Welding and REACH
Legal Obligations and Good Practices

Final Report

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Disclaimer

This guidance is meant to facilitate the communication of appropriate risk management measures for welding+ processes. The information contained in this guidance and the associated use map on welding+ processes has been collated based on Eurofer, Eurometaux, EWA and EBRC experts' experience and technical knowledge at the time of issuing. The use of the guidance is voluntary and at the user's own risk. The authors and their employers hereby disclaim any liability that may arise from the use of the guidance, including, but not limited to, non-performance, misinterpretation, and improper use.

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1 Introduction

The purpose of this document is both to assist in ensuring workers' health during various welding+[1] processes and to facilitate compliance with the associated legal requirements for registrants and downstream users under REACH. It is provided as a summary document and, as such, is neither intended as a treatise on welding nor as a comprehensive account of all legal aspects or aspects of health and safety associated with the welding+ process. The document rather provides information on how to effectively communicate risk management measures to users of welding consumables. Under REACH, the main tool supporting this communication are so-called **use maps** that comprehensively describe the **exposure scenarios relevant for welding processes** (including formal use descriptors according to the relevant ECHA guidance (ECHA, 2015) and the specific conditions of use that enable safe welding).

Section 5 proposes a tiered risk assessment approach that relies on the catalogue of risk management measures as developed by Eurofer, Eurometaux and EWA and as attached to this document (Appendix 2). The approach fulfils the REACH requirements but is also able to identify (at the screening level) where a refined assessment may be required.

This document aims to supersede the document "REACH and the Welding of Metals and Alloys" by Eurofer, Eurometaux and EWA, which was published in 2010 in view of the first REACH registration deadline for phase-in substances. Since 2010, interpretation and guidance on the REACH Regulation has been evolving. There have also been developments in other areas regarding the safety and health of workers during welding that have prompted an update of this document. In addition, existing best practices to protect workers' health can be communicated via established means, i.e., extended safety datasheets.

[1] Welding+ processes are defined as welding and allied processes including processes like laser cutting, flame cutting, brazing, gouging, etc. The term "welding+ fumes" is defined as fumes generated from welding and allied processes.

2 Welding+ processes and involved substances

The term “welding” is used for various processes that are used to join metals and alloys using heat, pressure, or both. Some of the techniques used in welding are also used for metal and alloy cutting. There are more than 80 different types of welding and associated processes, they involve melting the base metal and a filler material either during gas welding (using fuel gases), arc welding (using electricity) or beam welding (using laser/electron beams). During welding, metals (in the base and filler material) are vapourised and the vapour condenses into particles. This particulate matter is called welding+ fume and consists not only of metals and their oxides but also of spinels, which are complex structures of metals together with other substances present in fillers.

For welding or similar processes, the formation of (welding) fumes and the potential for health risks from these processes have been under discussion by various national and international authorities and there are many regulations and recommendations to be considered for the risk assessment during welding. Recently, in 2022, the European Chemicals Agency (ECHA) has published a scoping study report for the evaluation of limit values for welding fumes and fumes from other processes that generate fume in a similar way at the workplace (ECHA, 2022). With the latter, processes such as soldering, thermal cutting, gouging, thermal spraying, and flame straightening are included in ECHA’s scoping study report. For ease of reference, the terms “welding processes+” and “welding fumes+” being defined by ECHA as welding and allied processes (including laser cutting, flame cutting, brazing, gouging, etc.) and fumes generated from welding or allied processes, are used in a similar way (i.e., as “welding+”) in this document. It is however noted that the parent metals and alloys are not melted during brazing and soldering operations, and, in addition, these processes are performed at lower temperatures than welding. Therefore, the contribution of the parent metals and alloys to welding+ fumes in brazing and soldering operations is different, and would be expected to be lower than that derived from welding processes.

Welding+ processes have a unique exposure profile, where extreme heat, high radiant energy, high electromagnetic fields, spatter and fume are often featured. There are several reasons why welding may be a potentially dangerous occupation:

- there is a multiplicity of factors that can endanger the health of a welder, such as heat, burns, radiation, noise, fumes, gases, electrocution, and even the uncomfortable postures involved in the work;
- the high variability in chemical composition of welding+ fumes which differs according to the workpiece, welding+ process employed, and surrounding environment; and
- the routes of entry through which these harmful agents access the body. The adverse health effects of welding come from chemical, physical, and radiation hazards.

Common chemical hazards include certain particulates and noxious gases. Physical hazards include electrical energy, optical radiation, electromagnetic fields, heat, noise, and vibration.

The health risks that arise specifically from the welding+ fumes, appear to be largely non-specific or not readily attributable to a single substance. Thus, experts of EWA, Eurofer and Eurometaux, reflecting on the first REACH registration deadline and the associated communication obligations, proposed that welding fume/dust be treated as potentially hazardous and to collate existing data and existing risk management recommendations of substances and welding+ fume to develop appropriate safe use information for REACH.

2.1 Generation of welding⁺ fumes in different welding⁺ processes

The type and location of the welding⁺ processes significantly influence the generation of welding⁺ fumes and the potential of exposure to these fumes. While welding⁺ may be performed in open spaces, some welding⁺ processes also take place in enclosed spaces or under water, under controlled atmospheres or within vacuum chambers. In addition, some of the processes being summarised under welding⁺ processes are conducted at significantly lower temperatures compared to others (e.g. brazing). Another important point is that the composition of the welding⁺ fumes, and accordingly, the associated hazard potential, varies with the composition of the materials used. Finally, also the particle sizes of different constituents in the fume vary depending on the welding⁺ conditions and influence the deposition of particles in the lung and their potential for causing health effects. Generally, welding⁺ fumes and gases come from:

- the base material being welded or the filler materials (in the form of wires, flux coated electrodes, powder cored electrodes, fluxes, etc.) used,
- coatings, paints and oil on the metal being welded, or coatings covering the electrode,
- shielding gases,
- chemical reactions which result by the action of ultraviolet light from the arc, and heat,
- contaminants in the air, for example vapours from cleaners and degreasers, and/or
- dust from insulating materials such as asbestos.

2.2 List of involved substances

The following substances and their compounds (in alphabetical order) may be involved in welding⁺ processes: alumina, aluminium, antimony, barium, beryllium, borax, boric acid, boron, cadmium, calcium carbonate, calcium fluoride, carbides, carbon, cellulose, chromium (III and VI), cobalt, copper, fluorides, gold, iron, lead, lime, limestone, magnesium, manganese, molybdenum, nickel, niobium, oxides (of calcium, magnesium, sodium, potassium and manganese), palladium, plastics, phosphorus, potassium, rare earth metals, silicon, silica, silver, strontium, sulfur, tin, titanium, titanium dioxide, tungsten, vanadium, wood flower, zinc, zirconium (Bell, 2004; TWI (1997-2024); please note that this list does not claim to be complete).

3 Health concerns associated with welding⁺ fumes

As already indicated above, there are numerous health risks associated with welding⁺ processes (list taken from OSHA Europe[2]), these include:

- fire and explosion risk,
- rupture of pressurised cylinders,
- heat and burns,
- electrical risks,
- risks from ultraviolet and other electromagnetic radiation,
- working in awkward positions, and
- fumes that may enter the breathing zone of the welders, their colleagues or bystanders.

This document focusses on the latter, i.e., health risks arising from welding⁺ fumes. The health effects (or hazards) associated with exposure to welding⁺ fumes are difficult to summarise, because these may contain many different substances that are known to be harmful (depending on the factors listed above). Furthermore, even if the same substances were involved, the composition of these fumes could vary during different welding⁺ processes. The individual components of welding⁺ fumes can affect several parts of the body, including the lungs, heart, kidneys, and central nervous system.

The effects of exposure to welding⁺ fumes have been extensively studied and reported on. The information reported below on the potential health hazards that has been associated with welding⁺ is drawn from several sources in the public domain. It is important to note that the authors of this document do not necessarily agree with all statements included in the different information sources.

In 2018, IARC published a Monograph (Volume 118), in which welding⁺ fumes were evaluated, and reclassified as Group 1 (carcinogenic to humans) from its previous classification as Group 2B (possibly carcinogenic to humans). In 2023, the Advisory Committee on Safety and Health at Work (ACSH) recommended the EC to adopt “Work involving exposure to fumes from welding processes+ containing substances that meet the criteria for CMR category 1A/1B set out in Annex I to the CLP regulation” as new entry into Annex I under Directive 2004/37/EC[3].

The authors of this document have elected to treat all welding⁺ fumes as potentially harmful, irrespective of the substances involved in the welding⁺ process or, indeed, the welding method itself. It is recommended that to eliminate the excess risk of lung cancer, welders and their managers must ensure that:

- exposure to welding⁺ fumes is minimised, at least to national guidelines,
- welders are not additionally exposed to other lung toxicants, such as there is no further exposure of welders to asbestos, respirable silica, and
- welders are encouraged and assisted not to smoke tobacco.

This approach does not imply that the substrate metals and alloys, filler metals and alloys, welding fluxes or gases are themselves harmful to human health or the environment.

3.1 Acute (short-term) health effects

High peak exposures to welding⁺ fumes containing metal compounds (such as those of zinc, copper, etc.) can cause metal fume fever. Symptoms of metal fume fever may occur 4 to 12 hours after

[2] https://oshwiki.osha.europa.eu/en/themes/dust-and-aerosols-welding-fumes

[3] not finalised in September 2024 (finalisation expected in 2025)

exposure, and include chills, thirst, fever, muscle ache, chest soreness, coughing, wheezing, fatigue, nausea, and a metallic taste in the mouth (AFSCME, 2011). Welding⁺ fumes can also irritate the eyes, nose, chest, and respiratory tract, and cause coughing, wheezing, shortness of breath, bronchitis, pulmonary oedema (fluid in the lungs) and pneumonitis (inflammation of the lungs). Gastrointestinal effects, such as nausea, loss of appetite, vomiting, cramps, and slow digestion, have also been associated with welding⁺ (Spear, 2004; OSHA, 2013). Gases given off by the welding⁺ process can also be extremely dangerous. For example, in the presence of ultraviolet radiation given off by welding, oxygen and nitrogen in the air can react to form ozone and nitrogen oxides. Although such levels are not to be expected during welding⁺ processes, these gases are deadly at high doses and can also cause irritation of the nose and throat and serious lung disease (Antonini, 2003). Ultraviolet rays given off by welding can also catalyse the formation of phosgene gas from hydrocarbon solvents, such as trichloroethylene, 1,1,1-trichloroethane, methylene chloride, and perchloroethylene. Even a very small amount of phosgene may be deadly, although early symptoms of exposure - dizziness, chills, and cough - usually take 5 or 6 hours to appear (AFSCME, 2011).

3.2 Chronic (long-term) health effects

Studies of insufficiently protected welders, flame cutters, and burners have shown that welders have an increased risk of lung cancer, and possibly cancer of the larynx (voice box) and urinary tract (AFSCME, 2011). These findings are not surprising in view of the large number of hazardous substances in welding⁺ fumes, including carcinogenic chemical agents such as compounds of cadmium, nickel, beryllium and chromium. Welders may also experience a variety of chronic respiratory (lung) problems, including bronchitis, asthma, pneumonia, emphysema, pneumoconiosis, decreased lung capacity, silicosis (caused by crystalline silica exposure), and siderosis (a dust-related disease caused by iron oxide dust in the lungs) Other health effects that appear to be related to welding⁺ include heart disease, skin diseases, hearing loss, and chronic gastritis (inflammation of the stomach), gastroduodenitis (inflammation of the stomach and small intestine), and ulcers of the stomach and small intestine. Welders exposed to fumes containing chromium- and nickel compounds have also experienced kidney damage, but a study of stainless steel (that contains both chromium and nickel) exposed workers reported no significant renal impairment (Government of Alberta, 2009).

4 Good practice under OSH legislation

The degree of risk during welding depends on the composition of the fume and the extent and pattern of exposure (e.g., duration, risk management measures, etc.). Fume exposure levels vary greatly between the different welding[+] processes and the specific settings (e.g. ventilation) at the welding site. A large database of information has been compiled by TWI (The Welding Institute, https://www.twi-global.com/) with sponsorship provided by the UK Health and Safety Executive and the Nickel Institute with the objectives of:

- examining the health effects of exposure to welding[+] fume,
- estimating/evaluating etc exposure levels for a particular welding[+] process etc.
- establishing occupational exposure limit values, and
- examining the economic effects of prescribing occupational exposure limit values.

Risk management measures including personal protective equipment requirements are described in existing data sheets provided with welding consumables. Based on this information, it was possible to incorporate risks for all welding situations into one of eight classes suitable for use in chemical safety assessments (CSAs) for REACH registrations.

4.1 Risk management measures for individual process/base material combinations

The guidance provided here is consistent with the recommendations that the International Institute of Welding (IIW) has issued based on their assessment of the IARC Monograph 118. Based on the current state of knowledge, IIW confirms its statement from 2011 on “Lung cancer and welding” and encourages all those responsible, to reduce the exposure to welding fume to a minimum. It also recommends that to eliminate the excess risk of lung cancer, welders and their managers must ensure that exposure to welding fume is minimized, at least to national guidelines. More details can be found in “Welding in the world 2011, volume 55, no 11/12. Lung cancer and arc welding of steels” and “IIW C-VIII-2290r2-21 Press release -Lung Cancer Statement”.

