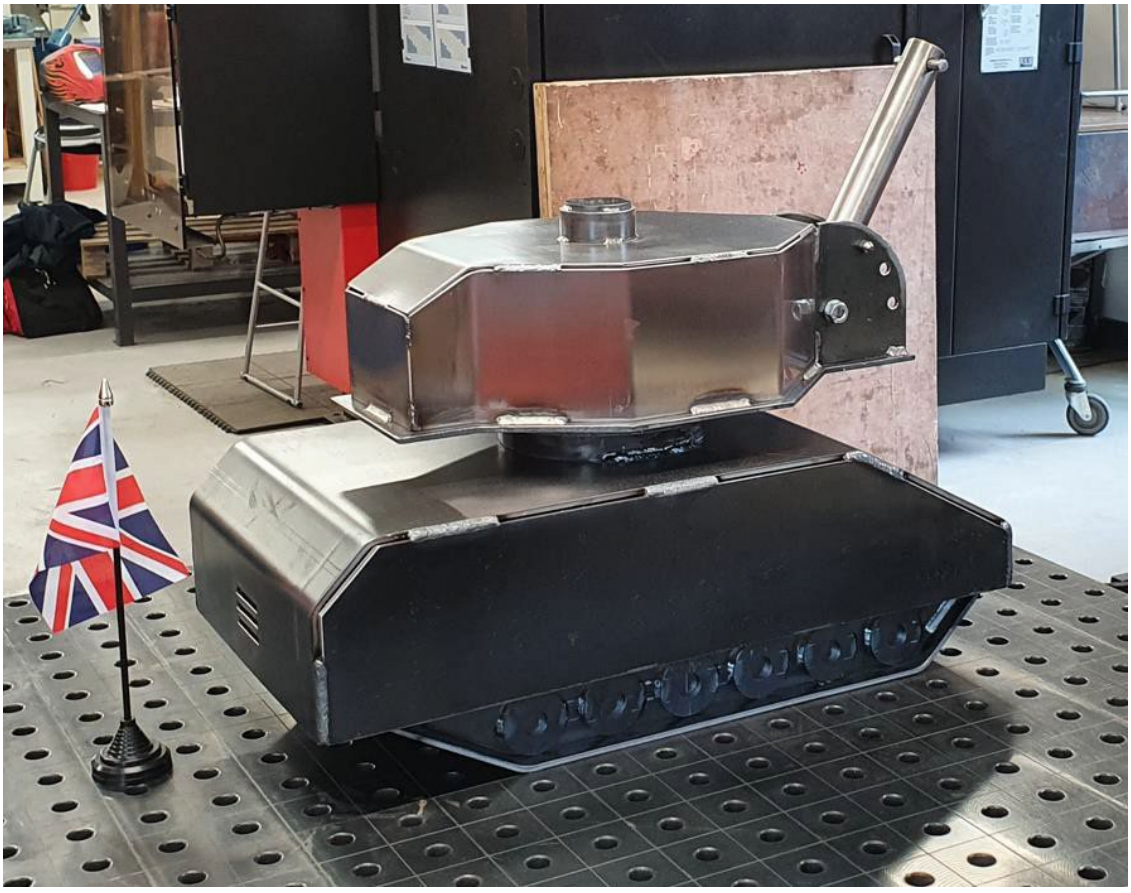

Metal Fabricator Competition Technical Handbook

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Overview

Metal Fabrication is a significant sector within the engineering industry with a broad purpose of carrying out metal fabrication work, using items such as all types of structural sections, pipe, hollow sections, steel plate and sheet metal, in various thicknesses, including ferrous and non-ferrous materials.

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

In 2022 changes have been made to the Construction Metalwork Competition, it will now be known as the WorldSkillsUK Metal Fabricator Competition, in line with the apprenticeship standard, ST0607, covering a range of ferrous and non-ferrous materials from 0.5mm to 20mm and above.

