



# Construction Metalwork/Metal Fabricator Competition Handbook

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We thank all of the amazing sponsors that make this competition possible:



Association of Welding and Fabrication Training and Education

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## Overview

Metal Fabrication (Construction Metalwork/Metal Fabricator) is a significant sector within the engineering industry with a broad purpose of carrying out metal fabrication work using items such as rolled steel joists, columns, channels, tubes, hollow sections, steel plate and metal sheet etc.

Metal fabricators utilise a wide range of skills, standards, and ideas. This guide will provide you with a clear path to follow, from initial registration to the National finals and beyond.

In 2022 some changes have been made to the Construction Metalwork Competition it will now be known as Construction Metal/Metal Fabricator Competition, all the tasks are now been mapped across, to link with all the Awarding Bodies in the UK, L3 Welding Fabrication course curriculums, they also match the Knowledge, Skills and Behaviour requirements in the L3 Metal Fabricator Apprenticeship Standard (STO607).

As part of the changes this year there are also drawings available for learning tasks that match the skills required in the competition, these can be used as part of the college/training providers curriculums.

## **Associated job roles and career work role(s) and occupation(s)**

Work includes manufacturing, steel structures, vessels, components that encompass the food & dairy, pharmaceutical & chemical industries, and the automotive sector. Together with light metal fabrication, architectural metalwork, equipment supports and anything that can be fabricated out of metal.

Very high standards of finish and quality are expected from the metalworker as food and pharmaceutical products are transported and produced from steel components that a construction metalworker would assemble. High-rise buildings, stadiums and bridges are erected using the skills of the construction metalworker along with cutting edge architectural designs that affect the modern landscape for innovative building designs.

Fabricators can work alone or in teams, in factories or on operational sites. Fabricators use a large range of metals including steel, aluminium and titanium at a range of thicknesses from 0.5mm up to over 20mm. The size and weight of the fabrications can range from components that can easily be picked up by hand, to massive structures that require several cranes to manipulate.

In their daily work, an employee in this occupation interacts with planners, supervisors, inspectors, designers, welders, pipefitters, fitters, machinists, riggers, steel erectors, stores personnel, painters and many others involved in manufacturing, production, maintenance and repair.

An employee in this occupation will be responsible for the quality and accuracy of their own work whilst ensuring it conforms to a relevant specification such as an engineering drawing or an international standard. Fabricators are also responsible for the health, safety and environmental (HS&E) protection of themselves and others around them.



## Careers Advice

The most popular route to a career in metal fabrication is via an apprenticeship. This can be with a local engineering company or a large multi-national business that recruit nationwide. The first steps would be to visit the government web site link below to find out about apprenticeships and subsequent links to the National Careers Service

<https://www.gov.uk/become-apprentice>

<https://nationalcareers.service.gov.uk/>

<https://apprenticeships.gov.uk>

Also, use your local further education college or training centre for advice and guidance. They have many local contacts for apprenticeship employment.

## Resources

For information and resources, including how to register, competition rules, and the steps to competing, visit:

<https://worldskillsuk.org/champions/national-skills-competitions/tools-and-resources>

## Pre-Competition Activity and Learning Resources

To supplement your knowledge and prepare you for taking part in competitions, visit:

Safe Use of Angle Grinder; [www.youtube.com/watch?v=JKQMu12XS\\_Q](http://www.youtube.com/watch?v=JKQMu12XS_Q)

Safe Use of Oxy Fuel Equipment; <https://www.youtube.com/watch?v=9SeZLXWt6Wk>

Plasma Cutting tips; [https://www.youtube.com/watch?v=qd1L\\_9nljdg](https://www.youtube.com/watch?v=qd1L_9nljdg)