Appendix 2 provides a general guidance for welding[+] processes and the base material based on technological means. An approximate ranking to mitigate the risk of welding[+] fumes exposure is given for each welding or allied process and base material combination. The individual process and base material combinations are ranked from low (**class I**) to high emission (**class VIII**), respectively. For each class, general recommendations on ventilation/extraction/filtration and personal protection equipment are proposed.

In addition, compliance with the European and national legislation regarding the exposure of welders and related personnel to welding[+] fumes, their components (with specific occupational exposure limit values) and gaseous substances with specific occupational exposure limit values shall be verified. It is therefore strongly recommended to seek clarification of specific European and national legislation that may apply.

4.2 General rules to reduce exposure to welding⁺ fumes and gases

When considering the emission of fumes generated during welding, brazing or cutting of metals, it is recommended to:

- apply risk management measures in combination with the general information and guidelines provided by this document and
- use the information provided by the safety data sheet, issued in accordance with REACH, by the welding consumable manufacturer. The REACH Regulation sets out the requirements the suppliers shall fulfil for the compilation for a safety data sheet.

Every employer has a duty to ensure that the risk from welding⁺ fumes to the safety and health of workers is reduced to a minimum and, if possible, eliminated. It is recommended that, prior to commencing new welding⁺ tasks, to start with an occupational safety and health risk inventory. Provided that local regulations do not prevent its use, the hierarchy of controls could be applied to assist this process. According to the European Agency for Safety and Health at Work[4], the hierarchy of controls has four levels of actions to reduce or remove hazards. The preferred order of action based on general effectiveness is:

1. **Measures at source**: Including elimination of the hazard, **substitution** with less hazard, process adaptation or isolation of the emission source. If welding⁺ needs to be conducted (i.e., elimination is not possible), select the applicable process/base material combinations with the lowest emission and with components of least hazard, whenever possible. Set the welding⁺ process with the lowest emission parameters (e.g. welding parameters/arc mode transfer, shielding gas composition). For example, in the MIG/MAG process, innovative waveform-controlled processes may generate less welding⁺ fumes and particles than conventional processes. The use of such processes can be an additional measure to reduce the exposure of the welder and other workers.
2. **Technological means**: Apply the relevant collective protective measures (general ventilation, local exhaust ventilation) in accordance with the class number (see below).
3. **Organisational measures**: Limit the time a worker is exposed to welding⁺ fumes. Establish and apply welding procedure specifications. Also consider bystanders.
4. **Personal protective equipment**: To protect the worker, assure they wear relevant personal protective equipment in accordance with the *duty cycle* (i.e., ratio of the time welding occurs to the total working period, usually expressed as %).

The above hierarchy slightly deviates from the also well-known **STOP-principle**, which starts with “Substitution by selection of the process” instead of “Measures at source”. However, the actions to be followed in the above hierarchy are the same and also include substitution as one possible measure, whenever elimination is impossible. While the use of the above hierarchy can lower worker exposures and reduce the risk of illness or injury, it is imperative that, whenever the substitution of a material or process is considered, it must not be driven simply by one or two narrow considerations. Any decision to change or substitute materials or welding processes must be a part of systematic and comprehensive risk assessment that considers all aspects of the item to be welded and the potential impact(s) of such a change or changes. These include the wider implications for health & safety pertaining to the welded item in its final application, its structural integrity within the original design parameters and its intended operating conditions, contractual obligations, standards that apply to the final application, whether the proposed changes are constrained by welding and/or health & safety protocols, legal restrictions, etc.. Furthermore, as part of any company’s Quality Management System such changes must be documented (along with the rationale for those

[4] https://oshwiki.osha.europa.eu/en/themes/hierarchy-controls-applied-dangerous-substances

changes) and approved by the company management. The process of a decision to apply any change may also involve liaison with those that commissioned the welding operation, specifiers, customers, local authorities, regulators, subcontractors, etc. Otherwise, there is a considerable risk of poor intervention decisions that could lead to undesired outcomes.

5 Legal obligations under REACH and tools[5]

REACH requires **manufacturers and importers** to prepare a Chemical Safety Report (CSR) for substances that meet the criteria specified in EC Regulation 1272/2008 (CLP). For classified substances, the CSR includes exposure scenarios (ES); to be annexed to the dossier and to the respective extended Safety Data Sheets (eSDS) that prescribe risk management measures (RMMs) and operational conditions for safe use (also referred to as conditions of use, CoU) of the substances. The chemical safety assessment (CSA) also needs to cover the service life of articles if a hazardous substance is included and can be released under reasonably foreseeable conditions.

Regardless of the classification of a substance, an adequate use description according to R.12 guidance (ECHA, 2015) needs to be included in the REACH registration dossier. These obligations apply to registrants of substances including substances that are put in mixtures or end up in articles.

Obligations of **downstream users of substances** (including substances included in mixtures) are mainly to implement the CoU for a hazardous substance that have been communicated to them via the eSDS by their supplier of that substance. If their use of a hazardous substance is not yet covered by the registrant, the downstream user must request such coverage by informing the supplier or conduct their own risk assessment to identify (and implement) safe use conditions.

For single substances or well-defined mixtures, the above principles ensure that workers are adequately protected when using substances. The procedure also allows to prescribe RMMs in a harmonised way for any downstream user, which is desirable in the case of welding⁺ fumes for which a catalogue of RMMs already exists and for which the complexity of risk assessment goes beyond the single “substance approach”. The following figure summarises the communication process (yellow fields) and legal obligations and tasks (green fields) for the relevant actors (grey fields) in the supply chain relevant for welding⁺ consumables in a simplified way.

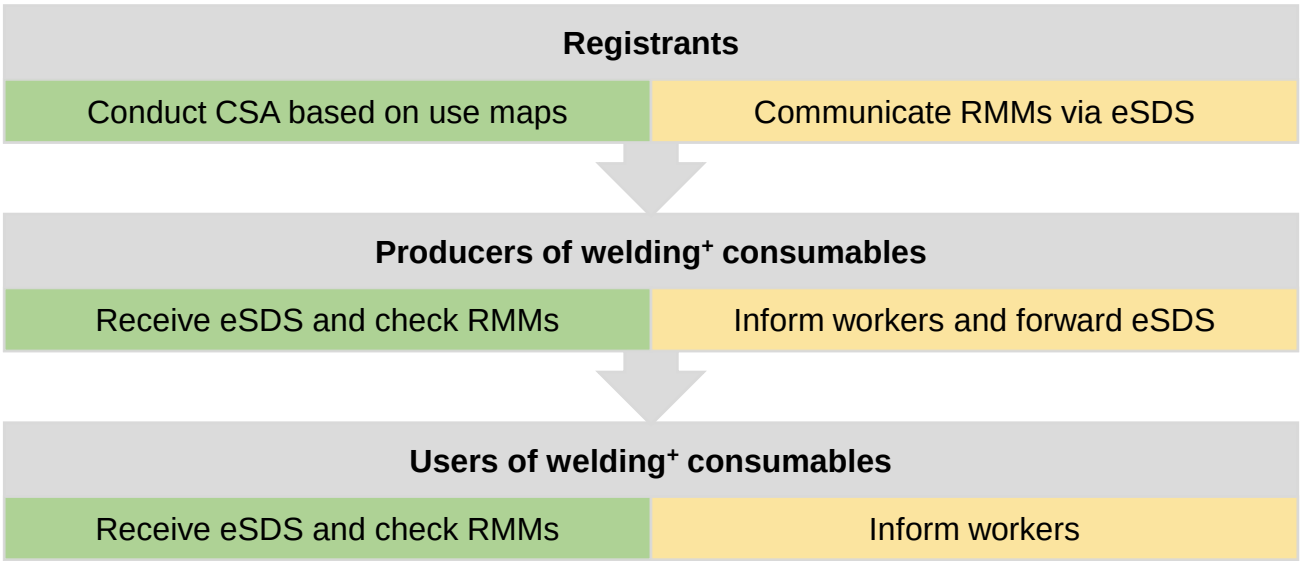

Figure 1: Legal obligations (green) and communications duties (yellow) for supply chain actors (grey) of welding⁺ consumables

[5] Please note that the current document does not provide exhaustive guidance on all REACH specific aspects for manufacturers and downstream users but is meant to provide practical guidance for welding-specific aspects under REACH.

However, two important aspects need to be considered when following this approach. These aspects have been formulated as questions with respective answers below:

Question 1: What happens if the registrant's substance in the welding⁺ consumable is not classified and how to communicate CoU?

When considering the legal REACH text, one may conclude that the registrant does not need to conduct a risk assessment for the substance and does not need to communicate any safe use conditions to downstream users. However, since the catalogue of risk management measures gets distributed with any classified substance and since some or at least one classified substance is to be expected in welding⁺ consumables, downstream users will be informed by at least one supplier about appropriate CoU. As an additional advantage, downstream users will receive a single set of CoU although multiple hazardous substances may be included in the welding⁺ consumable.

Question 2: What constitutes a meaningful risk assessment of welding⁺ under REACH?

It is explained above that the nature and extent of exposure to welding⁺ fumes are difficult to predict as they depend on the composition of welding⁺ goods and consumables and the type of process. Such considerations make it very difficult for the registrant of a single substance to conduct a comprehensive risk assessment. Thus, a tiered approach is proposed that ensures the protection of workers by a simple screening procedure at the first tier but at the same time also fulfils the legal requirements of REACH for registrants. If the screening at the first tier identifies an undue risk, a more refined assessment is required at the second tier. The tiered approach is based on two pre-requisites:

(i) the CoU are implemented as described in this document, and

(ii) the CoU are sufficiently protective for most welding⁺ situations.

The screening aims at checking if the welding⁺ situations are covered by the CoU (check of (ii) above).

At the first tier, such a check can be based on an exposure assessment of the single substance whereas the risk characterisation ratio (RCR[6]) threshold (of normally 1) would be reduced to a lower, i.e. more conservative value. Such a lower value should reflect the variable and combined exposure situation as well as the likely modified and thus unknown toxicological properties of the welding⁺ fume. A pragmatic value may be set at 0.5, thus leaving half of the RCR to cover the mentioned uncertainties. Further conservatism is built-in since the substance-specific exposure assessment at the screening level concludes on a reasonable worst case exposure level for the substance, whereas a combined exposure assessment may better consider typical exposure levels (Vetter et al., 2020, 2022). The appropriate toxicological reference value for the registered substance should be available to the registrant (e.g., as derived no-effect level (DNEL) under REACH). In addition, if there was knowledge that the DNEL of the substance may be higher when compared to the toxicological reference value of its potential transformation product in the welding⁺ fume, the lower value should be used for risk assessment. Reference values for the transformation product may be available via ECHA's dissemination website or via public databases on occupational exposure limit values. In addition, Section 5.3 provides an entry point on how to conduct the required exposure assessment by describing a selection of available tools. Finally, Appendix 3 includes an

[6] RCR = exposure level divided by toxicological reference value

example ES for the CSR in Chesar format addressing the use of nickel in welding consumables including an exposure assessment based on published data (Kendzia et al., 2017).

If the above screening results in an RCR above 0.5, a combined exposure assessment may be conducted (not further discussed here) or more restrictive respiratory protective equipment (RPE) may be considered at the second tier.

Below subsections provide a description of the available tools that support the approach integrating the communication of harmonised RMMs and the substance specific screening assessment as described above:

- To facilitate the harmonised implementation of CoU, Subsection 5.1 includes relevant entries for the use description of welding⁺ goods and consumables.
- Based on such use description, so-called use maps have been developed that contain the respective CoU for each of the contributing exposure scenarios. Subsection 5.2 explains how these use maps can be used when reporting the risk assessment in Chesar and when using Chesar for the generation of exposure scenarios for communication.
- Finally, a short introduction to available exposure assessment tools that can be used in the above-described screening approach is given in Subsection 5.3.

5.1 Use description (UD)

Appendix 1 includes a typical description of uses of welding⁺ goods and consumables in the standard CSR, Section 2 format. The subsections below describe the rationale behind those use entries. It is noted that the use entries are to be seen as generic templates. When adapting, only relevant physical forms and welding⁺ processes should be selected and reported in the REACH dossier by the registrant (or DU if the use is not covered).

5.1.1 Welding⁺ consumables

Since welding consumables are to be consumed (melted with the complete loss of shape and internal structure) during use (implying that their shape and structure is less important than their chemical composition), it must be concluded that they represent substances or mixtures of substances rather than articles (see ECHA guidance (ECHA, 2017) on substances in articles, Figure 2 on page 18, Example 21 on page 93)[7]. The production of these consumables therefore represents a formulation use. The resulting consumables can be used in industrial and in professional settings requiring two separate use entries in the use description of the respective dossier (Section 3.5 and related of IUCLID and Section 2 of the chemical safety report, CSR). Because of the lower temperatures and resulting emission potential involved, a separate industrial and professional use entry is also foreseen for soldering and brazing consumables. Thus, a total of five use entries may be required if the registered substance is included in welding⁺ consumables (or less, if soldering and brazing are exclusively or not at all relevant).