All the tasks are designed to link with all the awarding bodies in England, Ireland, Scotland and Wales, L2 and L3 Welding Fabrication courses, all the test projects are also mapped against the Knowledge, Skills and Behaviour requirements, in the L3 Metal Fabricator Apprenticeship Standard (ST0607), the competition time, can be used by the apprentices, as part of their 20% off the job training requirements.

The changes also include the availability of drawings from past test projects etc. for competitors, colleges or independent training providers to use as teaching materials, competition training tasks and as part of their curriculums.

Job roles and occupations.

Metal Fabrication includes, manufacturing steel structures, pipework, pressure vessels, components for the food & dairy industry, pharmaceutical & chemical industries, aircraft industry and the automotive sector. Together with other areas of light metal fabrication, architectural metalwork, etc.

In the food, pharmaceutical and aircraft industries, very high standards of finish and quality are required in various metallic materials. Large and high-rise buildings, stadiums and bridges, are fabricated in structural steels, where quality is also important for the safety of the structure, architectural designs are also fabricated from ferrous and non-ferrous materials where the finish, as well as quality is an important part of the fabrication.

Job roles and occupations contd.

Metal Fabricators can work alone or in teams, in factories or on site. Metal Fabricators use a large range of ferrous and non-ferrous materials, in a range of thicknesses from 0.5mm up to and 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, a fabricator may need to interact with planners, supervisors, inspectors, designers, welders, pipefitters, fitters, machinists, riggers, steel erectors, stores personnel, painters and many others involved in manufacturing, production, installation, maintenance, and repair.

Metal Fabricators are also 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, the environment and others that might be affected by the work they are involved with.

Every item in our daily lives, involves welding and metal fabrication, in many ways, currently there is a global shortage of these skills, the average age of skilled metal fabricators in the world, are over 50 years old.

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 recruits nationwide. The first steps would be to visit the government website, (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, your local further education college or training centre will be able to give you help and advice. They usually are in contact with local employers and can help you find employment or an apprenticeship.