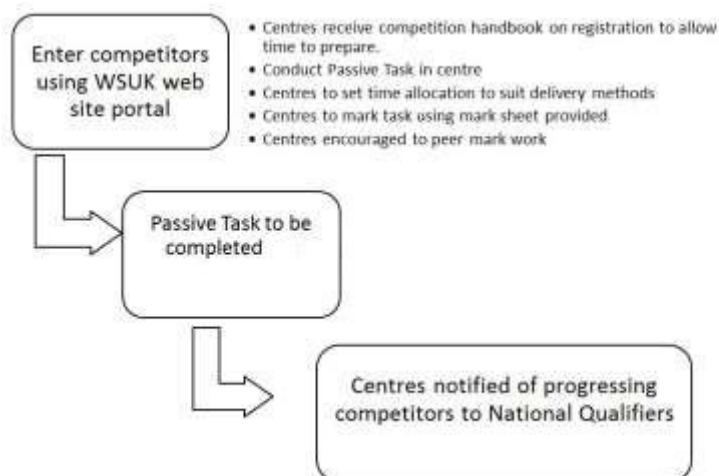
Marking Lines on Steel; <https://www.youtube.com/watch?v=03THgpS-YAo>

Welding Information; <https://www.lincolnelectric.com/en-gb/Pages/default.aspx>

## Competition Cycle

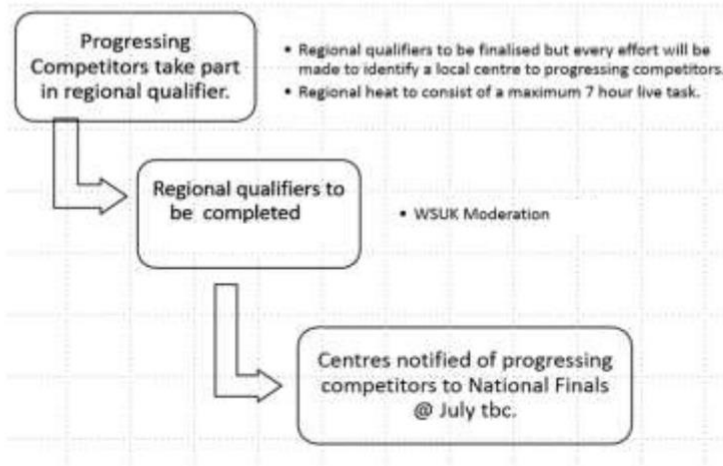
The competition takes the form of a pre-competition activity, passive task, national qualifier and national final. Please refer to the competition cycle flow chart.

### Stage 1 Passive Task





## Stage 2 Qualifiers



## Stage3 National Final LIVE



## Core Competences and Project Specifications

The core competences of this competition are:

- work organization and management.
- marking out techniques.
- material cutting techniques.
- material forming techniques.
- assembly and finishing techniques.
- welding and joining techniques.

Projects are designed to test competitor's technical ability to and competitors taking part should be able to:

