



TECHNICAL DESCRIPTION **WELDING**



WorldSkills International, by a resolution of the Technical Committee and in accordance with the Constitution, the Standing Orders and the Competition Rules, has adopted the following minimum requirements for this skill for the WorldSkills Competition.

The Technical Description consists of the following:

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1 INTRODUCTION

1.1 NAME AND DESCRIPTION OF THE SKILL COMPETITION

1.1.1 The name of the skill competition is

Welding

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

A welder prepares and joins a range of metals of various gauges using electrical and electrical/gas shielded processes. A welder needs to be able to interpret engineering working drawings, standards and symbols correctly translate these requirements into accurate structures and products.

Welders need to have a thorough knowledge and understanding of safe working procedures and personal protection equipment. They need to gain specific knowledge of a wide range of welding equipment and processes as well as a good working knowledge of metallurgy. They need to be familiar with electricity and electrical processes.

Welders join sections, pipe and plate and fabricate large and small pressure vessels. A welder prepares, assembles and joins a wide range of metals and metal alloys using various welding processes including MMAW (manual metal arc welding), MAGSW (metal arc gas shielded welding), TAGSW (Tungsten arc gas shielded welding) gas welding and cutting. They use gas, electrical, and gas shielded electrical processes to join and cut a wide range of materials. They must be able to choose and operate the correct equipment, process and methodology depending upon the material being joined.

Welders may be engaged in using thermal cutting processes and should be able to identify and follow 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 and finish 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.

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, and construction, service and leisure industries. Welders also work on site preparation, construction, and the repair and maintenance of structures within the areas described above. A welder can work in many locations and situations, ranging from a bench in a factory, to shipyards, power stations and off-shore structures in order to inspect and repair gas or oil rig terminals. Welders also work in engineering, construction, power generating and petro-chemical plants. The working environment may include hazardous settings such as the open sea.

The modern welder may specialize in one or a number of welding processes and environments. He or she may also be asked to work in exotic alloys such as duplex stainless steels and cupronickels. The quality of the welding will vary according to cost and function, with the most skilled welders depended upon to carry out the finest work where faults and failure may have the most serious consequences in terms of cost, safety and environmental damage.

1.2 THE RELEVANCE AND SIGNIFICANCE OF THIS DOCUMENT

This document contains information about the standards required to compete in this skill competition, and the assessment principles, methods and procedures that govern the competition.

Every Expert and Competitor must know and understand this Technical Description.

In the event of any conflict within the different languages of the Technical Descriptions, the English version takes precedence.



1.3 ASSOCIATED DOCUMENTS

Since this Technical Description contains only skill-specific information it must be used in association with the following:

- WSI – Competition Rules
- WSI – WorldSkills Standards Specification framework
- WSI – WorldSkills Assessment Strategy (when available)
- WSI – Online resources as indicated in this document
- Host Country – Health and Safety regulations



2 THE WORLDSKILLS STANDARDS SPECIFICATION (WSSS)

2.1 GENERAL NOTES ON THE WSSS

The WSSS 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/WSSS).

The skill competition is intended to reflect international best practice as described by the WSSS, and to the extent that it is able to. The Standards Specification 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 not be separate tests of knowledge and understanding.

The Standards Specification 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 Specification. The sum of all the percentage marks is 100.

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

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



2.2 WORLDSKILLS STANDARDS SPECIFICATION

SECTION		RELATIVE IMPORTANCE (%)
1	Work organization and management	25
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> • The standards and laws relating to the health, safety, security and hygiene in the welding industry • The standards and regulations relating to safe working practices, accident procedures, evacuation procedures and escape routes • 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 dangerous tasks • The safety recommendations and regulations relating to the welding of materials in all conditions including wet/damp areas, confined spaces and situations where oxygen levels are likely to be below those required for safe working. • The recommendations, regulations and procedures required to prevent explosion, fire or combustion in all circumstances • Terminology and safety data supplied by manufacturers • The dangers of slips, trips and falls while engaged in welding operations • Primary electrical supply circuit terminology and its operation • Secondary electrical / welding circuit terminology and operation • The requirements and effects of welding production for the environment and sustainability issues • Basic mathematical manipulation and unit conversion • Geometrical principles, techniques and calculations 	
	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> • Work safely with regard to themselves and others in all circumstances • Select, wear and maintain PPE to high standards as appropriate • Select, maintain and wear specialist safety PPE as appropriate to tasks • Recognize hazardous situations and take appropriate actions with regard to their own and others safety • Follow correct procedural processes when working in dangerous and semi-dangerous environments • Demonstrate the adherence to manufacturers safety data sheets • Maintain a clean working environment • Store used materials in relevant containers for recycling and sustainability • Complete work within agreed timescales • Calculate material requirements, consumables and costs of welding • Calculate areas and volumes using geometric formulae • Recognize and inspect the main components of primary and secondary electrical/welding circuits • Make essential connections for specific welding procedures being undertaken 	



