

Welding



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WorldSkills Occupational Standards (WSOS)

Occupation description and WSOS

The name of the occupation is

Welding

Description of the associated work role(s) or occupation(s)

Welding is a critical process that is controlled by both national and international standards and specifications to regulate the quality of the deposited weld metal and the skill of the welder.

A welder prepares and joins a range of metals and metallic alloys using mainly processes where an electric arc is the heat source. Electric arc processes utilize a gas shield or a flux to protect the molten weld area from contamination by the surrounding atmosphere. A welder needs to be able to interpret engineering drawings, standards and symbols and correctly translate these requirements into accurate structures and fabrications.

Welders need to have a thorough knowledge and understanding of safe working practices, personal protection equipment and the hazards and practices associated with the welding and fabrication industries. They need to gain specific knowledge of a wide range of welding equipment and processes as well as an understanding of how welding will affect the structure of the material being welded. They need to be familiar with electricity and how it is utilized for welding.

A welder prepares, assembles and joins a wide range of metals and metal alloys using various welding processes including manual metal arc welding, shielded metal arc welding, metal arc gas shielded welding, gas metal arc welding, tungsten arc gas shielded welding, gas tungsten arc welding, and flux cored arc welding. A welder will use mainly processes where the heat utilized for welding will be an electric arc to join a range of materials including the commonly joined and fabricated materials – carbon steel, stainless steels, aluminium and copper and their associated alloys. They must be able to select the correct equipment, process variables, and welding technique, depending upon the material being joined.

Welders may use thermal cutting processes and should be able to identify the correct preparation for joining as applied to the type, thickness and intended use of the joint. They use grinding and cutting equipment to prepare welded joints. Modern methods of joining, as well as those noted above, include mechanized processes such as submerged arc, plasma arc, stud welding, and laser welding.

Welders join sections, pipe and plate and fabricate large and small pressure vessels. A welder can work in a unit or factory which produces fabrications and/or structures for industries as diverse as civil engineering, mechanical engineering, transport, marine engineering, construction, service, and leisure industries. Welders also work on site preparation, construction, and the repair and maintenance of structures. A welder can work in many locations and situations, ranging from a bench in a factory, to shipyards, power stations and off-shore structures. Welders also work in engineering, construction, power generating, and petro-chemical plants. The working environment may include hazards such as being off-shore, with extreme weather conditions and also in confined spaces where access to the joint to be welded is restricted.

The modern welder may specialize in one or a number of welding processes and environments. They may also be asked to work on exotic alloys such as duplex and super duplex stainless steels and cupronickels. Welders are required to carry out the finest work where faults and failure may have the most serious consequences in terms of cost, safety, and environmental damage.

General notes on the WSOS

The WSOS specifies the knowledge, understanding, and specific skills that underpin international best practice in technical and vocational performance. It should reflect a shared global understanding of what the associated work role(s) or occupation(s) represent for industry and business (www.worldskills.org/WSOS).

The skill competition is intended to reflect international best practice as described by the WSOS, and to the extent that it is able to. The Standard is therefore a guide to the required training and preparation for the skill competition.

In the skill competition the assessment of knowledge and understanding will take place through the assessment of performance. There will only be separate tests of knowledge and understanding where there is an overwhelming reason for these.

The Standard is divided into distinct sections with headings and reference numbers added.

Each section is assigned a percentage of the total marks to indicate its relative importance within the Standards. This is often referred to as the “weighting”. The sum of all the percentage marks is 100. The weightings determine the distribution of marks within the Marking Scheme.

Through the Test Project, the Marking Scheme will assess only those skills that are set out in the Standards Specification. They will reflect the Standards as comprehensively as possible within the constraints of the skill competition.

The Marking Scheme will follow the allocation of marks within the Standards to the extent practically possible. A variation of up to five percent is allowed, provided that this does not distort the weightings assigned by the Standards.

WorldSkills Occupational Standards

Section	Relative importance (%)
1 Work organization and management	10

The individual needs to know and understand:

- The standards and legislation relating to the health, safety, security, and hygiene in the welding industry
- The range, use and maintenance of personal protective equipment used in the industry for any given circumstances
- The selection and use of safety equipment related to specific or hazardous tasks
- ISO A and/or E (American and European) drawing representation
- Technical terms and symbols used in drawings and plans
- Terminology and safety data supplied by manufacturers
- The requirements and effects of welding production for the environment and sustainability issues
- Basic mathematical manipulation and unit conversion
- Geometrical principles, techniques, and calculations

The individual shall be able to:

- Work safely with regard to themselves and others.
- Select, wear, and maintain PPE as required
- Recognize hazardous situations and take appropriate actions with regard to their own and others safety
- Follow correct procedural processes when working in hazardous environments
- Locate and identify dimensions and weld symbols
- Adhere to manufacturers' safety data sheets
- Maintain a clean working environment
- Complete work within agreed timescales
- Make essential connections for specific welding procedures.