Competition Resources

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

https://www.worldskillsuk.org/skills/national-competitions/

https://engineeringskillscompetitions.org/metal-fabricator

Pre-Competition Activity and Learning Resources

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

Safe Use of Angle Grinder; www.youtube.com/watch?v=JKQMu12XS_Q

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

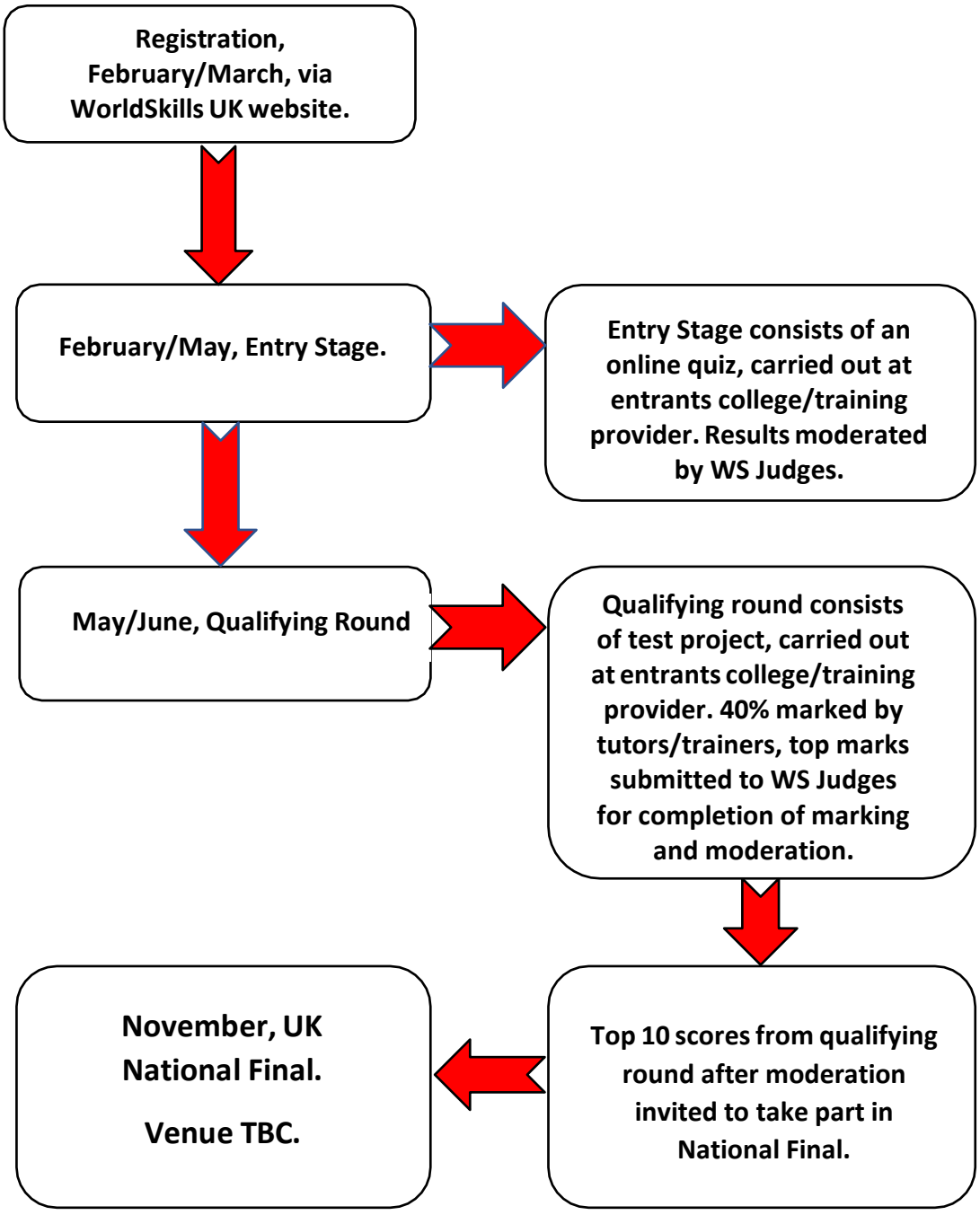
Plasma Cutting tips; https://www.youtube.com/watch?v=qd1L_9nljdg

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 an Entry Stage, National Qualifier and UK National Final. Please refer to the competition cycle flow chart below.



Core Competences and Project Specifications

The core competences of this competition are:

- Work organisation 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 and competitors taking part should be able to:

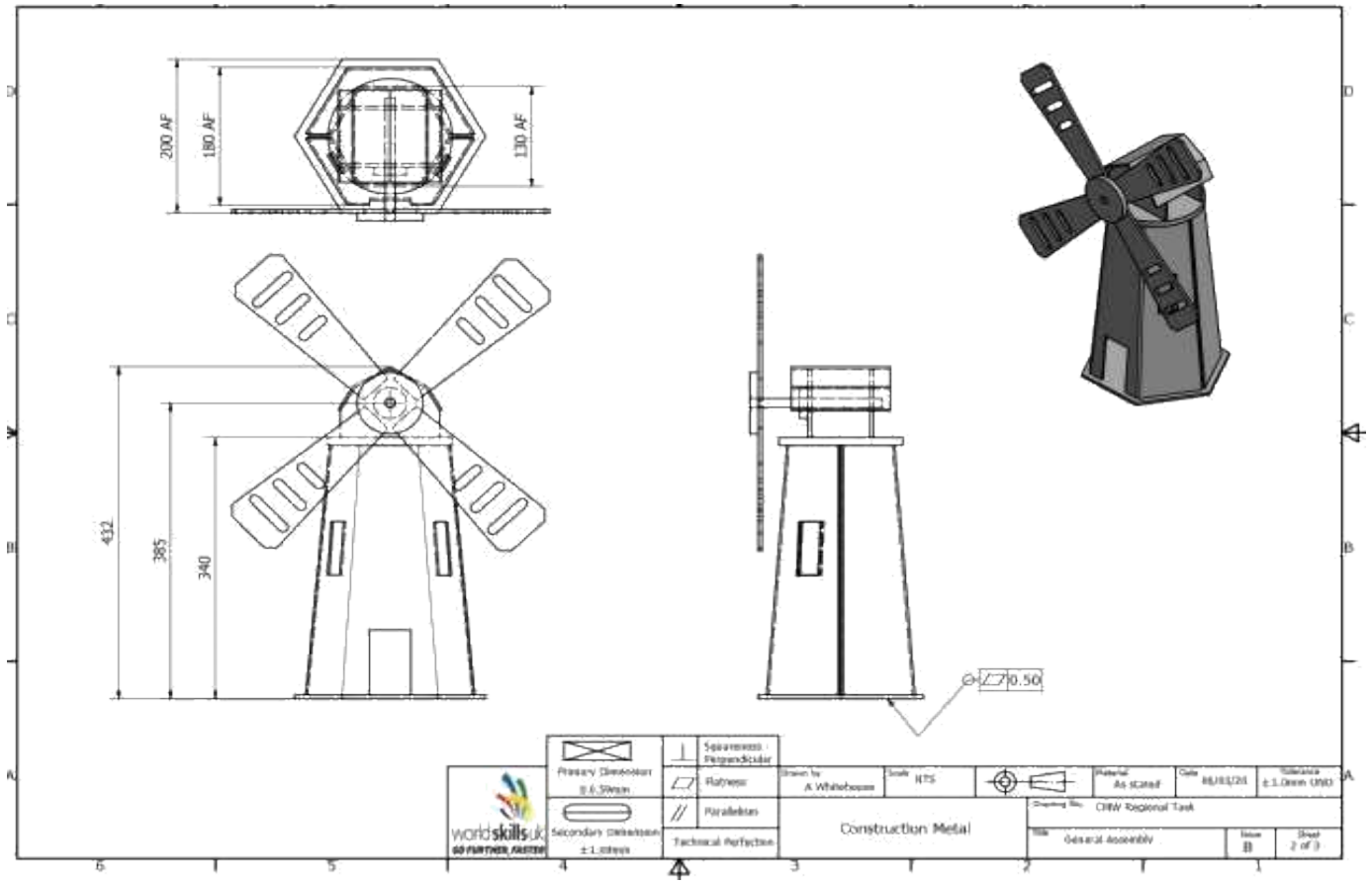
- Read and interpret engineering drawings i.e., 1st / 3rd angle, welding requirements and weld symbols and geometric tolerances.
- Plan tasks and organise work including material nesting and time management.
- Apply workshop calculations including areas, volumes, Pythagoras theorem and trigonometry.
- Measure and marking materials to drawing specifications and requirements.
- Set out 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, thermal cutting and grinding, etc.
- Use thermal cutting equipment (Oxy fuel / Plasma) 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 (MAG) and GTAW (TIG).
- 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	Entry	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%