2	PREPARATION FOR WELDING	5
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none"> • The interpretation of welding / engineering drawings and weld symbols • Correct alignment of process with material being used • The classification and specific uses of welding consumables including: <ul style="list-style-type: none"> • Colour coding of gas cylinders • Coding and designation of welding rods • Diameters and specific use of welding wire • Choice and preparation of welding electrodes • Forms of edge preparation process available • How surface contamination can influence the finished weld characteristics • The correct machine settings to be aligned to: <ul style="list-style-type: none"> • 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 characteristics and properties of filler materials • The methods of edge preparation to align with joint profile, strength, material and drawing specification • Welding parameters/variables for specific tasks • Effects of changes in welding variables/ parameters of completed weld 	
	<p>The individual shall be able to:</p> <ul style="list-style-type: none"> • Prepare material edges as per drawing specification • Select welding consumables by use, size, positional characteristic and material being welded • Remove surface contamination prior to welding • Select correct filler material and size to suit materials being welded • Adjust welding equipment with consideration to welding parameters/variables • Set up welding equipment to manufacturers specification including (but not limited to) <ul style="list-style-type: none"> • Welding polarity • Welding amperage • Welding voltage • Wire feed speed • Travel speed • Travel/electrode angles • Mode of metal transfer • Prepare material edges in line with specification and drawing requirements 	



3	WELDING MATERIAL	10
	<p>The individual needs to know and understand:</p> <ul style="list-style-type: none">• The mechanical and engineering properties of carbon steels• The mechanical and engineering properties of (5000 and 6000 series) aluminium and its alloys• The mechanical and engineering properties of stainless steel (austenitic 300 series)• Selection, and storage of welding consumables• Correct storage and handling of welding consumables• Selection and safe use of electrical power tools• The influence of time taken on the outcome cost of services• The supply costs of metals and consumables used for specific tasks• The control of material and welding operations in environmental protection	
	<p>The individual shall be able to:</p> <ul style="list-style-type: none">• Use materials with consideration to their mechanical and engineering properties• Store welding consumables correctly with reference to type, use and safety considerations• Select and prepare materials with reference to drawing material list and welding symbols• Prepare materials according to their properties and surface characteristics• Use electrical power tools safely to cut, grind and prepare / finish welds• Work efficiently within time limits set• Use material efficiently with a view to supply and replacement costs• Carry out work effectively and efficiently with regard to environmental protection	



4	WELDING PROCESSES	60
	<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• The precautions necessary for the safe use of power tools and welding equipment• Terminology, characteristics and safe use of welding and purging gasses• Recognition and selection of welding consumables• The selection, use and techniques of the various welding process used• The specific methods used in shielding the weld area from contamination• The selection of gasses used for shielding and purging• Weld positions, weld angles and electrode travel speeds• Faults / inclusions that may occur during welding• Methods of distortion control in steels, alloys and aluminium• Appropriate methods of finishing completed welds• Range of destructive and non-destructive weld testing• The techniques for efficient stop / starts• The selection, adjustment and safe operation of electrical power tools• The methods used to control heat input• Methods and processes used in transfer of weld metal to the weld area• The benefits of alloying to improve the properties of welding material• The benefits and limitations of specific welding processes• Weld defects and their appropriate rectification• The importance of weld metal cleanliness in weld quality	



