and dust/fume extraction
		Individual protection (welding helmet with ventilation/air supply, extraction at source, or integrated into the welding torch, etc.) or general protection (work area ventilation, work outside, etc.)
		Ensure that all gas-containing parts are leak-free (bottles, valves, regulators, distribution systems, pipes, hoses, fittings, etc.)
		Prevent accumulation of gases in dangerous amounts (extraction, burning/flaring excess gas); prevent secondary flames
H23		Voice contact with diver
		Power supply above water level
		Appropriate welding equipment (“S” machines for diving)
		Hyperbaric wet welding (underwater welding)
		DC only; U0 max. = 65 V
		Use of dry suits rather than wet suits
		Hyperbaric dry welding (in an pressurized enclosure)
		Personal breathing operators with an air intake independent of the welding environment
		Flame retardant protective clothing
		Gas cylinders outside the pressurized chamber

Annex B
(informative)

List of activities associated with welding processes

Table B.1 reports typical relations among processes, activities, and hazards. Detailed assessment of the actual welding conditions should be considered.

Table B.2 lists commonly used abbreviations for the welding processes used in Table B.1.

Table B.1 — Typical activities associated with welding processes

A-No.	Activity	Hazard	H-No.	Welding processes											
Welding processes (W)				111	12	131	135	13	136	141	15	3	81	822	83
W1	Fusion welding in general (see also W2 and W3 for further details)	Ergonomic aspects (body work, body posture, climate etc.)	H1	x		x	x	x	x	x	x	x	x	x	x
		Fumes, gases, vapours and/or dust (explosive, inflammable, toxic, suffocating etc.)	H2.2	x		x	x	x	x	x	x	x	x	x	x
W2	Arc welding, cutting and joint preparation using an electrical arc	Non-ionizing radiation	H3	x		x	x	x	x	x	x				
		Hot (incl. liquid) metal, spatter and/or slag	H4	x	x	x	x	x	x	x	x				
		Hot surfaces	H5	x	x	x	x	x	x	x	x				
		Electrical currents	H6	x	x	x	x	x	x	x	x				
		Electromagnetic fields	H6.1	x	x	x	x	x	x	x	x				
W3	Gas welding, cutting and joint preparation using a gas flame	Non-ionizing radiation	H3									x	x	x	x
		Hot (incl. liquid) metal, spatter and/or slag	H4									x	x	x	x
		Hot surfaces	H5									x	x	x	x
		Flame	H7									x	x	x	x
A-No.	Activity	Hazard	H-No.	Welding processes											
General activities (G)															
G1	Grinding / mechanical cutting and joint preparation	Projectiles	H8	x	x	x	x	x	x	x	x	x			
		Sparks	H9	x	x	x	x	x	x	x	x	x			
		Noise	H10	x	x	x	x	x	x	x	x	x			
		Dust and fumes	H2.1	x	x	x	x	x	x	x	x	x			
		Sharp edges	H11	x	x	x	x	x	x	x	x	x			
		Hand transmitted vibration	H12	x	x	x	x	x	x	x	x	x			
		Hot surfaces	H5	x	x	x	x	x	x	x	x	x			
		Rotating parts	H13	x	x	x	x	x	x	x	x	x			
G2	Cleaning	Hazardous materials (acids, solvents, gases etc.	H14	x	x	x	x	x	x	x	x	x	x	x	x
		Sharp edges	H11	x	x	x	x	x	x	x	x	x			
G3	Operating electrical tools	Electrical currents	H6	x	x	x	x	x	x	x	x	x			
G4	Using compressed air	Projectiles	H8	x	x	x	x	x	x	x	x	x			
G5	Cutting in genera	Released parts or stresses	H15	x	x	x	x	x	x	x	x	x	x	x	x
G6	Mechanized, semi- and fully automated processes	Moving machinery	H16	x	x	x	x	x	x	x	x	x	x	x	x

A-No.	Activity	Hazard	H-No.	Welding processes											
Welding processes (W)				**111**	**12**	**131**	**135**	**13**	**136**	**141**	**15**	**3**	**81**	**822**	**83**
Activities associated with specific welding processes (A)															
A1	Slag removal	Hot (incl. liquid) metal, spatter, and/or slag	H4	x	x		x	(x)	x						
		Projectiles	H8	x			x	(x)	x						
		Noise	H10	x			x	(x)	x						
A2	Gas handling	Hazardous materials (acids, solvents, gases etc.)	H14			x	x	x	x	x	x	x	x	x	x
		Explosive atmosphere and/or release of highly flammable gases	H20									x	x		
		Pressurized gas	H17			x	x	x	x	x	x	x	x	x	x
A3	Drying of electrodes and flux/powder	Hot surfaces	H5	x	x										
A4	Flux/powder handling	Dust	H2		x										
		Ergonomic aspects (body work, body posture, climate etc.)	H1		x										
A5	Disposal of electrode stubs	Hot surfaces	H5	x											
		Slipping	H18	x											
A6	Regrinding of thoriated tungsten electrodes	Radioactive dust	H19							x	x				
A-No.	Activity	Hazard	H-No.	Welding processes											
Surroundings / welding environment (S)															
S1	Welding in dangerous or sensitive environments	Explosive atmosphere and/or release of highly flammable gases	H20									x	x		
		Combustible materials	H21	x		x	x	x	x	x	x	x	x	x	x
S2	Welding in confined spaces	Ergonomic aspects (body work, body posture, climate etc.)	H1	x		x	x	x	x	x	x	x	x	x	x
		Fumes, gases, vapours and/or dust (explosive, inflammable, toxic, suffocating etc.)	H2.2	x	x	x	x	x	x	x	x	x	x	x	x
S3	Welding in electrically conducting surroundings	Electrical currents with potentially elevated risk	H6.2	x	x	x	x	x	x	x	x			x	x
S4	Welding under water	Ergonomic aspects (body work, body posture, climate etc.)	H1	x				(x)	x				x		
		Electrical currents	H6	x				(x)	x						
		Diving related hazards	H22	x				(x)	x				x		