5.1.2 Objects, components and parts subject to welding⁺ processes

Objects, components and parts subject to welding⁺ processes may be considered as articles given that the main purpose of welding is either the joining of such parts with other parts or the division of objects into a number of separate parts, for example during flame cutting in demolition of ships. Thus, with the exception of small areas where melting occurs, objects, components and parts subject

[7] https://echa.europa.eu/documents/10162/2324906/articles_en.pdf

to welding+ processes retain their original shape and dimensions. It is noted that soldering and brazing operations do not have separate use entries but instead are covered by the generic use entry for welding+ processes. A risk assessment is usually not required for objects, components and parts subject to the welding+ processes soldering and brazing as the process temperature is below their melting point and relevant emissions from them are therefore not expected during foreseeable conditions of use. Thus, a total of two use entries is foreseen for the service life of objects, components and parts subject to the welding+ processes.

5.2 Use maps

The complete UD is reflected in the use maps that can be imported in Chesar[8]. The contributing scenarios for workers for welding+ activities (i.e., each PROC 25 entry) included represent individual entries in the catalogue of RMMs (see Appendix 1 and Appendix 2). In addition to the UD, the RMMs from the catalogue are included in the use maps, thus can be used for the communication of harmonised RMMs to downstream users and as an assessment basis (if an assessment is required). The flow chart below summarises how the use maps can be used.

Figure 2: Utilisation of use maps for welding+ processes

The use maps for welding+ can be downloaded on the official ECHA website for use maps:

https://echa.europa.eu/csr-es-roadmap/use-maps/use-maps-library

It is noted that some RMMs that may be relevant for the exposure assessment for specific welding+ processes, e.g., the concentration of a substance in the process and the exposure duration (other than full shift or 1 h per shift) are deliberately not reflected in the use maps but may be included by the risk assessor as appropriate.

5.3 Exposure assessment tools

For the screening risk assessment for REACH as described above, it is required to conduct an exposure assessment for the registered substance. Such exposure assessment may be based on modelled data or measured data. The focus of this subsection is on an exposure assessment for metals and their inorganic compounds. Vapours and/or gases are not addressed here.

[8] Chesar is a server-based tool that facilitates the conduct and/or reporting of chemical safety assessments in REACH dossiers. It also offers the possibility to generate so-called exposure scenarios for communication that are meant to be distributed as attachment to the eSDS. Such exposure scenarios for communication contain the RMMs and operational conditions to enable safe use of the substance for each use. The tool can be downloaded and used free of charge: https://chesar.echa.europa.eu/de/

ECHA's scoping study (ECHA, 2022) proposes the following emission groups based on emission rates that have been provided by TRGS 528, which describe the release of welding⁺ fumes, pointing towards possible exposure of workers:

Table 1: Emission potential by welding⁺ process (modified from ECHA, 2022)

Process (example list)	Emission group
Submerged arc welding	Low
Gas welding (autogenous process)	Low
TIG	Low
Laser beam welding without filler	Medium
MIG/MAG (low-energy inert gas welding)	Medium to high
Laser beam welding with additional material	High
MIG (solid wire, nickel, nickel-based alloys)	High
MIG (aluminium materials)	Low to very high
MAG (solid wire)	High
Manual arc welding	High
MAG (cored wire welding with shielding gas)	High to very high
MAG (cored wire welding without shielding gas)	Very high
Soft soldering	Low
Brazing / hard soldering	Medium to high
MIG soldering	Medium to high
Laser beam cutting	High to very high
Autogenous flame cutting	Very high
Plasma cutting	Very high
Arc spraying	Very high
Flame spraying	Very high

The proposed emission groups may be used as a starting point for occupational exposure assessments.

5.3.1 Modelled data: MEASE / MEASE 2

Contributing exposure scenarios for workers under REACH are categorised by process categories (PROCs). Exposure assessments for metal-related processes at the first-tier level may be conducted with the MEASE tool (the Metal's EASE). Welding⁺ processes are addressed in the MEASE tool under PROC 25. For this PROC, the initial exposure estimate is selected based on the ratio of process temperature and melting point. The initial exposure estimate is then further refined by the conditions of use (operational conditions and risk management measures) and personal protective equipment. The MEASE tool is supposed to deliver conservative (i.e., precautionary/higher) estimates of exposure. Both versions of the tool can be downloaded free of charge: https://www.ebrc.de/tools/downloads.php.

5.3.2 Measured exposure data

Monitoring data of (inhalation) exposure are available from published literature (a selection is listed in Section 6.3) or from regular exposure monitoring from industry. The basic data requirements have been summarised in Vetter et al. (2016) and may be roughly categorised in qualifying and contextual

information. For REACH, it is important that the CoU prevailing during sampling match those that are described in the respective contributing exposure scenarios.

5.3.2.1 Published data

A short selection of available publications including exposure monitoring data relevant for welding^{+} processes is provided in Section 6.3 of this document. Some of these provide analyses of exposure monitoring data from the German MEGA database (available on https://www.dguv.de/ifa/gestis/expositionsdatenbank-mega/index-2.jsp), which is a compilation of data gathered through air monitoring and material analyses. These data provide information on:

- the industrial workplace,
- the work and manufacturing methods,
- the substances used,
- the protective measures,
- the exposure situation and
- the conditions of sampling and chemical analysis.

5.3.2.2 Public databases

The Center for Construction Research and Training (CPWR) provides an exposure control database, where some exposure monitoring data for welding^{+} processes are available (https://ecd.cpwrconstructionsolutions.org/hazard/1/welding-fumes) that can be accessed by a simple decision tree guiding the user to applicable datasets.

6 References

The references section has been divided into several subsections, providing not only publications which were referenced in the text, but also pointing towards international standards and EU regulations relevant for risk assessments for welding⁺, assessments of potential exposure levels during welding⁺ and further general information on welding⁺ for ease of reference.

6.1 References cited in this document

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Bell, V (2004): Welding fume health hazards, available on: http://www.scsprocess.com/library/WeldingSmokeArticle.pdf

CLP: Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures

ECHA, 2015: Guidance on Information Requirements and Chemical Safety Assessment; Chapter R.12: Use description; Version 3.0; ECHA-15-G-11-EN; available on: https://echa.europa.eu/documents/10162/17224/information_requirements_r12_en.pdf

ECHA, 2017: Guidance on requirements for substances in articles; Version 4.0; ECHA-17-G-19-EN; available on: https://echa.europa.eu/documents/10162/2324906/articles_en.pdf

ECHA, 2022: ECHA Scoping Study report for evaluation of limit values for welding fumes and fumes from other processes that generate fume in a similar way at the workplace, 17 November 2022, available on: https://echa.europa.eu/documents/10162/7399806/report_welding_fumes_en.pdf

Eurofer, Eurometaux and EWA, 2010: REACH and the Welding of Metals and Alloys

Government of Alberta, 2009: Welder’s Guide to the Hazards of Welding Gases and Fumes, Work safe Alberta, available on: https://open.alberta.ca/dataset/b15f90d9-a316-41af-954b-ef45ddc3b833/resource/92687979-5230-442b-a49b-1860ceb63caa/download/whs-pub-ch032.pdf

IARC Monograph, 2018: Welding, Molybdenum Trioxide, and Indium Tin Oxide, IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Volume 118, 2018, available on: https://publications.iarc.fr/569

OSHA Fact Sheet „Controlling Hazardous Fume and Gases during Welding“, 2013, available on: https://www.osha.gov/sites/default/files/publications/OSHA_FS-3647_Welding.pdf

OSHA Europe https://oshwiki.osha.europa.eu/en/themes/dust-and-aerosols-welding-fumes

REACH Regulation: Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals

Spear, J, 2004: Welding Fume and Gas Exposure. Jerome E Spear, 2004 J.E. Spear Consulting, LLC, available on: https://jespear.com/wp-content/uploads/2024/02/welding-fume-and-gas.pdf

TRGS 528 (2020): Committee on Hazardous Substances (AGS), "Technical Rules for Hazardous Substances TRGS 528 – Welding work", available on: https://www.baua.de/DE/Angebote/Regelwerk/TRGS/TRGS-528.html

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Vetter D (2020): Exposure Estimates, Derived from Measured data, Presentation given during the MISA workshop (online) on worker exposure, on 23 November 2020.

Vetter, D, Schade, J, Bodenschatz, T, Horzella, M, 2022: Methodology applied in the occupational exposure scenarios for Precious Metals Refinables, Final Report, Version 2.1, 19 December 2022

6.2 International standards and EU directives

The following ISO standards, European Norms and Directives address general information for risk assessments of exposure to welding⁺ fumes and gases released by welding and allied processes. In addition, national regulations and recommendations need to be consulted and applied:

ISO 4063:2023: Welding, brazing, soldering and cutting — Nomenclature of processes and reference numbers

ISO EN 21904-1:2020: Health and safety in welding and allied processes - Equipment for capture and separation of welding fume - Part 1: General requirements

ISO EN 21904-2:2020: Health and safety in welding and allied processes - Equipment for capture and separation of welding fume -Part 2: Requirements for testing and marking of separation efficiency

ISO EN 21904-3:2018: Health and safety in welding and allied processes - Requirements, testing and marking of equipment for air filtration - Part 3: Determination of the capture efficiency of on-torch welding fume extraction devices

ISO EN 21904-4:2020: Health and safety in welding and allied processes - Equipment for capture and separation of welding fume -Part 4: Determination of the minimum air volume flow rate of capture devices

ISO 15607:2019: Specification and qualification of welding procedures for metallic materials - General rules

EN ISO 15609-1:2019: Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding

EN ISO 15609-2:2019: Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 2: Gas welding

EN ISO 15609-3:2004: Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 3: Electron beam welding

EN ISO 15609-4:2009: Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 4: Laser beam welding

EN ISO 15609-5:2011: Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 5: Resistance welding

EN ISO 15609-6:2013: Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 6: Laser-arc hybrid welding

ISO 17916:2016: Safety of thermal cutting machines

EN 149:2001+A1:2009: Respiratory protective devices. Filtering half masks to protect against particles. Requirements, testing, marking

EN 14594:2018: Respiratory protective devices. Continuous flow compressed air line breathing devices. Requirements, testing and marking

EN 12941:2023 - Respiratory protective devices - Powered filtering devices incorporating a loose fitting respiratory interface - Requirements, testing, marking

EN 143:2021 - Respiratory protective devices - Particle filters - Requirements, testing, marking

EN 529:2005: Respiratory protective devices - Recommendations for selection, use, care and maintenance – Guidance document

Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work

Directive 2004/37/EC on the protection of workers from the risks related to exposure to carcinogens or mutagens at work

Directive 2017/2398 Amending Directive 2004/37/EC on chromium VI exposure limit

Directive 2017/164/EU indicative occupational exposure limit values (for nitrogen oxides)

Directive 2019/130 Amending Directive 2004/37/EC on the protection of workers from the risks related to exposure to carcinogens or mutagens at work

A list of standards (international, European and others) has also been published by the International institute of welding (iiw) and is available on: https://european-welding.org/wp-content/uploads/2018/01/VIII-2079r4-17-list-of-welding-related-standards-1.pdf

An assortment of further international standards for the conduct of exposure monitoring is as follows:

ISO 10882-1:2024: Health and safety in welding and allied processes — Sampling of airborne particles and gases in the operator's breathing zone — Part 1: Sampling of airborne particles

ISO 10882-2:2024: Health and safety in welding and allied processes — Sampling of airborne particles and gases in the operator's breathing zone — Part 2: Sampling of gases

ISO 15767:2009: Workplace atmospheres — Controlling and characterizing uncertainty in weighing collected aerosols

ISO 15202-1:2020: Workplace air — Determination of metals and metalloids in airborne particulate matter by inductively coupled plasma atomic emission spectrometry — Part 1: Sampling

ISO 15202-2:2020: Workplace air — Determination of metals and metalloids in airborne particulate matter by inductively coupled plasma atomic emission spectrometry — Part 2: Sample preparation

ISO 15202-3:2004: Workplace air — Determination of metals and metalloids in airborne particulate matter by inductively coupled plasma atomic emission spectrometry — Part 3: Analysis

ISO 30011:2010: Workplace air — Determination of metals and metalloids in airborne particulate matter by inductively coupled plasma mass spectrometry

IEC 62990-2:2021: Workplace atmospheres — Part 2: Gas detectors — Selection, installation, use and maintenance of detectors for toxic gases and vapours

6.3 Exposure Concentrations

Freire de Carvalho, M., Kliebert, J., & Urbanus, J. (2023). Levels and control of welding fume exposure to total particulate, hexavalent chromium, and manganese in contracted activities in an oil refinery setting (2008–2018). Journal of Occupational and Environmental Hygiene, 21(1), 35–46. https://doi.org/10.1080/15459624.2023.2264350; **Short summary:** 10-year series of personal exposure measurements was analysed for SMAW or stick and tungsten inert gas

welding used in an oil refinery setting. The analysis focused on total particulate, hexavalent chromium and manganese.