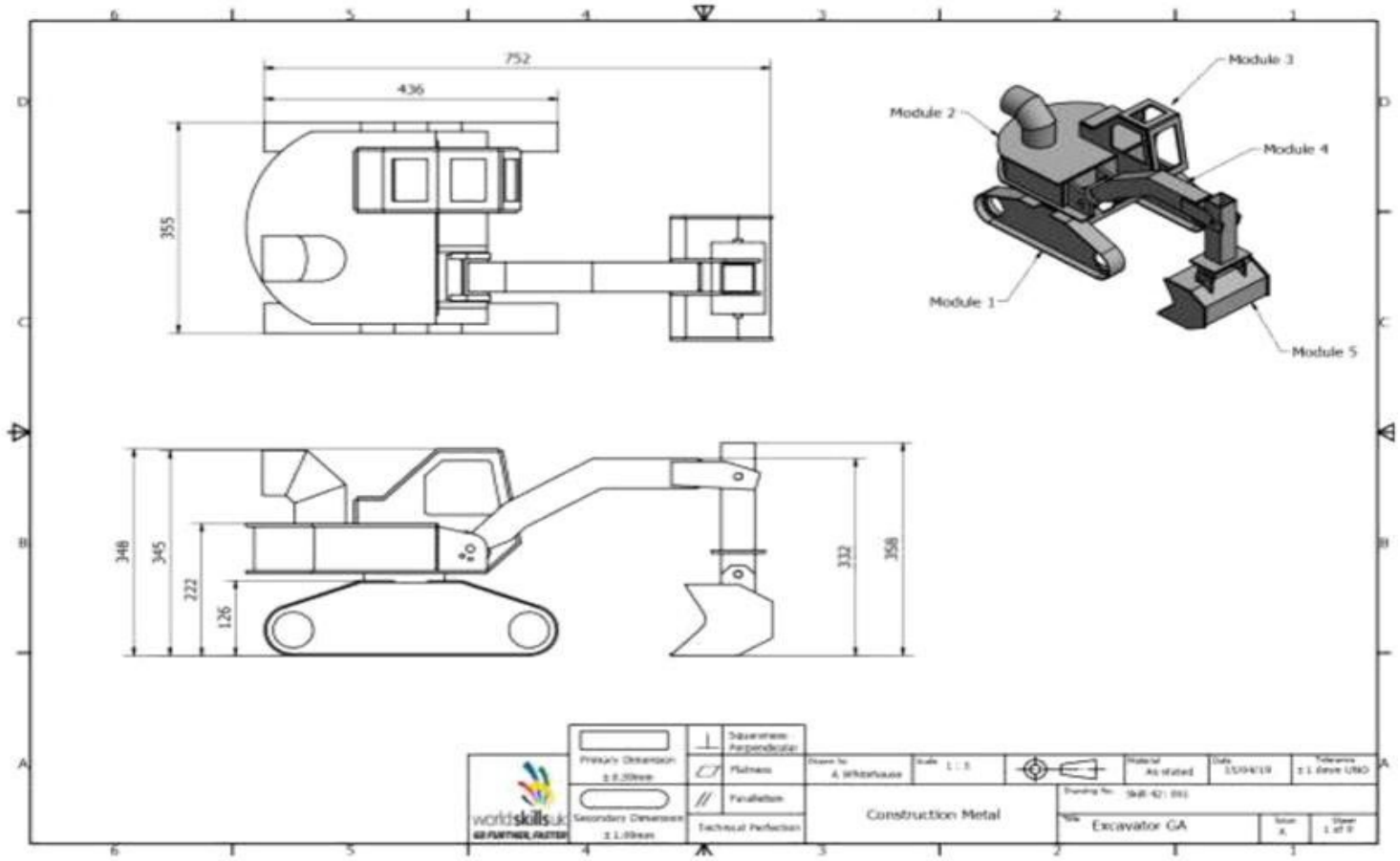
Project example: National Qualifiers

Material	Ferrous and non-ferrous, plate, sheet, and sectional materials.
Time	➢ 1 hour Planning and Familiarisation period ➢ 7.5 hours fabrication time.
Additional data	• 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.


200 AF
180 AF
130 AF
432
385
340
0.50
Construction Metal
CRW Regional Task
General Assembly

Project example: National Finals

Design specification	
Material	Ferrous and non-ferrous, plate, sheet, and sectional materials.
Time	➢ 3-hour Planning and Familiarization period ➢ 18 hours fabrication time.
Additional data	• 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 in accordance with standard weld symbols and specifications. • Application of workshop calculations. • Presentation of finished work and functionality


752
436
355
Module 3
Module 2
Module 4
Module 1
Module 5
348
345
222
126
332
358
Construction Metal
Excavator GA

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 (±1.0mm)
- Assembly dimensions (±1.5mm)
- Flatness, Parallelism, Squareness (0.5mm)

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±1.0, full marks will be awarded from 39.0mm to 41.0mm. 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.