Table B.2 — Commonly used abbreviations for welding processes

Abbreviations and commonly used names	Process name (ISO 4063)	Processes number (ISO 4063)	Group referenced in Table B.1
MMA SMAW (USA) Stick electrode welding	Manual metal arc welding (metal arc welding with covered electrode) Shielded metal arc welding (USA)	111	111
Self-shielded flux cored arc welding Flux-cored arc welding with self-shielded wires (FCAW-SS)	Self-shielded tubular cored arc welding	114	114
SAW Sub-arc welding	Submerged arc welding	12	12
GMAW	Gas-shielded metal arc welding Gas metal arc welding, USA	13	13
MIG	MIG welding with solid wire electrode Gas metal arc welding using inert gas and solid wire electrode, USA	131	131
MAG	MAG welding with solid wire electrode Gas metal arc welding using active gas with solid wire electrode, USA	135	135
Flux-cored arc welding FCAW Flux-cored wire welding with shielding gas	MAG welding with flux cored electrode Gas metal arc welding using active gas and flux cored electrode, USA	136	13
Metal-cored arc welding MCAW	MAG welding with metal-cored electrode; gas metal arc welding using active gas and metal-cored electrode	138	13
TIG GTAW	Gas-shielded arc welding with non-consumable tungsten electrode Gas tungsten arc welding, USA	14	(141)
TIG (with filler metal) GTAW (with filler metal)	TIG welding with solid filler material (wire/rod) Gas tungsten arc welding using inert gas and solid filler material (wire/rod), USA	141	141
TIG (without filler metal) GTAW (without filler metal)	Autogenous TIG welding Autogenous gas tungsten arc welding using inert gas, USA	142	141
Plasma welding PAW	Plasma arc welding	15	15
Gas welding	Gas welding Oxyfuel gas welding, USA	3	3
Oxyfuel welding	Oxyfuel gas welding Oxyfuel gas welding, USA	31	3

Table B.2 *(continued)*

TIG (without filler metal) GTAW (without filler metal)	Autogenous TIG welding Autogenous gas tungsten arc welding using inert gas, USA	142	141
Oxyacetylene welding	Oxyacetylene welding Oxyacetylene welding, USA	311	3
Flame cutting	Flame cutting Oxygen cutting, oxyfuel cutting, USA	81	81
Arc cutting	Arc cutting	82	822
Carbon arc cutting	Air arc cutting Air carbon arc cutting, USA	821	822
Oxy-arc cutting	Oxygen arc cutting	822	822
Plasma Cutting	Plasma cutting Plasma arc cutting, USA	83	83
Gouging	Flame gouging Thermal gouging, USA	86	(81)
Arc gouging	Arc gouging	87	(83)
Carbon arc gouging	Air arc gouging Air carbon arc cutting, USA	871	(822)
Plasma gouging	Plasma gouging	88	(83)

Annex C
(informative)

Health and safety management systems in welding fabrication

Several national standards and guidelines are available to define criteria for health and safety management. The key elements to realize an adequate and acceptable health and safety management system are the following, at least:

— to define and implement a correct occupational health and safety policy;

— to appoint an occupational health and safety expert person, responsible to establish and maintain the system in the welding fabrication process;

— to perform a risk assessment analysis at the beginning of the implementation of the system and after any welding process' significant change;

— to define a health and safety operating plan;

— to ensure a continuous improvement of the implemented system.

In the specific case of welding fabrication activities, it shall be considered important that welding and allied activities are already appropriately controlled from the operational point of view. The correct management of welding procedures, processes, techniques, and consumables gives assurance that the risks are reduced at the origin by avoidance of useless operations and that the technical conditions implemented are correct.

This Technical Report provides support for the performance of the risk assessment analysis, but it shall be considered that other activities have to be implemented in order to ensure adequate control of the health and safety matter in welding fabrication.

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[6] IIW document VIII-1901-00: Welding with non-consumable thoriated tungsten electrodes

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