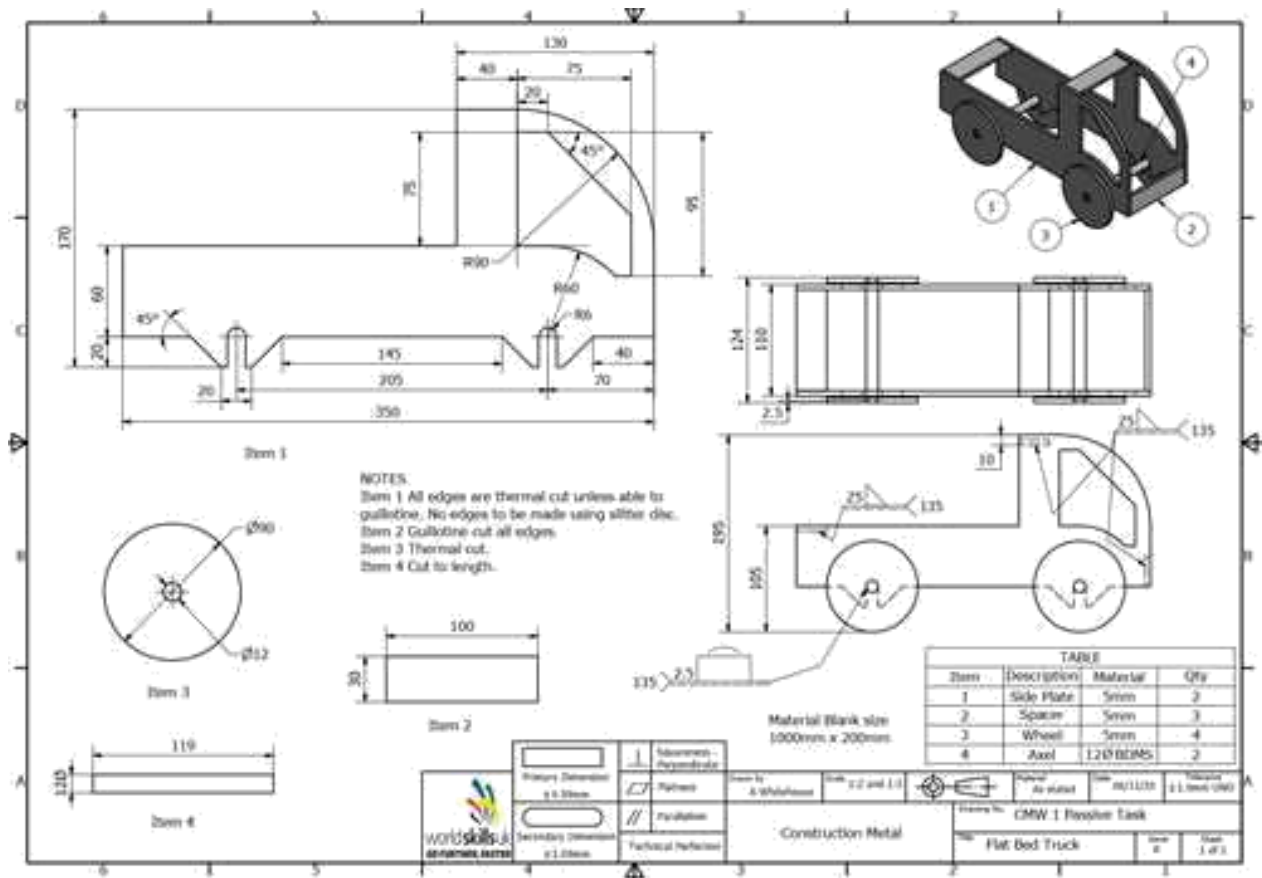
- read and interpret i.e., engineering drawings (1st / 3rd angle), welding requirements and weld symbols and geometric tolerances
- plan tasks and organise work including material nesting and time management
- apply workshop calculations including areas, volumes, Pythagoras theorem and trigonometry
- measure and marking materials to drawing specifications and requirements
- make drawing set outs for work using datum points and templates using plate fabrication techniques to include; parallel line, radial line and triangulation
- cut materials to size using; guillotines, saws, drill, cutting / grinding, etc
- use thermal cutting equipment to cut various thickness, profiles and shapes
- form materials to shape using mechanical and powered equipment (presses, rolls, folding machines, etc.)
- hot form bar, plate and sectional materials
- assemble parts to dimensional accuracy with correct alignment and orientation.
- weld joints to specifications and quality requirements using gmaw
- present work that is clean, free tool marking and functions as per drawing specifications

Typical weighting of proportion of marks allocated to each stage of the competition.

Competence	Passive	Qualifier	UK Final
Work Organisation and Management	10%	10%	10%
Marking Out Techniques	15%	10%	10%
Material Cutting Techniques	25%	20%	20%
Material Forming Techniques	10%	15%	15%
Assembly and Finishing Techniques	25%	30%	30%
Welding and Joining Techniques	15%	15%	15%