	<p>The individual shall be able to:</p> <ul style="list-style-type: none">• Make welded joints in relation to international specifications• Interpret welding terminology to complete task to specification• Maintain welding equipment to deliver quality results• Select and use appropriate method of shielding the weld area from contamination• Select and adjust welding equipment to provide appropriate methods of Weld metal transfer to the weld area• Select correct welding consumable to suit process and conditions• Perform welding in all positions on pipe and plate for all nominated welding processes as detailed in ISO 2553 and AWS A3.0/A2.4• Weld steel plate and sections using the manual metal arc welding process (111)• Weld steel plate and sections using the gas metal arc welding process (135)• Weld steel plate and sections using the flux cored welding process (136)• Weld stainless steel plate and sections using the Gas tungsten arc welding process (141)• Weld aluminium plate and sections using the gas tungsten arc welding process (141)• Dress welds using wire brushes, scrapers, chisels etc.• Perform stop / starts to weld processes• Dress completed welds• Work accurately to drawing specification• Produce welds to meet drawing and legislative specifications• Correct weld faults and inclusions to maintain quality• Check completed work against drawing requirements to reflect accuracy, square and flatness where necessary• Set up and operate appropriate controls to minimize and correct distortion• Perform non-destructive weld testing• Demonstrate the preparation and safe use of electrical power tools and equipment• Carry out appropriate procedures to control heat input• Recognize weld defects and take appropriate action to rectify them• Take appropriate actions to ensure that weld metal cleanliness is maintained	
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3 THE ASSESSMENT STRATEGY AND SPECIFICATION

3.1 GENERAL GUIDANCE

Assessment is governed by the WorldSkills Assessment Strategy. The Strategy establishes the principles and techniques to which WorldSkills assessment must conform.

Expert assessment practice lies at the heart of the WorldSkills Competition. For this reason it is the subject of continuing professional development and scrutiny. The growth of expertise in assessment will inform the future use and direction of the main assessment instruments used by the WorldSkills Competition: the Marking Scheme, Test Project, and Competition Information System (CIS).

Assessment at the WorldSkills Competition falls into two broad types: measurement and judgment. These are referred to as **objective** and **subjective**, respectively. For both types of assessment the use of explicit benchmarks against which to assess each Aspect is essential to guarantee quality.

The Marking Scheme must follow the weightings within the Standards Specification. The Test Project is the assessment vehicle for the skill competition, and also follows the Standards Specification. The CIS enables the timely and accurate recording of marks, and has expanding supportive capacity.

The Marking Scheme, in outline, will lead the process of Test Project design. After this, the Marking Scheme and Test Project will be designed and developed through an iterative process, to ensure that both together optimize their relationship with the Standards Specification and the Assessment Strategy. They will be agreed by the Experts and submitted to WSI for approval together, in order to demonstrate their quality and conformity with the Standards Specification.

Prior to submission for approval to WSI, the Marking Scheme and Test Project will liaise with the WSI Skill Advisors in order to benefit from the capabilities of the CIS.



4 THE MARKING SCHEME

4.1 GENERAL GUIDANCE

This section describes the role and place of the Marking Scheme, how the Experts will assess Competitors' work as demonstrated through the Test Project, and the procedures and requirements for marking.

The Marking Scheme is the pivotal instrument of the WorldSkills Competition, in that it ties assessment to the standards that represent the skill. It is designed to allocate marks for each assessed aspect of performance in accordance with the weightings in the Standards Specification.

By reflecting the weightings in the Standards Specification, the Marking Scheme establishes the parameters for the design of the Test Project. Depending on the nature of the skill and its assessment needs, it may initially be appropriate to develop the Marking Scheme in more detail as a guide for Test Project design. Alternatively, initial Test Project design can be based on the outline Marking Scheme. From this point onwards the Marking Scheme and Test Project should be developed together.

Section 2.1 above indicates the extent to which the Marking Scheme and Test Project may diverge from the weightings given in the Standards Specification, if there is no practicable alternative.

The Marking Scheme and Test Project may be developed by one person, or several, or by all Experts. The detailed and final Marking Scheme and Test Project must be approved by the whole Expert Jury prior to submission for independent quality assurance. The exception to this process is for those skill competitions which use an external designer for the development of the Marking Scheme and Test Project.

In addition, Experts are encouraged to submit their Marking Schemes and Test Projects for comment and provisional approval well in advance of completion, in order to avoid disappointment or setbacks at a late stage. They are also advised to work with the CIS Team at this intermediate stage, in order to take full advantage of the possibilities of the CIS.

In all cases the complete and approved Marking Scheme must be entered into the CIS at least eight weeks prior to the Competition using the CIS standard spreadsheet or other agreed methods.

4.2 ASSESSMENT CRITERIA

The main headings of the Marking Scheme are the Assessment Criteria. These headings are derived in conjunction with the Test Project. In some skill competitions the Assessment Criteria may be similar to the section headings in the Standards Specification; in others they may be totally different. There will normally be between five and nine Assessment Criteria. Whether or not the headings match, the Marking Scheme must reflect the weightings in the Standards Specification.

Assessment Criteria are created by the person(s) developing the Marking Scheme, who are free to define criteria that they consider most suited to the assessment and marking of the Test Project. Each Assessment Criterion is defined by a letter (A-I).