Section	Relative importance (%)
2 Preparation and assembly techniques	10

The individual needs to know and understand:

- The interpretation of fabrication or engineering drawings and weld symbols
- The classification and specific uses of welding consumables including:
 - Coding and designation of welding rods
 - Diameters and specific use of welding wire
 - Choice and preparation of welding electrodes
- How surface contamination can influence the finished weld characteristics
- The correct machine settings to be aligned to:
 - Welding polarity
 - Welding position
 - Material
 - Material thickness
 - Filler material and feed speed
- Any fine adjustments needed to machine hardware, TIG electrode shape, wire type and diameter etc.
- The methods of edge preparation to align with joint profile, strength, and material
- Methods of distortion control in steels, alloys, and aluminium

The individual shall be able to:

- Set up welding equipment to manufacturers' specifications including (but not limited to)
 - Welding polarity
 - Welding amperage
 - Welding voltage
 - Wire feed speed
 - Travel speed
 - Travel/electrode angles
 - Mode of metal transfer
- Prepare material edges in line with specifications and drawing requirements
- Set up and operate appropriate controls to minimize and correct distortion
- Carry out appropriate procedures to control heat input

Section	Relative importance (%)
3 Welding materials	10

The individual needs to know and understand:

- The mechanical and physical properties of:
 - carbon steels
 - aluminium and its alloys
 - stainless steels;
- Correct the alignment of process with the material being used
- The selection of welding consumables
- The correct storage and handling of welding consumables
- Terminology, characteristics, and safe use of welding and purging gases
- The effects of welding on the structure of the material

The individual shall be able to:

- Use materials with consideration to their mechanical and physical properties
- Store welding consumables correctly with reference to type, use and safety considerations
- Select and prepare materials with reference to drawing material list
- Select methods used in shielding the weld area from contamination
- Select gasses used for shielding and purging

4 SMAW (111) and GMAW (135) Process	25
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The individual needs to know and understand:

- Drawing weld symbol interpretation
- Weld positions, weld angles and travel speeds
- The techniques for efficient stops/starts
- The techniques utilised to deposit single sided root penetration welds
- The techniques utilised to deposit defect free butt and fillet welds

The individual shall be able to:

- Make welded joints in relation to international specifications
- Interpret welding terminology to complete task to specification
- Perform welding of carbon steel material in all positions (except vertical down) on pipe and plates deposit single sided full penetration root pass welds
- Deposit full penetration butt and fillet welds on pipe and plate
- Perform stop/starts

Section	Relative importance (%)
5 FCAW-G (136) Process	10

The individual needs to know and understand:

- Drawing weld symbol interpretation
- Weld positions, weld angles and travel speeds
- The techniques for efficient stop/starts
- The techniques utilised to deposit defect free butt and fillet welds

The individual shall be able to:

- Make welded joints in relation to international specifications
- Interpret welding terminology to complete task to specification
- Perform welding on carbon steel material in all positions (except vertical down) on pipe and plate
- Perform stop/starts
- Deposit full penetration butt and fillet welds on pipe and plate

6 GTAW (141) Process	15
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The individual needs to know and understand:

- Drawing weld symbol interpretation
- Weld positions, weld angles and travel speeds
- The techniques for efficient stops/starts
- The techniques utilised to deposit defect free butt and fillet welds

The individual shall be able to:

- Make welded joints in relation to international specifications
- Interpret welding terminology to complete task to specification
- Perform welding on carbon steel, aluminium sheet and stainless-steel sheet material in all positions (except vertical down) on pipe and plate
- Perform stop/starts
- Deposit full penetration butt and fillet welds on pipe and plate
- Deposit utilising a single pass on stainless steel and aluminium sheet, root and capping pass combination

Section	Relative importance (%)
7 Finishing, quality assurance, and testing	20
<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> • The international specifications for the control of weld quality • Specific terminology used in the welding industry • Imperfections/defects that may occur during welding • The importance of weld metal cleanliness in weld quality • A range of destructive and non-destructive testing • Welder certification test coupons in accordance with international standards 	
<p>The individual shall be able to:</p> <ul style="list-style-type: none"> • Produce welds to meet drawing and legislative specifications • Recognize weld defects and take appropriate action to rectify them • Utilize correct techniques to ensure weld metal cleanliness is maintained • Dress welds using wire brushes, scrapers, chisels, etc. • Check completed work against drawing requirements to reflect accuracy, square and flatness where necessary • Carry out basic non-destructive testing and be familiar with more advanced testing methods • Complete pressure vessels capable of withstanding hydrostatic pressure testing. 	
Total	100

References for industry consultation

WorldSkills is committed to ensuring that the WorldSkills Occupational Standards fully reflect the dynamism of internationally recognized best practice in industry and business. To do this WorldSkills approaches a number of organizations across the world that can offer feedback on the draft Description of the Associated Role and WorldSkills Occupational Standards on a two-yearly cycle.

In parallel to this, WSI consults three international occupational classifications and databases:

- ISCO-08: (<http://www.ilo.org/public/english/bureau/stat/isco/isco08/>)
- ESCO: (<https://ec.europa.eu/esco/portal/home>)
- O*NET OnLine (www.onetonline.org/)

The WSOS appears to relate most closely to *Welders, Cutters, and Welder Fitters*:
<https://www.onetonline.org/link/summary/51-4121.06>

and/or *Welder*:

<http://data.europa.eu/esco/occupation/7aedaa07-3884-4c5b-88f9-80997b2aa54b>

These links can also be used to explore adjacent occupations.

The following table indicates which organizations were approached and provided valuable feedback for the Description of the Associated Role and WorldSkills Occupational Standards in place for WorldSkills Shanghai 2022.

Organization	Contact name
American Welding Society	Martica Ventura, Senior Manager, Competitions and Events
China Engineering Construction Welding Association	Liu Jingfeng, Executive Vice President
Vermeer Corporation (Global)	David Landon, Welding Engineering Manager