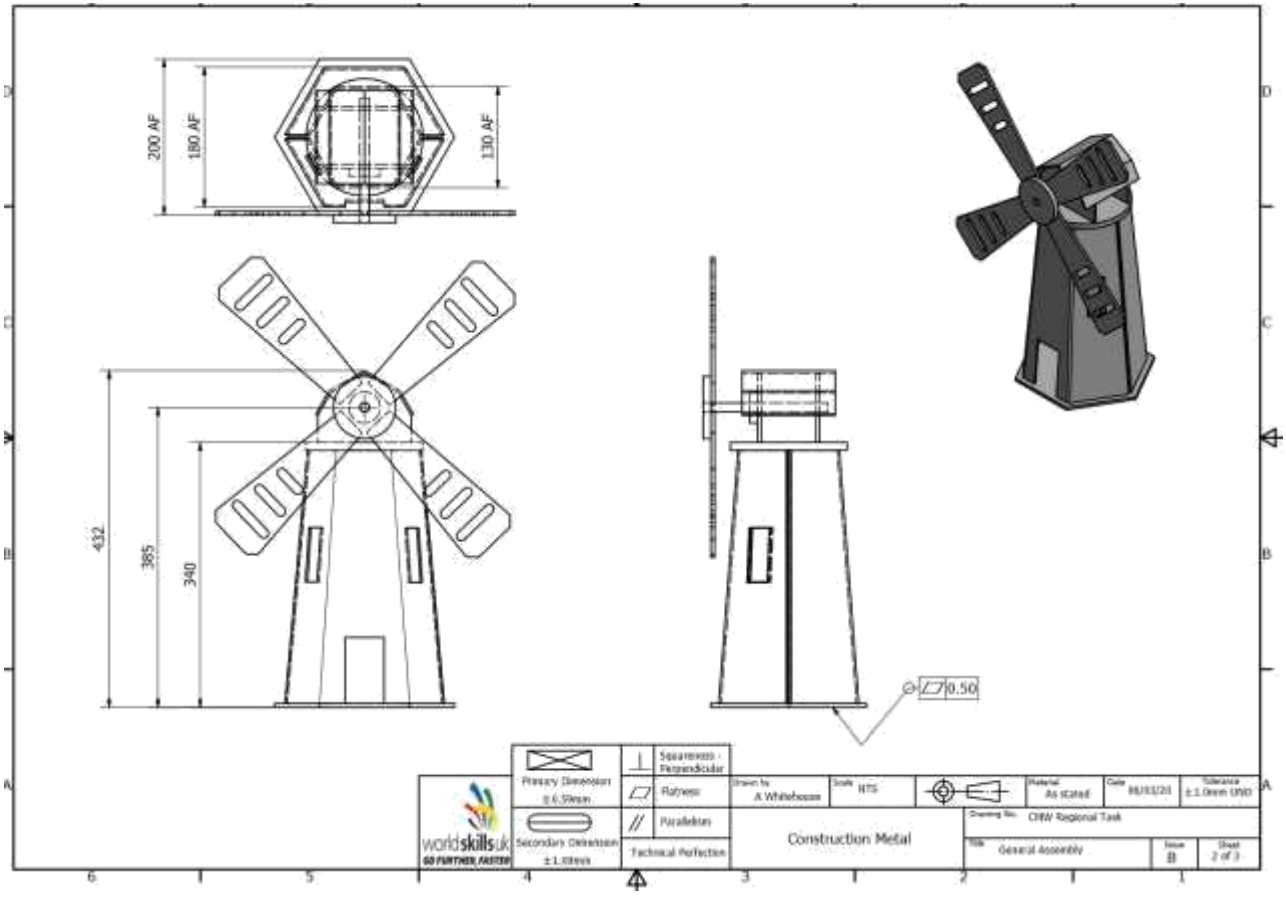
### **Project example: Passive task**

Design specification	
Material	5mm and 12BDMS
Time Determined by individual centre	
Additional data	<ul style="list-style-type: none"> <li>• Use Centre delivery pack as guidance for task.</li> </ul>