Insley, A. L., Maskrey, J. R., Hallett, L. A., Reid, R. C. D., Hynds, E. S., Winter, C., & Panko, J. M. (2019). Occupational survey of airborne metal exposures to welders, metalworkers, and bystanders in small fabrication shops. Journal of Occupational and Environmental Hygiene, 16(6), 410–421. https://doi.org/10.1080/15459624.2019.1603389; **Short summary:** The objective of this study was to characterize worker exposure to airborne metal and particulate matter in shops where multiple types of metalworking tasks were performed, including flux-cored arc welding. Samples were analys ed for 21 individual metals.

Kendzia B, Pesch B, Koppisch D, Van Gelder R, Pitzke K, Zschiesche W, Behrens T, Weiss T, Siemiatycki J, Lavoué J, Jöckel KH, Stamm R, Brüning T (2017): Modelling of occupational exposure to inhalable nickel compounds. J Expo Sci Environ Epidemiol. 2017 Jul;27(4):427-433. doi: 10.1038/jes.2016.80. Epub 2017 Jan 18. PMID: 28098161; **Short summary:** 10 The aim of this study was to estimate average occupational exposure to inhalable nickel during welding and other metal working tasks using the German exposure database MEGA.

Kendzia B, Van Gelder R, Schwank T, Hagemann C, Zschiesche W, Behrens T, Weiss T, Brüning T, Pesch B. Occupational Exposure to Inhalable Manganese at German Workplaces. Ann Work Expo Health. 2017 Nov 10;61(9):1108-1117. doi: 10.1093/annweh/wxx080. PMID: 29136417; **Short summary:** Personal measurements of inhalable manganese together with information on sampling conditions and job tasks from the German MEGA database were used to assess exposure levels in welders and other occupations.

Kendzia, B., Koppisch, D., Van Gelder, R., Gabriel, S., Zschiesche, W., Behrens, T., Brüning, T. & Pesch, B. (2019). Modelling of exposure to respirable and inhalable welding fumes at German workplaces. Journal of Occupational and Environmental Hygiene, 16(6), 400–409. https://doi.org/10.1080/15459624.2019.1566734; **Short summary:** The aim of this study is to estimate exposure levels to inhalable and respirable welding fumes by welding process to use them for exposure assessments by using exposure monitoring data from the German MEGA database.

Pesch B, Weiss T, Kendzia B, Henry J, Lehnert M, Lotz A, Heinze E, Käfferlein HU, Van Gelder R, Berges M, Hahn JU, Mattenklott M, Punkenburg E, Hartwig A, Brüning T. Levels and predictors of airborne and internal exposure to manganese and iron among welders. J Expo Sci Environ Epidemiol. 2012 May-Jun;22(3):291-8. doi: 10.1038/jes.2012.9. Epub 2012 Feb 29. PMID: 22377681; **Short summary:** Airborne and internal exposure to manganese and iron was investigated among welders conducting different welding processes.

6.4 Further links and sources of information

American standard on welding⁺, covering all aspects of safety and health in the welding environment and including examples and an extensive bibliography: ANSI Z49.1:2021: An American National Standard, Safety in Welding, Cutting, and Allied Processes, available on: https://aws-p-001-delivery.sitecorecontenthub.cloud/api/public/content/f524cc78ee9c4e00a703bbe12b2f368b

Information source for safe use of industrial gases: British Compressed Gases Association (bcga): Welding, Cutting and Allied Processes, available on: https://bcga.co.uk/topics/welding-cutting-and-allied-processes/

Guidance aiming on increasing inspectors' confidence in addressing and regulating health risks from welding⁺ activities and exposure to welding fume, available in different European languages: Guidance for National Labour Inspectors on addressing health risks from Welding Fume, Senior Labour Inspectors' Committee (SLIC), November 2018, available on: https://circabc.europa.eu/ui/group/fea534f4-2590-4490-bca6-504782b47c79/library/b13cee56-02e8-4b86-9b39-f4c61af8c98c

Overview on different information sources for welding+ fumes on the Health and Safety Executive (HSE) website: https://www.hse.gov.uk/welding/index.htm

HSE practical guidance on assessment and selection of personal protective equipment for welding+ processes (information document 668/25): https://www.cambridgesafety.co.uk/wp-content/uploads/2018/02/weldingppe.pdf

British Occupational Hygiene Society (BOHS) initiative “Breathe Freely” aiming at reducing occupational lung disease in the UK: https://breathefreely.org.uk/

European welding association (EWA) statement for ECHA on the call for comments and evidence on Occupational exposure limits of welding fumes: https://european-welding.org/wp-content/uploads/2021/09/Sept-2nd- -EWA-comments-to-ECHA-call-on-welding-fumes-EWA-.pdf

Overview of the European welding association (EWA) on the importance of welding industries in Europe: https://european-welding.org/welding-in-europe/importance-welding-europe/

Website of The Welding Institute, an engineering institution supporting professionals with welding+ technologies: https://www.theweldinginstitute.com/

UK Guideline including a list of commonly used welding standards in the United Kingdom: Safety assessment federation (SAFed): Guidelines - Welding Procedures and Welders, Approval Testing, WG 01, Issue 03, 2020, available on: https://www.safed.co.uk/publications-home/tc4-welding-materials/guidelines-1/59-wg-1-guidelines-welding-procedures-and-welders-guidelines-on-approval-testing/file

German Technical Rules for Hazardous Substances focussing on welding work on metallic materials during which gaseous and particulate hazardous substances may be generated: TRGS 528 (2020): Committee on Hazardous Substances (AGS), "Technical Rules for Hazardous Substances TRGS 528 – Welding work", available on: https://www.baua.de/DE/Angebote/Regelwerk/TRGS/TRGS-528.html

Control of Substances Hazardous to Health (COSHH) advice for managers, issued by HSE, providing further information on the COSHH essentials series on welding+ processes (WL series) describing good practice for controlling exposure to hazardous substances in the welding industry: WL0, COSHH essentials for welding, hot work and allied processes, 2019, available on: https://www.hse.gov.uk/pubnsbens/guidance/wl0.pdf

7 Abbreviations

Abbreviation	Term
AC	Article category
AM	Additive manufacturing
AW	Arc welding
CAD	Chemical agents directive
CMD	Carcinogens and mutagens directive
CMRD	Carcinogens, mutagens or reprotoxic substances directive
CoU	Conditions of use
CSA	Chemical safety assessment
CSR	Chemical safety report
DC	Duty cycle, expressed on 8 hours
DNEL	Derived no-effect level
DU	Downstream user
ECHA	European Chemicals Agency
EGW	Electrogas welding
ERC	Environmental release category
ES	Exposure scenarios
eSDS	Extended safety data sheet
ESW	Electro-slag welding
FCAW	Flux cored arc welding
FFP2	Filtering facepiece class 2, refer to EN529 for further information
FFP3	Filtering facepiece class 3, refer to EN529 for further information
GMAW	Gas metal arc welding
GTAW	Gas tungsten arc welding
GV	General ventilation
HVAF	High velocity air fuel spraying
HVOF	High velocity oxy-liquid fuel spraying
IARC	International Agency for Research on Cancer
LDH2	Light duty airline hood or helmet class 2
LDH3	Light duty airline hood or helmet class 3
LEV	Local exhaust ventilation
MAG	Metal active gas welding
MEASE	The Metals' EASE, Occupational Exposure Assessment Tool for REACH
MEGA	Measurement data relating to workplace exposure to hazardous substances; Messdaten zur Exposition gegenüber Gefahrstoffen am Arbeitsplatz" in German
MIG	Metal inert gas welding
MMAW	Manual metal arc welding
na	Not applicable
nr	Not recommended
OSH	Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PAW	Plasma arc welding
PC	Product category
PPE	Personal protective equipment
PROC	Process category
PSD	Particle size distribution
PTA	Powder plasma transferred arc
RCR	Risk characterisation ratio
RMM	Risk management measures
RPE	Respiratory protective equipment
SAW	Submerged arc welding
SDS	Safety data sheet

Abbreviation	Term
SMAW	Shielded metal arc welding
SU	Sector of end use
SW	Arc stud welding
TH2	Powder hood or helmet class 2
TH3	Powder hood or helmet class 3
TIG	Tungsten inert gas welding
UD	Use description
WSP	Water stabilized plasma spraying

8 Appendix 1: Use description in CSR format

The use description below is also included in the use maps for welding⁺ in Chesar. It is noted that in the overview below, all different types of welding⁺ processes are included. However, only welding⁺ processes that are relevant for the registered substances should be maintained in the associated REACH dossier.

Whenever a substance is used in a welding⁺ process, the need for a service life scenario needs to be considered (please refer to ECHA Guidance R.12 for further information on different life cycle stages and use description). PROC24, which is used for finishing operations in service life scenarios, is relevant for welding⁺ processes, except for soldering.

Please note that exclusively industrial and professional workers are considered in the use map for welding⁺ processes, since it is assumed that these processes are not conducted by “consumers” in the sense of REACH or the associated guidance. Instead, it is assumed that persons that are conducting welding⁺ processes for non-commercial purposes, have a specific background and training that qualifies them to safely conduct these processes. In addition, relatively expensive equipment needs to be obtained, and welders need to be well-trained to ensure a successful welding result. Such training normally involves aspects of personal protective equipment that needs to be worn during welding. Under such circumstances it appears highly reasonable to assume that exclusively trained, healthy and adult persons would conduct welding operations. Consequently, in such consumer risk assessments, the worker DNEL should be used for risk assessment of welding and brazing. With the same reasoning, the oral route of exposure is not considered relevant (i.e. mouthing of welding consumables or brazing solder is not relevant under foreseeable use conditions). Furthermore, due to the formation of fumes, gases and the significant fire hazard, welding processes are best conducted outdoors or at least in well-ventilated large workrooms, rather than inside private households, so that bystander exposure would likely be negligible due to the spatial distance (to avoid exposure to heat, radiation, smoke and spatters) and dilution effect. Finally, non-commercial welding activities are taking place for a reduced exposure duration (typically not exceeding 60 minutes) compared to welding at professional sites (which may last for the entire shift) and on a very low annual frequency both compensating for remaining uncertainties related to the considerations outlined above.

The use descriptor system as used in the following appendices is based on descriptor-lists with standard entries and codes. It provides categories for some of the key elements of use description:

Sector of use (**SU**): Market description (sector of economy where the use takes place)

Product category (**PC**): Market description (type of product); Contributing activities (consumers)

Process category (**PROC**): Contributing activities (workers)

Environmental release category (**ERC**): Contributing activities (environment)

Article category (**AC**): Market description (type of article)

Technical function (**TF**): Technical function of the substance

More detailed information can be found in ECHA Guidance R.12.

Use of welding+ consumables in industrial settings

	Uses at industrial sites
IW-1	**Use of welding+ consumables in industrial settings - Duration of activity > 1h** Further description of the use: Contributing activity/technique for the environment: **- Use of welding+ consumables in industrial settings - Duration of activity > 1h (ERC5)** Contributing activity/technique for the workers: **- Handling of massive welding+ consumable (PROC 21)** **- Handling of solid formulated consumable (PROC 8b; PROC 9)** **- Handling of liquid formulated consumable (PROC 8b; PROC 9)** **-Brushing of liquid formulated consumable (PROC 10)** **- Class I welding (For all base materials except aluminium in unconfined spaces with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521]) (PROC 25)** **- Class I welding (For all base materials except cadmium-containing alloy in unconfined spaces with duration of welding+ activity > 1h) (applicable to Brazing and soldering [9]) (PROC 25)** **- Class I welding (For all base materials in closed systems with duration of welding+ activity > 1h) (applicable to Laser welding [52], Laser cutting [84], Electron beam welding [51]) (PROC 25)** **- Class II welding (For aluminium as base materials in unconfined space with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141]) (PROC 25)** **- Class III welding (For all base materials except Be-, Mn-, Ni-, V-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to Manual metal arc welding [111]) (PROC 25)** **- Class III welding (For all base materials except Ni-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137]) (PROC 25)** **- Class III welding (For all base materials except Be-, Cu- and V-alloys with duration of welding+ activity > 1h) (applicable to MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135]) (PROC 25)** **- Class III welding (For all base materials except Be-, Cu-, Mn-, Ni-, V-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to Powder plasma arc welding [152]) (PROC 25)** **- Class IV welding (For painted/primed/oiled base materials without Pb in the primer with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521]) (PROC 25)** **- Class IV welding (For painted/primed/oiled base materials without Pb in the primer with duration of welding+ activity > 1h) (applicable to Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152]) (PROC 25)** **- Class V welding (For Be-, Ni-, V-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to Manual metal arc welding [111])** **- Class V welding (For Mn-, Ni-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137]) (PROC 25)**