Thermal Cutting Judgement examples

Zero marks

One mark

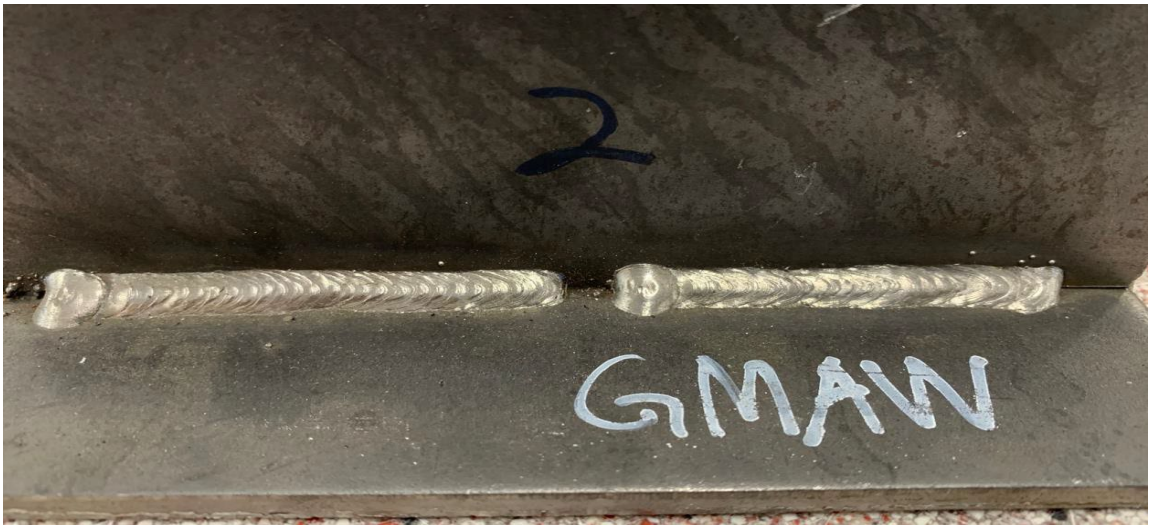
Two marks

Three marks

GMAW/MAG Weld Judgement Examples

Zero marks

One mark



Two marks

GMAW/MAG Weld Judgement Examples contd.