## Project example: National Qualifiers

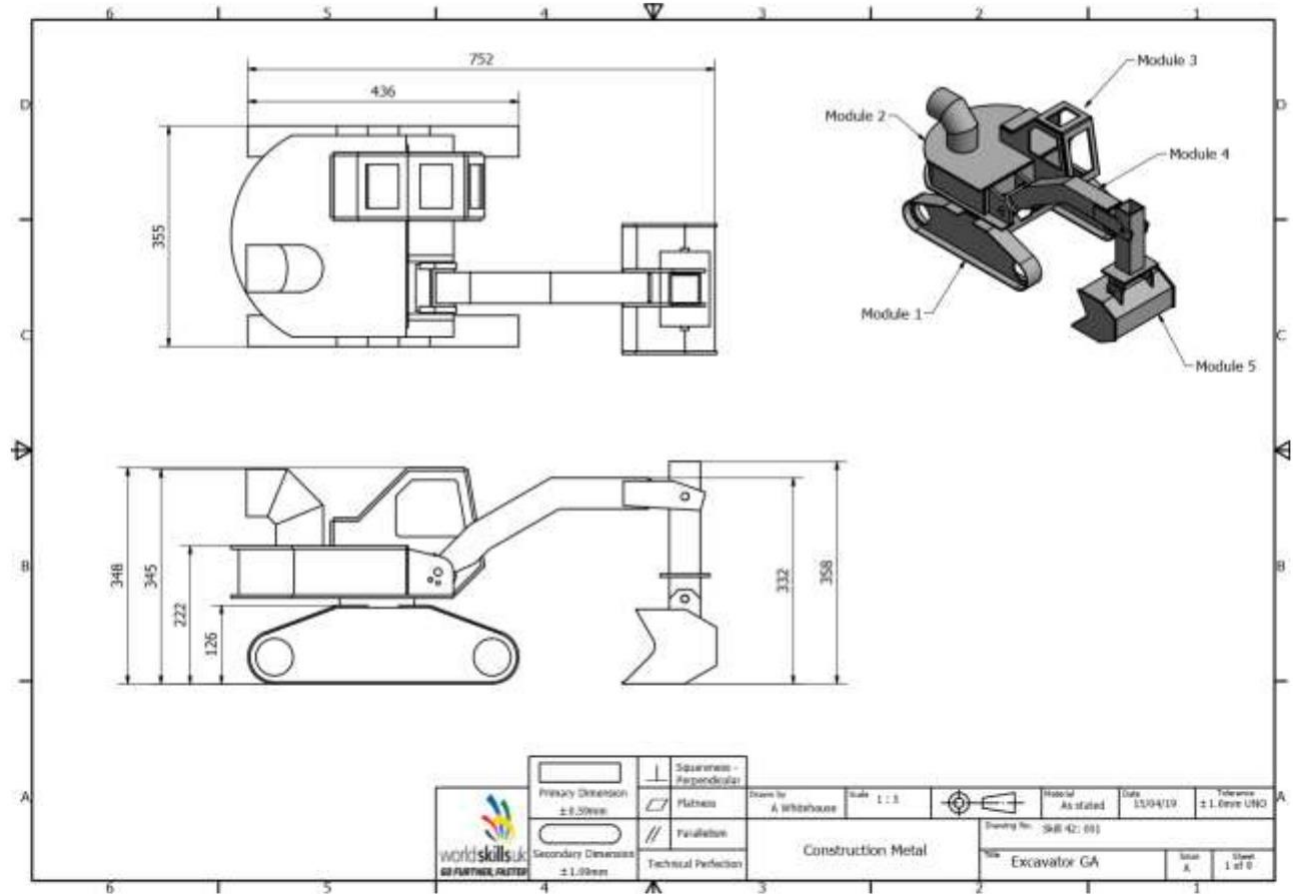
Design specification	
Material	3mm, 5mm and 10mm low carbon steel plate and sectional materials
Time	<ul style="list-style-type: none"> <li>➤ 1 hour Planning and Familiarisation period</li> <li>➤ 7.5 hours fabrication time.</li> </ul>
Additional data	<ul style="list-style-type: none"> <li>● Reading and interpretation of workshop detail drawings.</li> <li>● Work planning and organisation and material nesting.</li> <li>● Measure and marking.</li> <li>● Drawing and template making.</li> <li>● Thermal cutting various thickness and profiles.</li> <li>● Accuracy of drilling.</li> <li>● Dimensional accuracy.</li> <li>● Fitting and assembly with correct alignment.</li> <li>● Cleaning and Deburring.</li> <li>● Use of tools, plant, and machinery in a correct and safe manner.</li> <li>● Welding to specifications.</li> <li>● Application of workshop calculations.</li> <li>● Presentation of finished work.</li> </ul>