	Uses at industrial sites
	- Class V welding (For Cu-alloys with duration of welding+ activity > 1h) (applicable to MIG welding with solid wire electrode [131]) (PROC 25) **- Class V welding (For Cu-, Mn-, Ni-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to Powder plasma arc welding [152]) (PROC 25)** **- Class VI welding (For Be- and V-alloys with duration of welding+ activity > 1h) (applicable to MIG welding with solid wire electrode [131], Powder plasma arc welding [152]) (PROC 25)** **- Class VI welding (Powdered plasma Arc) (PROC 25)** **- Class VII welding (For un-, high-alloyed steel, cored wire, not containing Ba with duration of welding+ activity > 1h) (applicable to Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For un-, high-alloyed steel, cored wire, containing Ba with duration of welding+ activity > 1h) (applicable to Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For painted/primed/oiled base materials with Pb in the primer with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521], Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152],Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For all base materials in unconfined spaces with duration of welding+ activity > 1h) (applicable to Cutting and gouging [8]) (PROC 25)** **- Class VII welding (For all base materials in unconfined spaces with duration of welding+ activity > 1h) (applicable to Thermal spraying) (PROC 25)** **- Class VII welding (For all base materials, except Cd-alloys in unconfined spaces with duration of welding+ activity > 1h) (applicable to Brazing and soldering [9]) (PROC 25)** **- Class VIII welding (For all base materials in confined space with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521], Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152], Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Cleaning and maintenance (PROC28)** **Product Category used:** PC 7: Base metals and alloys; PC 38: Welding and soldering products, flux products **Sector of end use** SU 2b: Offshore industries ; SU 14: Manufacture of basic metals, including alloys ; SU 15: Manufacture of fabricated metal products, except machinery and equipment ; SU 17: General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment ; SU 19: Building and construction work **Technical function of the substance:** alloying element use registered according to REACH Article 10; total tonnage manufactured/imported >=10tonnes/year per registrant Tonnage of substance for that use: <=0 tonnes/year Substance supplied to that use: as such; in a mixture Subsequent service life relevant for that use: yes Link to the subsequent service life: Service life of objects, components and parts subject to the welding+ processes in industrial settings - Duration of activity > 1h *Related assessment: use assessed in an own CSR*

	Uses at industrial sites
IW-2	**Use of welding+ consumables in industrial settings - Duration of activity <= 1h** Further description of the use: Contributing activity/technique for the environment: **- Use of welding+ consumables in industrial settings - Duration of activity <= 1h (ERC5)** Contributing activity/technique for the workers: **- Handling of massive welding+ consumable (PROC 21)** **- Handling of solid formulated consumable (PROC 8b; PROC 9)** **- Handling of liquid formulated consumable (PROC 8b; PROC 9)** **-Brushing of liquid formulated consumable (PROC 10)** **- Class I welding (For all base materials except aluminium in unconfined spaces with duration of welding+ activity <= 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521]) (PROC 25)** **- Class I welding (For all base materials except cadmium-containing alloy in unconfined spaces with duration of welding+ activity <= 1h) (applicable to Brazing and soldering [9]) (PROC 25)** **- Class I welding (For all base materials in closed systems with duration of welding+ activity <= 1h) (applicable to Laser welding [52], Laser cutting [84], Electron beam welding [51]) (PROC 25)** **- Class II welding (For aluminium as base materials in unconfined space with duration of welding+ activity <= 1h) (applicable to TIG welding with solid filler material [141]) (PROC 25)** **- Class III welding (For all base materials except Be-, Mn-, Ni-, V-alloys and stainless alloys with duration of welding+ activity <= 1h) (applicable to Manual metal arc welding [111]) (PROC 25)** **- Class III welding (For all base materials except Ni-alloys and stainless alloys with duration of welding+ activity <= 1h) (applicable to MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137]) (PROC 25)** **- Class III welding (For all base materials except Be-, Cu- and V-alloys with duration of welding+ activity <= 1h) (applicable to MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135]) (PROC 25)** **- Class III welding (For all base materials except Be-, Cu-, Mn-, Ni-, V-alloys and stainless alloys with duration of welding+ activity <= 1h) (applicable to Powder plasma arc welding [152]) (PROC 25)** **- Class IV welding (For painted/primed/oiled base materials without Pb in the primer with duration of welding+ activity <= 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521]) (PROC 25)** **- Class IV welding (For painted/primed/oiled base materials without Pb in the primer with duration of welding+ activity <= 1h) (applicable to Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152]) (PROC 25)** **- Class V welding (For Be-, Ni-, V-alloys and stainless alloys with duration of welding+ activity <= 1h) (applicable to Manual metal arc welding [111])** **- Class V welding (For Mn-, Ni-alloys and stainless alloys with duration of welding+ activity <= 1h) (applicable to MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137]) (PROC 25)** **- Class V welding (For Cu-alloys with duration of welding+ activity <= 1h) (applicable to MIG welding with solid wire electrode [131]) (PROC 25)**

	Uses at industrial sites
	- Class V welding (For Cu-, Mn-, Ni-alloys and stainless alloys with duration of welding+ activity <= 1h) (applicable to Powder plasma arc welding [152]) (PROC 25) **- Class VI welding (For Be- and V-alloys with duration of welding+ activity <= 1h) (applicable to MIG welding with solid wire electrode [131], Powder plasma arc welding [152]) (PROC 25)** **- Class VI welding (Powdered plasma Arc) (PROC 25)** **- Class VII welding (For un-, high-alloyed steel, cored wire, not containing Ba with duration of welding+ activity <= 1h) (applicable to Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For un-, high-alloyed steel, cored wire, containing Ba with duration of welding+ activity <= 1h) (applicable to Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For painted/primed/oiled base materials with Pb in the primer with duration of welding+ activity <= 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521], Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152],Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For all base materials in unconfined spaces with duration of welding+ activity <= 1h) (applicable to Cutting and gouging [8]) (PROC 25)** **- Class VII welding (For all base materials in unconfined spaces with duration of welding+ activity <= 1h) (applicable to Thermal spraying) (PROC 25)** **- Class VII welding (For all base materials, except Cd-alloys in unconfined spaces with duration of welding+ activity <= 1h) (applicable to Brazing and soldering [9]) (PROC 25)** **- Class VIII welding (For all base materials in confined space with duration of welding+ activity <= 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521], Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152], Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Cleaning and maintenance (PROC28)** **Product Category used:** PC 7: Base metals and alloys; PC 38: Welding and soldering products, flux products **Sector of end use** SU 2b: Offshore industries ; SU 14: Manufacture of basic metals, including alloys ; SU 15: Manufacture of fabricated metal products, except machinery and equipment ; SU 17: General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment ; SU 19: Building and construction work **Technical function of the substance:** alloying element use registered according to REACH Article 10; total tonnage manufactured/imported >=10tonnes/year per registrant Tonnage of substance for that use: <=0 tonnes/year Substance supplied to that use: as such; in a mixture Subsequent service life relevant for that use: yes Link to the subsequent service life: Service life of objects, components and parts subject to the welding+ processes in industrial settings - Duration of activity <= 1h *Related assessment: use assessed in an own CSR*

Use of welding+ consumables in professional settings

	Uses by professional workers
PW-1	**Use of welding+ consumables in professional settings - Duration of activity > 1h** Further description of the use: Contributing activity/technique for the environment: **Use of welding+ consumables in professional settings - Duration of activity > 1h (ERC8c)** **-Use of welding+ consumables in professional settings - Duration of activity > 1h (ERC8f)** Contributing activity/technique for the workers: **- Handling of massive welding+ consumable (PROC 21)** **- Handling of solid formulated consumable (PROC 8b; PROC 9)** **- Handling of liquid formulated consumable (PROC 8b; PROC 9)** **-Brushing of liquid formulated consumable (PROC 10)** **- Class I welding (For all base materials except aluminium in unconfined spaces with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521]) (PROC 25)** **- Class I welding (For all base materials except cadmium-containing alloy in unconfined spaces with duration of welding+ activity > 1h) (applicable to Brazing and soldering [9]) (PROC 25)** **- Class I welding (For all base materials in closed systems with duration of welding+ activity > 1h) (applicable to Laser welding [52], Laser cutting [84], Electron beam welding [51]) (PROC 25)** **- Class II welding (For aluminium as base materials in unconfined space with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141]) (PROC 25)** **- Class III welding (For all base materials except Be-, Mn-, Ni-, V-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to Manual metal arc welding [111]) (PROC 25)** **- Class III welding (For all base materials except Ni-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137]) (PROC 25)** **- Class III welding (For all base materials except Be-, Cu- and V-alloys with duration of welding+ activity > 1h) (applicable to MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135]) (PROC 25)** **- Class III welding (For all base materials except Be-, Cu-, Mn-, Ni-, V-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to Powder plasma arc welding [152]) (PROC 25)** **- Class IV welding (For painted/primed/oiled base materials without Pb in the primer with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521]) (PROC 25)** **- Class IV welding (For painted/primed/oiled base materials without Pb in the primer with duration of welding+ activity > 1h) (applicable to Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152]) (PROC 25)** **- Class V welding (For Be-, Ni-, V-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to Manual metal arc welding [111])**

	Uses by professional workers
	- Class V welding (For Mn-, Ni-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137]) (PROC 25) **- Class V welding (For Cu-alloys with duration of welding+ activity > 1h) (applicable to MIG welding with solid wire electrode [131]) (PROC 25)** **- Class V welding (For Cu-, Mn-, Ni-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to Powder plasma arc welding [152]) (PROC 25)** **- Class VI welding (For Be- and V-alloys with duration of welding+ activity > 1h) (applicable to MIG welding with solid wire electrode [131], Powder plasma arc welding [152]) (PROC 25)** **- Class VI welding (Powdered plasma Arc) (PROC 25)** **- Class VII welding (For un-, high-alloyed steel, cored wire, not containing Ba with duration of welding+ activity > 1h) (applicable to Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For un-, high-alloyed steel, cored wire, containing Ba with duration of welding+ activity > 1h) (applicable to Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For painted/primed/oiled base materials with Pb in the primer with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521], Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152],Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For all base materials in unconfined spaces with duration of welding+ activity > 1h) (applicable to Cutting and gouging [8]) (PROC 25)** **- Class VII welding (For all base materials in unconfined spaces with duration of welding+ activity > 1h) (applicable to Thermal spraying) (PROC 25)** **- Class VII welding (For all base materials, except Cd-alloys in unconfined spaces with duration of welding+ activity > 1h) (applicable to Brazing and soldering [9]) (PROC 25)** **- Class VIII welding (For all base materials in confined space with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521], Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152], Self-shielded tubular cored arc welding [114]) (PROC 25)** **Product Category used:** PC 7: Base metals and alloys; PC 38: Welding and soldering products, flux products **Sector of end use** SU 2b: Offshore industries ; SU 14: Manufacture of basic metals, including alloys ; SU 15: Manufacture of fabricated metal products, except machinery and equipment ; SU 17: General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment ; SU 19: Building and construction work **Technical function of the substance:** alloying element use registered according to REACH Article 10; total tonnage manufactured/imported >=10tonnes/year per registrant Tonnage of substance for that use: <=0 tonnes/year Subsequent service life relevant for that use: yes Link to the subsequent service life: Service life of objects, components and parts subject to the welding+ processes in professional settings - Duration of activity > 1h

	Uses by professional workers
	Related assessment: use assessed in an own CSR *[2]: Use included for completeness here, should be assessed in respective at article service life scenario.*
PW-2	**Use of welding+ consumables in professional settings - Duration of activity <= 1h** Further description of the use: Contributing activity/technique for the environment: **Use of welding+ consumables in professional settings - Duration of activity <= 1h (ERC8c)** **-Use of welding+ consumables in professional settings - Duration of activity <= 1h (ERC8f)** Contributing activity/technique for the workers: **- Handling of massive welding+ consumable (PROC 21)** **- Handling of solid formulated consumable (PROC 8b; PROC 9)** **- Handling of liquid formulated consumable (PROC 8b; PROC 9)** **-Brushing of liquid formulated consumable (PROC 10)** **- Class I welding (For all base materials except aluminium in unconfined spaces with duration of welding+ activity <= 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521]) (PROC 25)** **- Class I welding (For all base materials except cadmium-containing alloy in unconfined spaces with duration of welding+ activity <= 1h) (applicable to Brazing and soldering [9]) (PROC 25)** **- Class I welding (For all base materials in closed systems with duration of welding+ activity <= 1h) (applicable to Laser welding [52], Laser cutting [84], Electron beam welding [51]) (PROC 25)** **- Class II welding (For aluminium as base materials in unconfined space with duration of welding+ activity <= 1h) (applicable to TIG welding with solid filler material [141]) (PROC 25)** **- Class III welding (For all base materials except Be-, Mn-, Ni-, V-alloys and stainless alloys with duration of welding+ activity <= 1h) (applicable to Manual metal arc welding [111]) (PROC 25)** **- Class III welding (For all base materials except Ni-alloys and stainless alloys with duration of welding+ activity <= 1h) (applicable to MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137]) (PROC 25)** **- Class III welding (For all base materials except Be-, Cu- and V-alloys with duration of welding+ activity <= 1h) (applicable to MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135]) (PROC 25)** **- Class III welding (For all base materials except Be-, Cu-, Mn-, Ni-, V-alloys and stainless alloys with duration of welding+ activity <= 1h) (applicable to Powder plasma arc welding [152]) (PROC 25)** **- Class IV welding (For painted/primed/oiled base materials without Pb in the primer with duration of welding+ activity <= 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521]) (PROC 25)** **- Class IV welding (For painted/primed/oiled base materials without Pb in the primer with duration of welding+ activity <= 1h) (applicable to Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152]) (PROC 25)** **- Class V welding (For Be-, Ni-, V-alloys and stainless alloys with duration of welding+**