Three marks

GTAW/TIG Weld Judgement Examples

Zero marks

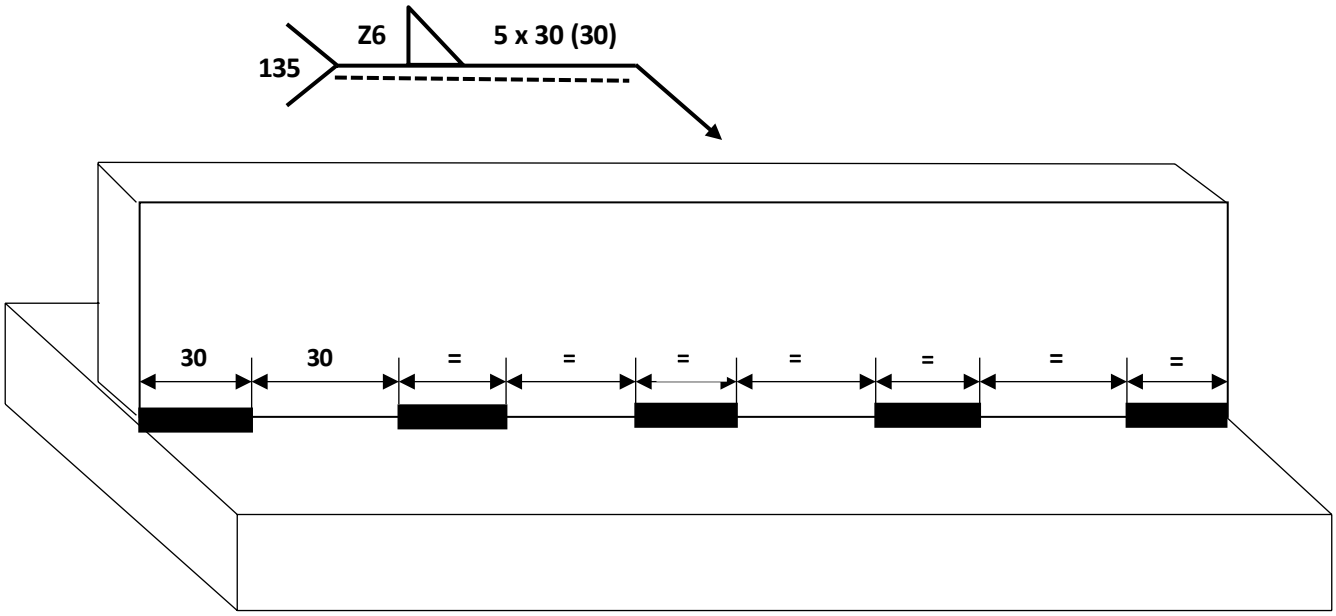
One mark

GTAW/TIG Weld Judgement Examples contd.