	Primary Dimension ± 0.05mm	Squareness Perpendicular	Drawn by A. Whitehouse	Date 1/15	Material As Stated	Code 84/11/21	Tolerance ± 1.0mm UNLESS STATED	
	Secondary Dimension ± 1.0mm	Parallelism Technical Perfection	Construction Metal		Drawing No. OEW Regional Task			
					Title General Assembly		Issue B	Sheet 2 of 3

## Project example: National Finals

Design specification	
Material	3mm, 5mm and 10mm low carbon steel plate and sectional materials
Time	<ul style="list-style-type: none"> <li>➤ 3hour Planning and Familiarization period</li> <li>➤ 18 hours fabrication time.</li> </ul>
Additional data	<ul style="list-style-type: none"> <li>● Reading and interpretation of workshop detail drawings.</li> <li>● Work planning and organisation and material nesting.</li> <li>● Measure and marking.</li> <li>● Drawing and template making.</li> <li>● Thermal cutting various thickness and profiles.</li> <li>● Accuracy of drilling.</li> <li>● Dimensional accuracy.</li> <li>● Fitting and assembly with correct alignment.</li> <li>● Cleaning and Deburring.</li> <li>● Use of tools, plant, and machinery in a correct and safe manner.</li> <li>● Welding to specifications.</li> <li>● Application of workshop calculations.</li> <li>● Presentation of finished work and functionality</li> </ul>





## Marking scheme

The marking scheme is designed to fairly compare every competitor's work. Marking is split between measurement and judgement aspects.

### Measurement

Any dimension on the drawing can be a measurement mark. The value of a given dimension is decided by its tolerance, which are split into:

Fabrication dimensions ( $\pm 1.0\text{mm}$ )

Assembly dimensions ( $\pm 1.5\text{mm}$ )

Flatness, Parallelism, Squareness ( $0.5\text{mm}$ )

All projects will be supplied with a mark summary form. The mark summary form will show only the number of marks assigned to each aspect, not the breakdown of marks (e.g., main dimensions: 40 marks maximum).

All marks for measurement criteria are "all or nothing", e.g., if a dimension is specified at  $40\pm 1.0$ , full marks will be awarded from  $39.0\text{mm}$  to  $41.0\text{mm}$ . Anything outside of this will be awarded zero marks.

### Judgement

Judgement marks are more subjective, for aspects such as:

- thermal cutting
- welding compliance and quality
- workmanship.

Judges will work to a judgement handbook with examples of each criterion. Each judge will reveal a value from zero to three, and an average will be taken. For example, if all judges assess the thermal cutting of a component as a two overall, the competitor will receive 66% of the possible marks. Judgement marking accounts for only 10% of the overall score.

## Judgement examples



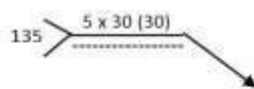
Zero



One



Two in parts Three



Incorrect

Tack weld – this is extra  
welding



Correct

Welded are  
per instruction



## Competition Instructions: Rules and Format

The following is an example of the general competition delivery information, rules and format. Each stage of the competition from Passive to Qualifier to National final gradually becomes more difficult and the instruction, rules and format reflect this progressive process.

For each stage a specific set of instructions, rules and delivery format is devised that are distributed prior to the competition taking place to enable competitors be familiarize themselves with the competition expectations.

### Example

The Construction metalwork project involves the marking out and fabrication of 3mm, 5mm and 10mm low carbon steel plate and sectional materials. Each competitor will be supplied with work sheets consisting of the project drawings and materials list together with specific fabrication instructions.

Each competitor will compete individually and will be allocated a workspace. They will also be allocated identical amounts of material and will be given equal access to the common machines/tools.