	Uses by professional workers
	activity <= 1h) (applicable to Manual metal arc welding [111]) **- Class V welding (For Mn-, Ni-alloys and stainless alloys with duration of welding+ activity <= 1h) (applicable to MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137]) (PROC 25)** **- Class V welding (For Cu-alloys with duration of welding+ activity <= 1h) (applicable to MIG welding with solid wire electrode [131]) (PROC 25)** **- Class V welding (For Cu-, Mn-, Ni-alloys and stainless alloys with duration of welding+ activity <= 1h) (applicable to Powder plasma arc welding [152]) (PROC 25)** **- Class VI welding (For Be- and V-alloys with duration of welding+ activity <= 1h) (applicable to MIG welding with solid wire electrode [131], Powder plasma arc welding [152]) (PROC 25)** **- Class VI welding (Powdered plasma Arc) (PROC 25)** **- Class VII welding (For un-, high-alloyed steel, cored wire, not containing Ba with duration of welding+ activity <= 1h) (applicable to Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For un-, high-alloyed steel, cored wire, containing Ba with duration of welding+ activity <= 1h) (applicable to Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For painted/primed/oiled base materials with Pb in the primer with duration of welding+ activity <= 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521], Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152],Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For all base materials in unconfined spaces with duration of welding+ activity <= 1h) (applicable to Cutting and gouging [8]) (PROC 25)** **- Class VII welding (For all base materials in unconfined spaces with duration of welding+ activity <= 1h) (applicable to Thermal spraying) (PROC 25)** **- Class VII welding (For all base materials, except Cd-alloys in unconfined spaces with duration of welding+ activity <= 1h) (applicable to Brazing and soldering [9]) (PROC 25)** **- Class VIII welding (For all base materials in confined space with duration of welding+ activity <= 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521], Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152], Self-shielded tubular cored arc welding [114]) (PROC 25)** **Product Category used:** PC 7: Base metals and alloys; PC 38: Welding and soldering products, flux products **Sector of end use** SU 2b: Offshore industries ; SU 14: Manufacture of basic metals, including alloys ; SU 15: Manufacture of fabricated metal products, except machinery and equipment ; SU 17: General manufacturing, e.g. machinery, equipment, vehicles, other transport equipment ; SU 19: Building and construction work **Technical function of the substance:** alloying element use registered according to REACH Article 10; total tonnage manufactured/imported >=10tonnes/year per registrant Tonnage of substance for that use: <=0 tonnes/year Substance supplied to that use: as such; in a mixture Subsequent service life relevant for that use: yes

	Uses by professional workers
	Link to the subsequent service life: Service life of objects, components and parts subject to the welding+ processes in professional settings - Duration of activity <= 1h *Related assessment: use assessed in an own CSR*

Service life of objects, components and parts subject to the welding+ processes in industrial settings

	Article service life
SL-1	**Service life of objects, components and parts subject to the welding+ processes in industrial settings - Duration of activity > 1h** Further description of the use: Article used by: workers Substance intended to be released from article: no **Article category related to subsequent service life (AC):** AC 1: Vehicles; AC 2: Machinery, mechanical appliances, electrical/electronic articles; AC 7: Metal articles Contributing activity/technique for the environment: **- Service life of objects, components and parts subject to the welding+ processes in industrial settings - Duration of activity > 1h (ERC 12a)** Contributing activity/technique for consumers: Contributing activity/technique for the workers: **- Handling of objects, components and parts subject to the welding+ processes (PROC 21)** **- Class I welding (For all base materials except aluminium in unconfined spaces with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521]) (PROC 25)** **- Class I welding (For all base materials except cadmium-containing alloy in unconfined spaces with duration of welding+ activity > 1h) (applicable to Brazing and soldering [9]) (PROC 25)** **- Class I welding (For all base materials in closed systems with duration of welding+ activity > 1h) (applicable to Laser welding [52], Laser cutting [84], Electron beam welding [51]) (PROC 25)** **- Class II welding (For aluminium as base materials in unconfined space with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141]) (PROC 25)** **- Class III welding (For all base materials except Be-, Mn-, Ni-, V-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to Manual metal arc welding [111]) (PROC 25)** **- Class III welding (For all base materials except Ni-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137]) (PROC 25)** **- Class III welding (For all base materials except Be-, Cu- and V-alloys with duration of welding+ activity > 1h) (applicable to MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135]) (PROC 25)** **- Class III welding (For all base materials except Be-, Cu-, Mn-, Ni-, V-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to Powder plasma arc welding [152]) (PROC 25)** **- Class IV welding (For painted/primed/oiled base materials without Pb in the primer with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521]) (PROC 25)** **- Class IV welding (For painted/primed/oiled base materials without Pb in the primer with duration of welding+ activity > 1h) (applicable to Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135],**

	Article service life
	Powder plasma arc welding [152]) (PROC 25) **- Class V welding (For Be-, Ni-, V-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to Manual metal arc welding [111])** **- Class V welding (For Mn-, Ni-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137]) (PROC 25)** **- Class V welding (For Cu-alloys with duration of welding+ activity > 1h) (applicable to MIG welding with solid wire electrode [131]) (PROC 25)** **- Class V welding (For Cu-, Mn-, Ni-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to Powder plasma arc welding [152]) (PROC 25)** **- Class VI welding (For Be- and V-alloys with duration of welding+ activity > 1h) (applicable to MIG welding with solid wire electrode [131], Powder plasma arc welding [152]) (PROC 25)** **- Class VI welding (Powdered plasma Arc) (PROC 25)** **- Class VII welding (For un-, high-alloyed steel, cored wire, not containing Ba with duration of welding+ activity > 1h) (applicable to Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For un-, high-alloyed steel, cored wire, containing Ba with duration of welding+ activity > 1h) (applicable to Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For painted/primed/oiled base materials with Pb in the primer with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521], Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152],Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For all base materials in unconfined spaces with duration of welding+ activity > 1h) (applicable to Cutting and gouging [8]) (PROC 25)** **- Class VII welding (For all base materials in unconfined spaces with duration of welding+ activity > 1h) (applicable to Thermal spraying) (PROC 25)** **- Class VII welding (For all base materials, except Cd-alloys in unconfined spaces with duration of welding+ activity > 1h) (applicable to Brazing and soldering [9]) (PROC 25)** **- Class VIII welding (For all base materials in confined space with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521], Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152], Self-shielded tubular cored arc welding [114]) (PROC 25)** **-Finishing of objects, components and parts subject to the welding+ processes (PROC 24)** **-Handling and packaging of objects, components and parts subject to the welding+ processes (PROC 21)** **Technical function of the substance:** alloying element use registered according to REACH Article 10; total tonnage manufactured/imported >=10tonnes/year per registrant Tonnage of substance for that use: <=0 tonnes/year *Related assessment: use assessed in an own CSR*
SL-2	**Service life of objects, components and parts subject to the welding+ processes in**

	Article service life
	industrial settings - Duration of activity <= 1h Further description of the use: Article used by: workers Substance intended to be released from article: no **Article category related to subsequent service life (AC):** AC 1: Vehicles; AC 2: Machinery, mechanical appliances, electrical/electronic articles; AC 7: Metal articles Contributing activity/technique for the environment: **- Service life of objects, components and parts subject to the welding+ processes in industrial settings - Duration of activity <= 1h (ERC 12a)** Contributing activity/technique for consumers: Contributing activity/technique for the workers: **- Handling of objects, components and parts subject to the welding+ processes (PROC 21)** **- Class I welding (For all base materials except aluminium in unconfined spaces with duration of welding+ activity <= 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521]) (PROC 25)** **- Class I welding (For all base materials except cadmium-containing alloy in unconfined spaces with duration of welding+ activity <= 1h) (applicable to Brazing and soldering [9]) (PROC 25)** **- Class I welding (For all base materials in closed systems with duration of welding+ activity <= 1h) (applicable to Laser welding [52], Laser cutting [84], Electron beam welding [51]) (PROC 25)** **- Class II welding (For aluminium as base materials in unconfined space with duration of welding+ activity <= 1h) (applicable to TIG welding with solid filler material [141]) (PROC 25)** **- Class III welding (For all base materials except Be-, Mn-, Ni-, V-alloys and stainless alloys with duration of welding+ activity <= 1h) (applicable to Manual metal arc welding [111]) (PROC 25)** **- Class III welding (For all base materials except Ni-alloys and stainless alloys with duration of welding+ activity <= 1h) (applicable to MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137]) (PROC 25)** **- Class III welding (For all base materials except Be-, Cu- and V-alloys with duration of welding+ activity <= 1h) (applicable to MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135]) (PROC 25)** **- Class III welding (For all base materials except Be-, Cu-, Mn-, Ni-, V-alloys and stainless alloys with duration of welding+ activity <= 1h) (applicable to Powder plasma arc welding [152]) (PROC 25)** **- Class IV welding (For painted/primed/oiled base materials without Pb in the primer with duration of welding+ activity <= 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521]) (PROC 25)** **- Class IV welding (For painted/primed/oiled base materials without Pb in the primer with duration of welding+ activity <= 1h) (applicable to Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152]) (PROC 25)** **- Class V welding (For Be-, Ni-, V-alloys and stainless alloys with duration of welding+ activity <= 1h) (applicable to Manual metal arc welding [111])** **- Class V welding (For Mn-, Ni-alloys and stainless alloys with duration of welding+**

	Article service life
	activity <= 1h) (applicable to MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137]) (PROC 25) **- Class V welding (For Cu-alloys with duration of welding+ activity <= 1h) (applicable to MIG welding with solid wire electrode [131]) (PROC 25)** **- Class V welding (For Cu-, Mn-, Ni-alloys and stainless alloys with duration of welding+ activity <= 1h) (applicable to Powder plasma arc welding [152]) (PROC 25)** **- Class VI welding (For Be- and V-alloys with duration of welding+ activity <= 1h) (applicable to MIG welding with solid wire electrode [131], Powder plasma arc welding [152]) (PROC 25)** **- Class VI welding (Powdered plasma Arc) (PROC 25)** **- Class VII welding (For un-, high-alloyed steel, cored wire, not containing Ba with duration of welding+ activity <= 1h) (applicable to Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For un-, high-alloyed steel, cored wire, containing Ba with duration of welding+ activity <= 1h) (applicable to Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For painted/primed/oiled base materials with Pb in the primer with duration of welding+ activity <= 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521], Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152],Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For all base materials in unconfined spaces with duration of welding+ activity <= 1h) (applicable to Cutting and gouging [8]) (PROC 25)** **- Class VII welding (For all base materials in unconfined spaces with duration of welding+ activity <= 1h) (applicable to Thermal spraying) (PROC 25)** **- Class VII welding (For all base materials, except Cd-alloys in unconfined spaces with duration of welding+ activity <= 1h) (applicable to Brazing and soldering [9]) (PROC 25)** **- Class VIII welding (For all base materials in confined space with duration of welding+ activity <= 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521], Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152], Self-shielded tubular cored arc welding [114]) (PROC 25)** **-Finishing of objects, components and parts subject to the welding+ processes (PROC 24)** **-Handling and packaging of objects, components and parts subject to the welding+ processes (PROC 21)** **Technical function of the substance:** alloying element use registered according to REACH Article 10; total tonnage manufactured/imported >=10tonnes/year per registrant Tonnage of substance for that use: <=0 tonnes/year *Related assessment: use assessed in an own CSR*

Service life of objects, components and parts subject to the welding+ processes in professional settings

	Article service life
SL-3	**Service life of objects, components and parts subject to the welding+ processes in professional settings - Duration of activity > 1h** Further description of the use: Article used by: workers Substance intended to be released from article: no **Article category related to subsequent service life (AC):** AC 1: Vehicles; AC 2: Machinery, mechanical appliances, electrical/electronic articles; AC 7: Metal articles Contributing activity/technique for the environment: **- Service life of objects, components and parts subject to the welding+ processes in professional settings - Duration of activity > 1h (ERC10a, ERC11a)** Contributing activity/technique for consumers: Contributing activity/technique for the workers: **- Handling of objects, components and parts subject to the welding+ processes (PROC 21)** **- Class I welding (For all base materials except aluminium in unconfined spaces with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521]) (PROC 25)** **- Class I welding (For all base materials except cadmium-containing alloy in unconfined spaces with duration of welding+ activity > 1h) (applicable to Brazing and soldering [9]) (PROC 25)** **- Class I welding (For all base materials in closed systems with duration of welding+ activity > 1h) (applicable to Laser welding [52], Laser cutting [84], Electron beam welding [51]) (PROC 25)** **- Class II welding (For aluminium as base materials in unconfined space with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141]) (PROC 25)** **- Class III welding (For all base materials except Be-, Mn-, Ni-, V-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to Manual metal arc welding [111]) (PROC 25)** **- Class III welding (For all base materials except Ni-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137]) (PROC 25)** **- Class III welding (For all base materials except Be-, Cu- and V-alloys with duration of welding+ activity > 1h) (applicable to MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135]) (PROC 25)** **- Class III welding (For all base materials except Be-, Cu-, Mn-, Ni-, V-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to Powder plasma arc welding [152]) (PROC 25)** **- Class IV welding (For painted/primed/oiled base materials without Pb in the primer with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521]) (PROC 25)** **- Class IV welding (For painted/primed/oiled base materials without Pb in the primer with duration of welding+ activity > 1h) (applicable to Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135],**