Two marks

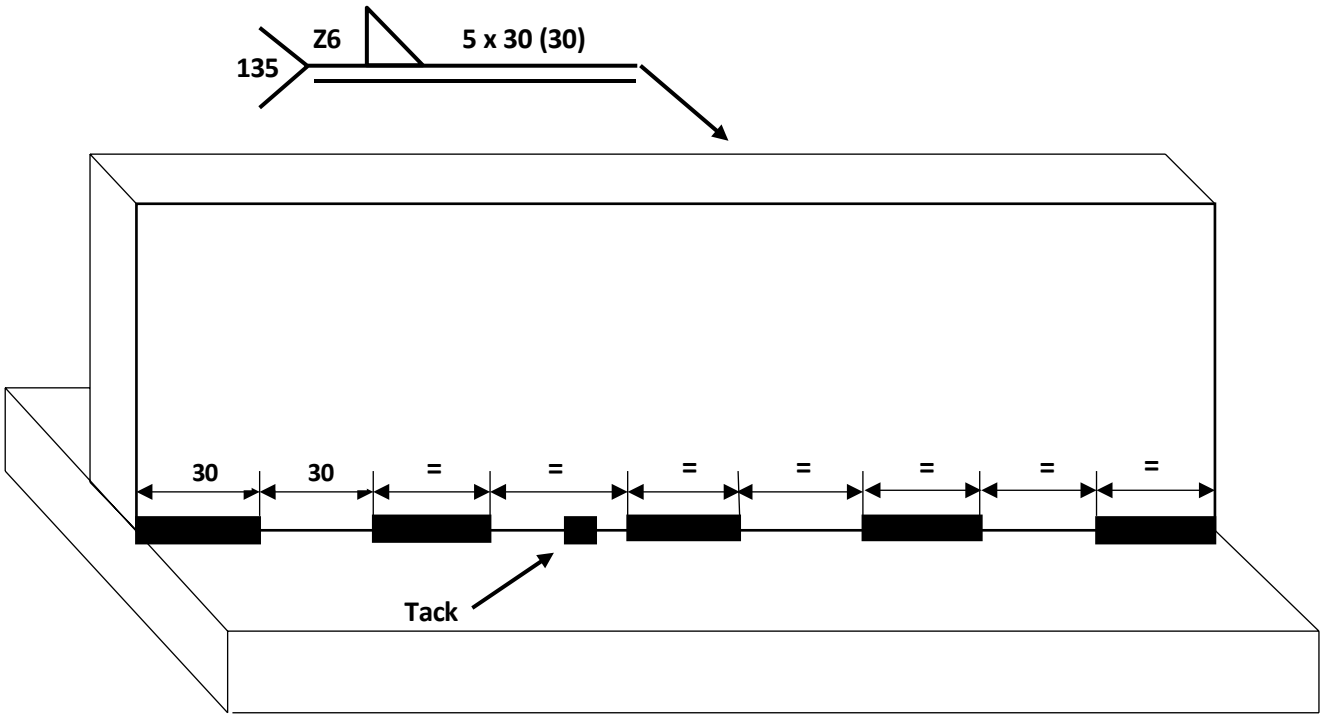
Three marks

Weld Symbol Example



Correct

The above symbol indicates, a fillet weld, welded this side with a 6mm leg length, with 5 welds 30mm long, with 30mm spaces, equally spaced along the length.



Incorrect

The above symbol indicates the same welds with the same spaces as above, but the tack weld counts as a weld making this incorrect.

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 Entry 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 are devised and are distributed prior to the competition taking place, to enable competitors to familiarize themselves with the competition expectations.

Example

Each Metal Fabricator competition test project involves the marking out and fabrication of ferrous and non-ferrous, plate, sheet, 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 each 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 Metal Fabrication:

- 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.

Competition Instructions: Rules and Format contd.

- 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 Familiarisation period.
- 7.5 hours fabrication time (Project build (3 Hrs), Project assembly (4.5 Hrs).

Familiarisation:

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 or sketches during this period but are **NOT** allowed to mark out work on competition materials. Competitors are allowed to check sizes of supplied materials.

Competition Instructions: Rules and Format contd.

Competition Period

The following points are to be observed during the competition:

- Each competitor **MUST** wear the required PPE.
- It is essential that **All** safety instructions are followed.
- Competitors are to work individually; it is not a team project.
- Competitors will start and stop work as directed by the judges.
- 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, before the start of the competition with judges)

Fabrication / Welding Notes

Fabrication Notes

- Competitors must work on the modules shown on Work Schedule and Module submission table.
- Thermal cutting requirements will be shown on the project drawings or discussed prior to the competition starting.
- **No Thermal** cut edges/faces can be ground or filed; marks will be deducted if competitors do so.
- All edges and holes must have burs and sharp edges removed.
- 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.
- 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.
- Guillotined edges cannot be **GROUND** to make a measurement (unless agreed with judges).

Welding Notes

1. All welding symbols are to be followed in the welding of the project.
2. The welding process will be specified on the drawings.
3. All slag and spatter (where relevant) 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 limiting 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, by the judges.

Equipment provided by World Skills UK and various competition sponsors.

- ➢ Welding plant, equipment, and consumables.
- ➢ Thermal cutting plant and equipment and consumables.
- ➢ Vernier height gauge and callipers for assessment of completed work.
- ➢ Off-hand grinders and consumables.
- ➢ Drill, drill bits and power saws.
- ➢ Metal forming equipment; press brake, horizontal press, and rolls.

Equipment contd.

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/judging 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, and burning bar, for straight cuts only.
- Personal thermal cutting attachment for circle cuts.
- Welding shield.
- Combination square set, engineering protractor and magnets
- Drawing equipment, French chalk.
- Calculator, Note pad, Pencil/pen.

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

Familiarisation and safety training will be provided for all powered machinery.

Training.

Self-directed training

All competitors will need to practice their skills to give them the best opportunity to demonstrate their competence and be successful 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 Entry 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 familiarise 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 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 clearly so they can be clearly seen when cutting. Use chalk, sharpie pens, scribers 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, large-scale event, 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.

Since the covid lock down it has been held at colleges strategically located around the UK.

In 2023, it has not been confirmed, where the National Finals will be taking place. However, do expect to have a rewarding experience nonetheless!

National Finals contd.

Completed Tasks, Competitors and Delivery Team.

Beyond the National Finals.

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

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