The project is designed to satisfy the following objectives:

1. To allow objective marking and basic interpretation, marking, cutting and assembly skills.
2. To provide tasks which are achievable for the regional competitor.
3. To utilise competitor's skills to produce a set task in a given timescale which is marked to World Skills National standards.

The project is designed to test the Competitors skill and ability in the following areas related to Construction metalwork:

- Reading and interpretation of workshop detail drawings.
- Work planning and organisation and material nesting.
- Measure and marking.
- Drawing and template making.
- Thermal cutting various thickness and profiles.

- Accuracy of drilling.
- Dimensional accuracy.
- Fitting and assembly with correct alignment.
- Cleaning and Deburring.
- Use of tools, plant, and machinery in a correct and safe manner.
- Welding to specifications.
- Application of workshop calculations.
- Presentation of finished work.

### **Time allocation**

- 1 hour Planning and Familiarization period
- 7.5 hours fabrication time (Project build (3 Hrs), Project build (4.5 Hrs)).

### **Familiarization:**

During this period competitors will be instructed in the safe operation of the fabrication equipment.

Each competitor shall be provided with the project drawings and fabrication instructions.

The competitor is permitted to plan activities, make notes, perform calculations and produce templates / sketches during this period but NOT allowed to mark out work on competition materials. Competitors are allowed to check sizes of supplied materials.

### **Competition Period**

The following points are to be observed during the competition:

1. Each competitor **MUST** wear the required PPE.
2. It is essential that **All** safety instructions are followed
3. Competitors are to work alone; it is not a team project.
4. Competitors will start and stop work as directed by the judges
5. Meal breaks will be taken as directed.

6. No competitor is to remain in or enter the competition area whilst meal breaks are in progress
7. The use of mobile phones is prohibited during the competition (unless agreed with judges)

## **Fabrication / Welding Notes**

### **Fabrication Notes**

1. Competitors are **FREE** to commence work on any aspect of the task.
2. Thermal cutting requirements; Items 1.1 window and door openings, 1.2, 1.5 slots and 1.6
3. **No Thermal** cut edges/faces can be ground or filed; marks will be deducted if competitors do so.
4. All edges and holes must have burs and shape edges removed.
5. If a component is submitted with only tack welds **NO** welding marks will be awarded for the welding aspect. However, dimensional measurements will be assessed.
6. Extra Material - Competitors will be deducted mark(s) for any extra materials requested which they require to complete the test project due to the part been lost, damaged or inaccurately cut/formed by the Competitor.
7. Guillotined edges cannot be **GROUND** to make a measurement (unless agreed with judges).

### **Welding Notes**

1. All welding symbols are to be follow in the welding of the project.
2. Any welding process may be used.
3. All slag and spatter must be removed from all welds.

**90% of welding must be completed as per the welding instructions. Failure to meet this minimum standard results in non-compliance with welding and the loss of welding marks**

## Equipment

During training and delivery of the National finals a basic toolkit is supplied for all competitors. However, competitors are free to bring a small quantity of their own tools for use in the competition if they wish. Access and movement of toolboxes is restricted during the opening hours of the competition and to comply with the restrictions it is recommend to limit personal tools to ones that can be carried to the competition venue.

No pre-made templates are allowed to be brought to the competition. All personal tools must be declared and competitor workstations / toolboxes are subject to random toolbox checks.

Equipment provided by World Skills UK and various competition sponsors.

- Welding plant, equipment and consumables.
- Thermal cutting plant and equipment (Circle cutter, wheels etc.) and consumables
- Vernier height gauge and calliper's
- Off-hand grinders and consumables
- Drill, drill bits and power saws
- Metal forming equipment; press brake, horizontal press and rolls

The following is a list of hand tools supplied for each competitor.

- G clamps
- Engineers square
- Steel rules, 300mm, 600mm, etc.
- Engineers hammer.
- Centre punch and cold chisels
- Engineering scriber.
- Files various shapes, sizes.

The assessment team will use Vernier Calliper and Height Gauges to measure work. Competitors are free to use this measuring equipment during the competition for use on their own work.