	Article service life
	Powder plasma arc welding [152]) (PROC 25) **- Class V welding (For Be-, Ni-, V-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to Manual metal arc welding [111])** **- Class V welding (For Mn-, Ni-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137]) (PROC 25)** **- Class V welding (For Cu-alloys with duration of welding+ activity > 1h) (applicable to MIG welding with solid wire electrode [131]) (PROC 25)** **- Class V welding (For Cu-, Mn-, Ni-alloys and stainless alloys with duration of welding+ activity > 1h) (applicable to Powder plasma arc welding [152]) (PROC 25)** **- Class VI welding (For Be- and V-alloys with duration of welding+ activity > 1h) (applicable to MIG welding with solid wire electrode [131], Powder plasma arc welding [152]) (PROC 25)** **- Class VI welding (Powdered plasma Arc) (PROC 25)** **- Class VII welding (For un-, high-alloyed steel, cored wire, not containing Ba with duration of welding+ activity > 1h) (applicable to Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For un-, high-alloyed steel, cored wire, containing Ba with duration of welding+ activity > 1h) (applicable to Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For painted/primed/oiled base materials with Pb in the primer with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521], Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152],Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For all base materials in unconfined spaces with duration of welding+ activity > 1h) (applicable to Cutting and gouging [8]) (PROC 25)** **- Class VII welding (For all base materials in unconfined spaces with duration of welding+ activity > 1h) (applicable to Thermal spraying) (PROC 25)** **- Class VII welding (For all base materials, except Cd-alloys in unconfined spaces with duration of welding+ activity > 1h) (applicable to Brazing and soldering [9]) (PROC 25)** **- Class VIII welding (For all base materials in confined space with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521], Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152], Self-shielded tubular cored arc welding [114]) (PROC 25)** **-Finishing of objects, components and parts subject to the welding+ processes (PROC 24)** **-Handling and packaging of objects, components and parts subject to the welding+ processes (PROC 21)** **Technical function of the substance:** alloying element use registered according to REACH Article 10; total tonnage manufactured/imported >=10tonnes/year per registrant Tonnage of substance for that use: <=0 tonnes/year *Related assessment: use assessed in an own CSR*
SL-4	**Service life of objects, components and parts subject to the welding+ processes in**

	Article service life
	professional settings - Duration of activity <= 1h Further description of the use: Article used by: workers Substance intended to be released from article: no **Article category related to subsequent service life (AC):** AC 1: Vehicles; AC 2: Machinery, mechanical appliances, electrical/electronic articles; AC 7: Metal articles Contributing activity/technique for the environment: **- Service life of objects, components and parts subject to the welding+ processes in professional settings - Duration of activity <= 1h (ERC10a, ERC11a)** Contributing activity/technique for consumers: Contributing activity/technique for the workers: **- Handling of objects, components and parts subject to the welding+ processes (PROC 21)** **- Class I welding (For all base materials except aluminium in unconfined spaces with duration of welding+ activity <= 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521]) (PROC 25)** **- Class I welding (For all base materials except cadmium-containing alloy in unconfined spaces with duration of welding+ activity <= 1h) (applicable to Brazing and soldering [9]) (PROC 25)** **- Class I welding (For all base materials in closed systems with duration of welding+ activity <= 1h) (applicable to Laser welding [52], Laser cutting [84], Electron beam welding [51]) (PROC 25)** **- Class II welding (For aluminium as base materials in unconfined space with duration of welding+ activity <= 1h) (applicable to TIG welding with solid filler material [141]) (PROC 25)** **- Class III welding (For all base materials except Be-, Mn-, Ni-, V-alloys and stainless alloys with duration of welding+ activity <= 1h) (applicable to Manual metal arc welding [111]) (PROC 25)** **- Class III welding (For all base materials except Ni-alloys and stainless alloys with duration of welding+ activity <= 1h) (applicable to MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137]) (PROC 25)** **- Class III welding (For all base materials except Be-, Cu- and V-alloys with duration of welding+ activity <= 1h) (applicable to MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135]) (PROC 25)** **- Class III welding (For all base materials except Be-, Cu-, Mn-, Ni-, V-alloys and stainless alloys with duration of welding+ activity <= 1h) (applicable to Powder plasma arc welding [152]) (PROC 25)** **- Class IV welding (For painted/primed/oiled base materials without Pb in the primer with duration of welding+ activity <= 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521]) (PROC 25)** **- Class IV welding (For painted/primed/oiled base materials without Pb in the primer with duration of welding+ activity <= 1h) (applicable to Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152]) (PROC 25)** **- Class V welding (For Be-, Ni-, V-alloys and stainless alloys with duration of welding+ activity <= 1h) (applicable to Manual metal arc welding [111])** **- Class V welding (For Mn-, Ni-alloys and stainless alloys with duration of welding+**

	Article service life
	activity <= 1h) (applicable to MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137]) (PROC 25) **- Class V welding (For Cu-alloys with duration of welding+ activity <= 1h) (applicable to MIG welding with solid wire electrode [131]) (PROC 25)** **- Class V welding (For Cu-, Mn-, Ni-alloys and stainless alloys with duration of welding+ activity <= 1h) (applicable to Powder plasma arc welding [152]) (PROC 25)** **- Class VI welding (For Be- and V-alloys with duration of welding+ activity <= 1h) (applicable to MIG welding with solid wire electrode [131], Powder plasma arc welding [152]) (PROC 25)** **- Class VI welding (Powdered plasma Arc) (PROC 25)** **- Class VII welding (For un-, high-alloyed steel, cored wire, not containing Ba with duration of welding+ activity <= 1h) (applicable to Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For un-, high-alloyed steel, cored wire, containing Ba with duration of welding+ activity <= 1h) (applicable to Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For painted/primed/oiled base materials with Pb in the primer with duration of welding+ activity <= 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521], Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152],Self-shielded tubular cored arc welding [114]) (PROC 25)** **- Class VII welding (For all base materials in unconfined spaces with duration of welding+ activity <= 1h) (applicable to Cutting and gouging [8]) (PROC 25)** **- Class VII welding (For all base materials in unconfined spaces with duration of welding+ activity <= 1h) (applicable to Thermal spraying) (PROC 25)** **- Class VII welding (For all base materials, except Cd-alloys in unconfined spaces with duration of welding+ activity <= 1h) (applicable to Brazing and soldering [9]) (PROC 25)** **- Class VIII welding (For all base materials in confined space with duration of welding+ activity <= 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521], Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152], Self-shielded tubular cored arc welding [114]) (PROC 25)** **-Finishing of objects, components and parts subject to the welding+ processes (PROC 24)** **-Handling and packaging of objects, components and parts subject to the welding+ processes (PROC 21)** **Technical function of the substance:** alloying element use registered according to REACH Article 10; total tonnage manufactured/imported >=10tonnes/year per registrant Tonnage of substance for that use: <=0 tonnes/year *Related assessment: use assessed in an own CSR*

9 Appendix 2: Catalogue of risk management measures

Class[1]	Process and number according to ISO 4063	Base materials	Remarks	Ventilation / Extraction / Filtration[14]	PPE[2] DC<15 %	PPE[2] DC>15 %
Unconfined space[15]						
I	GTAW *141*	All	Except Aluminium	GV low[3]	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	All	Except Cd- alloys	GV low[3]	n.r.	n.r.
II	GTAW *141*	Aluminium	n.a.	GV medium[4]	n.a.	FFP2[5]
III	MMAW *111*	All	Except Be-, V- , Mn-, Ni- alloys and Stainless[6]	GV low[7] LEV low[12]	Improved helmet[16]	FFP2[5]
	FCAW *136/137*	All	Except Stainless and Ni- alloys [6]			
	GMAW *131/135*	All	Except Cu-, Be-, V-alloys[6]			
	Powder Plasma Arc *152*	All	Except Be-, V-, Cu- , Mn-, Ni-alloys and Stainless [6]			
IV	All processes class I	Painted / primed / oiled	No Pb containing primer	GV low[3]	FFP2[5]	FFP3, TH2/P2, or LDH2[8]
	All processes class III	Painted / primed / oiled	No Pb containing primer	GV low [7] LEV low[12]		
V	MMAW *111*	Stainless, Ni-, Be-, and V-alloys	n.a.	LEV high[10]	TH3/P3, LDH3[11]	TH3/P3, LDH3[11]
	FCAW *136/137*	Stainless, Mn- and Ni-alloys				
	GMAW *131*	Cu-alloys				
	Powder Plasma Arc *152*	Stainless, Mn-, Ni-, and Cu-alloys				
VI	GMAW *131*	Be-, and V-alloys	n.a.	Reduced (negative) pressured area [9] LEV low[12]	TH3/P3, LDH3[11]	TH3/P3, LDH3[11]
	Powder Plasma Arc *152*					
VII	Self-shielded FCAW *114*	Un-, high alloyed steel	Cored wire, not containing Ba	Reduced (negative) pressured area [9] LEV medium[13]	TH3/P3, LDH3[11]	TH3/P3, LDH3[11]
	Self-shielded FCAW *114*	Un-, high alloyed steel	Cored wire, containing Ba	Reduced (negative) pressured area [9] LEV high[10]		
	All	Painted / primed	Paint / Primer containing Pb			
	Arc Gouging and Cutting *8*	All	n.a.			
	Thermal Spray	All	n.a.			
	Gases Brazing 9	Cd- alloys	n.a.			
Closed system or Confined space[15]						
I	Laser Welding *52*	All	Closed system	GV medium[4]	n.a.	n.a.
	Laser Cutting 84					
	Electron Beam *51*					
VIII	All	All	Confined space	LEV high[10] External air supply	LDH3[11]	LDH3[11]

[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] Personal Protective Equipment (PPE) required avoiding exceeding the National Exposure Limit Value (DC: Duty cycle expressed on 8 hours).
[3] 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.
[4] General Ventilation (GV) Medium (double compared to Low)
[5] Filtrating half mask (FFP2) with a minimum APF of 10
[6] When an alloyed consumable is used, measures from "Class V" are required.
[7] General Ventilation (GV) Low. When no Local Exhaust Ventilation, the ventilation requirement is 5-fold.
[8] Filtering half mask (FFP3) with a minimum APF of 30, helmet with powered filters (TH2/P2) with a minimum APF of 20/10, or helmet with external air supply (LDH2) with a minimum APF of 100
[9] Reduced (negative) pressured area: A separate, ventilated area where reduced (negative) pressure, compared to the surrounded area, is maintained.
[10] Local Exhaust Ventilation (LEV) High, extraction at source (includes table, hood, arm or torch extraction)
[11] Helmet with powered filters (TH3/P3) with a minimum APF of 100, or helmet with external air supply (LDH3) with a minimum APF of 1000
[12] Local Exhaust Ventilation (LEV) Low, extraction at source (includes table, hood, arm or torch extraction)
[13] Local Exhaust Ventilation (LEV) Medium, extraction at source (includes table, hood, arm or torch extraction)
[14] 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.
[15] A confined space, despite its name, is not necessarily small. Examples of confined spaces include ship, silos, vats, utility vaults, tanks, etc.
[16] Improved helmet designed to avoid direct flow of welding fumes inside
n.a. Not applicable
n.r. Not recommended

The assigned protection factors (APF) for respiratory protective equipment (RPE) given above have been selected according to EN 529:2005.

10 Appendix 3: Example exposure scenario

The example exposure scenario (ES) has been adopted from the Nickel CSR with kind permission by the Nickel Institute. Please note that the numbering of headings is retained from the original CSR numbering.

9.X Exposure scenario 1: Service life (professional worker) - EXAMPLE - Service life of nickel alloys and nickel-coated objects (machining and handling) in professional settings

Article categories:
AC 2: Machinery, mechanical appliances, electrical/electronic articles
AC 7: Metal articles
AC 13: Plastic articles

Worker contributing scenario(s):		
CS 1	Low energy handling of massive objects	PROC 21
CS 2	Class III welding (For all base materials except Be-, Cu- and V-alloys with duration of welding+ activity > 1h) (applicable to MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135])	PROC 25
CS 3	Class V welding (For Cu-alloys with duration of welding+ activity > 1h) (applicable to MIG welding with solid wire electrode [131])	PROC 25
CS 4	Class VIII welding (For all base materials in confined space with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521], Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152], Self-shielded tubular cored arc welding [114])	PROC 25
CS 5	Abrasive processes	PROC 24
CS 6	Handling and packaging of objects, components and parts subject to the welding+ processes	PROC 21

Explanation on the approach taken for the ES:

This occupational exposure assessment for PROC25 (welding⁺ processes) is based on published data by Kendzia et al. (2017). The original contributing scenarios (CS) have been adapted by using welding⁺ use map. Information for PROCs 21, 24 has been exclusively taken from the Nickel CSR.

9.X.1. Worker CS 1: Low energy handling of massive objects (PROC 21)

Task(s) covered in this contributing scenario: Handling of metal objects, manual cutting.

9.X.1.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Solid object	Analogous data
• Maximum emission potential: Very low Only the highest emission potential (EP) in this activity is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel or if the actual process temperature or the level of abrasion is lower) are thus automatically covered in this assessment.	Analogous data
• Percentage (w/w) of substance in mixture/article: <= 100 %	Analogous data

	Method
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: <= 8 h/day	Analogous data
Technical and organisational conditions and measures	
• Occupational Health and Safety Management System: Basic	Analogous data
• Room ventilation: Basic (up to 3 ACH)	
• Local exhaust ventilation: No	Analogous data
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protection: No	Analogous data
• Face/eye protection: No	
Other conditions affecting workers exposure	
• Operating temperature: <= 40 °C	Analogous data
• Place of use: Indoor	Analogous data

9.X.1.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

Table 9.2. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	0.015 mg/m³ (Measured data: Analogous data)	RCR = 0.3
Inhalation, local, long term	0.015 mg/m³ (Measured data: Analogous data)	RCR = 0.3
Inhalation, local, acute	0.06 mg/m³ (Measured data: Analogous data)	RCR < 0.01

Remarks on measured exposure:

Analogous data:
Identity of the substance used: Nickel
Inhalation exposure, long term concentration: Number of measured data points: 64
Explanation: Inhalation, long term:
The estimated exposure level represents the maximum likelihood estimate of the upper 90 % confidence limit for the 75th percentile of the exposure distribution for SEG (GM= mg Ni/m³, GSD=).
Inhalation, acute:
4 x the long term estimate (according to Kumagai & Matsunaga, 1994).

9.X.2. Worker CS 2: Class III welding (For all base materials except Be-, Cu- and V-alloys with duration of welding+ activity > 1h) (applicable to MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135]) (PROC 25)

Task(s) covered in this contributing scenario: Hot work operations.

9.X.2.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Solid object	Published data
• Maximum emission potential: High (temperature based) Only the highest emission potential (EP) in this activity is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel or if the actual process temperature or the level of abrasion is lower) are thus automatically covered in this assessment.	Published data

	Method
• Percentage (w/w) of substance in mixture/article: <= 100 %	Published data
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: <= 8 h/day	Published data
Technical and organisational conditions and measures	
• Occupational Health and Safety Management System: Basic	Published data
• Room ventilation: Basic (up to 3 ACH)	
• Local exhaust ventilation: Yes, specifically designed LEV such as receiving hoods (assumed effectiveness >= 80-90%) Generic local exhaust ventilation with standard efficiency Integrated local exhaust ventilation with standard efficiency	Published data
• Process temperature: Above melting point of the substance	Published data
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protection: Yes (APF >= 10) FFP2 (APF 10)	Published data
• Dermal protection: Yes (effectiveness >= 80%) Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 are prescribed on a precautionary basis at all workplaces unless dermal exposure to the substance can be excluded or mechanical or temperature risks require the use of gloves according to EN 388 or EN 407, respectively. Additionally, face protection is required to be worn as appropriate.	
• Face/eye protection: Face protection/visor	
• Chemical protective clothing: Standard safety clothing	
Other conditions affecting workers exposure	
• Place of use: Indoor	Published data

9.X.2.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

Table 9.3. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	0.041 mg/m³ (Measured data: Published data)	RCR = 0.81
Inhalation, local, long term	0.041 mg/m³ (Measured data: Published data)	RCR = 0.81
Inhalation, local, acute	0.121 mg/m³ (Measured data: Published data)	RCR = 0.01

Remarks on measured exposure:

Published data:
Identity of the substance used: Nickel
Inhalation exposure, long term concentration: Number of measured data points: 3.055
Explanation: Inhalation, long term:
The estimated exposure level represents the 75th percentile of the exposure distribution for gas metal arc welding (n=56).
Inhalation, acute:
3 x the long term estimate (according to Kumagai & Matsunaga, 1994).

9.X.3. Worker CS 3: Class V welding (For Cu-alloys with duration of welding+ activity > 1h) (applicable to MIG welding with solid wire electrode [131]) (PROC 25)

Task(s) covered in this contributing scenario: Hot work operations.

9.X.3.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Solid object	Published data
• Maximum emission potential: High (temperature based) Only the highest emission potential (EP) in this activity is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel or if the actual process temperature or the level of abrasion is lower) are thus automatically covered in this assessment.	Published data
• Percentage (w/w) of substance in mixture/article: <= 100 %	Published data
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: <= 8 h/day	Published data
Technical and organisational conditions and measures	
• Occupational Health and Safety Management System: Basic	Published data
• Room ventilation: Good (3 to 5 ACH)	
• Local exhaust ventilation: Yes, specifically designed fixed capturing hood, on tool extraction or enclosing hoods (assumed effectiveness >= 90-95%) Integrated local exhaust ventilation with high efficiency	Published data
• Process temperature: Above melting point of the substance	Published data
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protection: Yes (APF >= 40) TH3/P3 (APF 100); LDH3 (APF 1000)	Published data
• Dermal protection: Yes (effectiveness >= 80%) Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 are prescribed on a precautionary basis at all workplaces unless dermal exposure to the substance can be excluded or mechanical or temperature risks require the use of gloves according to EN 388 or EN 407, respectively. Additionally, face protection is required to be worn as appropriate.	
• Face/eye protection: Face protection/visor	
• Chemical protective clothing: Standard safety clothing	
Other conditions affecting workers exposure	
• Place of use: Indoor	Published data

9.X.3.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

Table 9.4. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	0.01 mg/m³ (Measured data: Published data)	RCR = 0.202
Inhalation, local, long term	0.01 mg/m³ (Measured data: Published data)	RCR = 0.202
Inhalation, local, acute	0.03 mg/m³ (Measured data: Published data)	RCR < 0.01

Remarks on measured exposure:

Published data:
Identity of the substance used: Nickel
Inhalation exposure, long term concentration: Number of measured data points: 3.055
Explanation: Inhalation, long term:
The estimated exposure level represents the 75th percentile of the exposure distribution for gas metal arc welding (n=56).
Inhalation, acute:
3 x the long term estimate (according to Kumagai & Matsunaga, 1994).

9.X.4. Worker CS 4: Class VIII welding (For all base materials in confined space with duration of welding+ activity > 1h) (applicable to TIG welding with solid filler material [141], Submerged arc welding [12], Gas welding [3], Plasma arc welding [15], Electroslag welding/Electrogas welding [72/73], Resistance welding [2], Arc stud welding [78], Solid state laser welding [521], Manual metal arc welding [111], MAG welding with flux cored electrode/MAG welding with metal cored electrode [136/137], MIG welding with solid wire electrode/MAG welding with solid wire electrode [131/135], Powder plasma arc welding [152], Self-shielded tubular cored arc welding [114]) (PROC 25)

Task(s) covered in this contributing scenario: Hot work operations.

9.X.4.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Solid object	Published data
• Maximum emission potential: High (temperature based) Only the highest emission potential (EP) in this activity is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel or if the actual process temperature or the level of abrasion is lower) are thus automatically covered in this assessment.	Published data
• Percentage (w/w) of substance in mixture/article: <= 100 %	Published data
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: <= 8 h/day	Published data
Technical and organisational conditions and measures	
• Occupational Health and Safety Management System: Basic	Published data
• Local exhaust ventilation: Yes, specifically designed fixed capturing hood, on tool extraction or enclosing hoods (assumed effectiveness >= 90-95%) Integrated local exhaust ventilation with high efficiency External air supply	Published data
• Process temperature: Above melting point of the substance	Published data
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protection: Yes (APF >= 200) LDH3 (APF 1000)	Published data
• Dermal protection: Yes (effectiveness >= 80%) Due to the potential adverse effects of the substance to skin, protective gloves according to EN 374 are prescribed on a precautionary basis at all workplaces unless dermal exposure to the substance can be excluded or mechanical or temperature risks require the use of gloves according to EN 388 or EN 407, respectively. Additionally, face protection is required to be worn as appropriate.	
• Face/eye protection: Face protection/visor	
• Chemical protective clothing: Standard safety clothing	
Other conditions affecting workers exposure	
• Place of use: Confined space Use takes place in a confined space. Care should be given to the following potential dangers: lack or excess of oxygen, inadequate dilution ventilation, presence of potentially harmful levels of pollutants, risk of engulfment, difficult entry and exit of work areas, etc. The relevant occupational health and safety regulations for work in confined spaces must be respected.	Published data

9.X.4.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

Table 9.5. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	2.025 µg/m³ (Measured data: Published data)	RCR = 0.04
Inhalation, local, long term	2.025 µg/m³ (Measured data: Published data)	RCR = 0.04
Inhalation, local, acute	6.075 µg/m³ (Measured data: Published data)	RCR < 0.01

Remarks on measured exposure:

Published data:
Identity of the substance used: Nickel
Inhalation exposure, long term concentration: Number of measured data points: 3.055
Explanation: Inhalation, long term:
The estimated exposure level represents the 75th percentile of the exposure distribution for gas metal arc welding (n=56).
Inhalation, acute:
3 x the long term estimate (according to Kumagai & Matsunaga, 1994).

9.X.5. Worker CS 5: Abrasive processes (PROC 24)

Task(s) covered in this contributing scenario: High energy handling of massive objects.

9.X.5.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Solid object	Analogous data
• Maximum emission potential: High (abrasion based) Only the highest emission potential (EP) in this activity is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel or if the actual process temperature or the level of abrasion is lower) are thus automatically covered in this assessment.	Analogous data
• Percentage (w/w) of substance in mixture/article: <= 100 %	Analogous data
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: <= 8 h/day	Analogous data
Technical and organisational conditions and measures	
• Occupational Health and Safety Management System: Basic	Analogous data
• Room ventilation: Basic (up to 3 ACH)	
• Local exhaust ventilation: Yes, specifically designed fixed capturing hood, on tool extraction or enclosing hoods (assumed effectiveness >= 90-95%) Integrated local exhaust ventilation with high efficiency	Analogous data
• Level of containment: Closed process	Analogous data
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protection: No	Analogous data
• Dermal protection: No	
• Face/eye protection: No	
Other conditions affecting workers exposure	
• Operating temperature: <= 40 °C	Analogous data
• Place of use: Indoor	Analogous data

9.X.5.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

Table 9.6. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	5E-3 mg/m³ (Measured data: Analogous data)	RCR = 0.1
Inhalation, local, long term	5E-3 mg/m³ (Measured data: Analogous data)	RCR = 0.1
Inhalation, local, acute	0.014 mg/m³ (Measured data: Analogous data)	RCR < 0.01

Remarks on measured exposure:

Analogous data:
Identity of the substance used: Nickel
Inhalation exposure, long term concentration: Number of measured data points: 19
Explanation: Inhalation, long term:
The estimated exposure level represents the maximum likelihood estimate of the upper 90 % confidence limit for the 75th percentile of the exposure distribution for SEG (GM= mg Ni/m³, GSD=).
Inhalation, acute:
3 x the long term estimate (according to Kumagai & Matsunaga, 1994).

9.X.6. Worker CS 6: Handling and packaging of objects, components and parts subject to the welding+ processes (PROC 21)

Task(s) covered in this contributing scenario: Handling of metal objects, shipping and packaging.

9.X.6.1. Conditions of use

	Method
Product (article) characteristics	
• Physical form of the used product: Solid object	Analogous data
• Percentage (w/w) of substance in mixture/article: <= 100 %	Analogous data
• Maximum emission potential: Very low Only the highest emission potential (EP) in this activity is reported. Lower EPs (e.g. if materials of lower dustiness are being handled in parallel or if the actual process temperature or the level of abrasion is lower) are thus automatically covered in this assessment.	Analogous data
Amount used (or contained in articles), frequency and duration of use/exposure	
• Duration of activity: <= 8 h/day	Analogous data
Technical and organisational conditions and measures	
• Occupational Health and Safety Management System: Basic	Analogous data
• Room ventilation: Good (3 to 5 ACH)	
• Local exhaust ventilation: No	Analogous data
• Process temperature: Ambient	Analogous data
Conditions and measures related to personal protection, hygiene and health evaluation	
• Respiratory protection: No	Analogous data
• Dermal protection: No	
• Face/eye protection: No	
• Chemical protective clothing: Standard safety clothing	
Other conditions affecting workers exposure	
• Place of use: Indoor	Analogous data

9.X.6.2. Exposure and risks for workers

The exposure concentrations and risk characterisation ratios (RCR) are reported in the following table.

Table 9.7. Exposure concentrations and risks for workers

Route of exposure and type of effects	Exposure concentration	Risk quantification
Inhalation, systemic, long term	0.015 mg/m³ (Measured data: Analogous data)	RCR = 0.3
Inhalation, local, long term	0.015 mg/m³ (Measured data: Analogous data)	RCR = 0.3
Inhalation, local, acute	0.06 mg/m³ (Measured data: Analogous data)	RCR < 0.01

Remarks on measured exposure:

Analogous data:
Identity of the substance used: Nickel
Inhalation exposure, long term concentration: Number of measured data points: 64
Explanation: Inhalation, long term:
The estimated exposure level represents the maximum likelihood estimate of the upper 90 % confidence limit for the 75th percentile of the exposure distribution for SEG (GM= mg Ni/m³, GSD=).
Inhalation, acute:
4 x the long term estimate (according to Kumagai & Matsunaga, 1994).