The following is a listing of tools and equipment that each competitor may choose to bring with them to the competition. The list is only a guide and not exhaustive.

- Personal PPE, Overalls, Gloves, safety glasses etc.
- Thermal cutting goggles, no anti flash glasses will be permitted and burning straight cut bar.
- Personal thermal cutting attachment for straight cuts.
- Welding shield
- Combination set
- Drawing equipment, French chalk
- Calculator, Note pad, Pencil/pen.

Competitors **MUST** supply their own safety footwear and are encouraged to wear employer branded equipment.

Familiarization training will be provided for all powered machinery

## Training

### Self-directed training

All competitors will need to practice their skills in order to give them the best opportunity to demonstrate their competence and be successfully at each stage of the competition.

Competitors are advised to seek guidance and further training with their tutors, peers and employers to perfect skills and apply knowledge. Dedication is key and the behaviours associated with the apprenticeship standard reflect the responsibility competitors need to commit too for effective competition performance.

Working through the core competences identifies key areas where competitors are expected to perform. Each stage from Passive to Qualifier to National final progressively becomes more difficult so it is good practice to revisit your core skills regularly.

### National Finals training

As part of the invitation to compete at the National finals, World Skills UK invites all competitors to mind-set training and skill masterclass events. This is an excellent opportunity for all competitors to boost their confidence using equipment in a safe environment, while replicating aspects of the competition project and expectations.

Specific test project fabrication instructions are made available to enable competitors to familiarize themselves with the content and expectations of the test project.

## Top Tips

Here are some basic top tips to help with you improve to performance, try them out and use them in all of your training sessions.

When starting a fabrication job make sure the preparation is done correctly i.e.

- Take time to plan work schedules – so learners know what needs to be done and in what order. It's a good idea to break down drawings into simple smaller steps.
- Check cutting lists – make sure sizes are correct and any allowances are made. Draw /sketches out on graph paper.



- Ensure the work area is ready for work – clean, free from clutter and tools readily available.

When cutting parts to size and shape make sure that;

- All materials are marked out and cut accurately so they can be clearly seen when cutting out. Use chalk, sharpie pens, scribes that give the best definitive line and lightly dot punch lines to highlight line marks.
- The learner knows where the shadow line is in relation to the guillotine blade if not using the back gauge – make a test cut to verify
- Always position cut parts under a clamp and check the pull-on thicker plate when cutting. If necessary, use an additional light source to verify cut position.
- Guillotine parts must be flat and free from twist before further use.

Before using the cut parts for fabrication ensure parts are;

- Flat and free from burrs or twists.
- Clean, degreased and ready for use.
- Stored safely and easily identifiable for future use.

## **National Finals**

### **What to expect**

In previous years, the National finals were a huge largescale event, usually taking place at the NEC, Birmingham. There were many skills in diverse sectors, so you had to be prepared to do a lot of walking in potentially crowded areas and your family, friends, and other visitors would try to get the best views of intense competitions going on.

Employers were able to enter the competition floor with the permission of the competition manager; and could take sponsorship photos or gain a better understanding of the competition itself. Competitors were also expected to wear the appropriate H&S equipment (e.g., safety boots, glasses) as well as a company work top and trousers while competing.

In 2022, it is still not yet confirmed where the National Finals will be taking place. However, do expect to have a rewarding experience nonetheless!

## National Finals

### Sample Workshop Floor plan



### Completed Task, Competitors and Delivery Team.



## **Beyond the National Finals**

Looking beyond the National finals, there are a host of opportunities for competitors. Age-eligible competitors who show the highest skills, passion, and drive to compete will be invited to train for the World Skills international competitions.

Those who are not eligible for international competitions may join the Champions programme, which allows continued involvement, including the opportunity to work with World Skills UK and visit schools, colleges, and events to inspire the next generations.

Alternatively, if training is of interest to you, you could consider supporting World Skills UK with organizing and training, and even helping to be part of the National finals.

*Please note the 2021 competition will not be a selection year for the international competitions.*

**Get inspired and you could become a part of Team UK!**