The Mark Summary Form generated by the CIS will comprise a list of the Assessment Criteria.

The marks allocated to each criterion will be calculated by the CIS. These will be the cumulative sum of marks given to each aspect of assessment within that Assessment Criterion.



4.3 SUB CRITERIA

Each Assessment Criterion is divided into one or more Sub Criteria. Each Sub Criterion becomes the heading for a WorldSkills marking form.

Each marking form (Sub Criterion) has a specified day on which it will be marked.

Each marking form (Sub Criterion) contains either objective or subjective Aspects to be marked. Some Sub Criteria have both objective and subjective aspects, in which case there is a marking form for each.

4.4 ASPECTS

Each Aspect defines, in detail, a single item to be assessed and marked together with the marks, or instructions for how the marks are to be awarded. Aspects are assessed either objectively or subjectively and appear on the appropriate marking form.

The marking form lists, in detail, every Aspect to be marked together with the mark allocated to it and a reference to the section of the skill as set out in the Standards Specification.

The sum of the marks allocated to each Aspect must fall within the range of marks specified for that section of the skill in the Standards Specification. This will be displayed in the Mark Allocation Table of the CIS, in the following format, when the Marking Scheme is reviewed from C-8 weeks. (Section 4.1)

		CRITERIA										TOTAL MARKS PER SECTION
STANDARD SPECIFICATION SECTIONS												
TOTAL MARKS PER CRITERION												100

SAMPLE OF TABLE FROM CIS



4.5 SUBJECTIVE MARKING

Subjective marking uses the 10 point scale below. To apply the scale with rigour and consistency, subjective marking should be conducted using:

- benchmarks (criteria) to guide judgment against each Aspect
- the scale to indicate:
 - 0: non attempt;
 - 1-4: below industry standard;
 - 5-8: at or above industry standard;
 - 9-10: excellence.

4.6 OBJECTIVE MARKING

A minimum of three experts will be used to judge each aspect. Unless otherwise stated only the maximum mark or zero will be awarded. Where they are used, partial marks will be clearly defined within the Aspect.



4.7 THE USE OF OBJECTIVE AND SUBJECTIVE ASSESSMENT

The final deployment of objective or subjective assessment will be agreed when the Marking Scheme and Test Project are finalized. The table below is advisory only for the development of the Test Project and Marking Scheme.

SECTION	CRITERION	MARKS		
		Subjective	Objective	Total
A	Visual			50
A1	Module one - Fillet weld one	0	2.4	
A2	Module one - 10mm Test coupon	0	2.2	
A3	Module one - 16mm Test coupon	0	2.2	
A4	Module one - Test Pipe coupon	0	2.2	
A5	Module two - Pressure vessel	0	21	
A6	Module three - Aluminium structure	0	10	
A7	Module four - Stainless steel structure	0	10	
B	Pressure Test			15
B1	Module two – Pressure Vessel – pressure test	0	15	
C	Destructive and Non- destructive Testing			25
C1	Module one - Fillet weld – fillet break test	0	4	
C2	Module one - 10mm coupon – Radiographic	0	7	
C3	Module one - 16mm coupon – Radiographic	0	7	
C4	Module one – test pipe coupon – Radiographic	0	7	
D	Assembly and Competency Interpretation			10
D1	All modules – Assembly and competency interpretation	0	10	
Total		0	100	100

Note: A Competitor cannot have marks deducted for the same imperfection more than once.



4.8 COMPLETION OF SKILL ASSESSMENT SPECIFICATION

The skill assessment criteria are clear concise aspect specifications which explain exactly how and why a particular mark is awarded. The following table is a guide to the visual assessment of weld seams.

IMPERFECTION DESCRIPTION	EXPLANATION	LIMITS FOR IMPERFECTIONS
1. Cracks	Is the weld free of all cracks?	Not permitted
2. Weld starts and craters	Are weld bead craters and starts completely filled? (From crown to crater bottom, or crown of stop and crown of restart)	Task two (PV) $\leq 1.5\text{mm}$ Task three (AL) - $\leq 1.0\text{mm}$ Task four (SS) - $\leq 1.0\text{mm}$
3. Stray Arc Strikes	Are stray arc strikes absent?	Not permitted
4. Slag and Spatter Removed	Is all surface slag and spatter removed from the joint and surrounding area?	Greater than 99% of all slag and spatter to be removed
5. Grinding Marks	Is the weld surface free from grinding or other metal removal on the cap pass (es) and penetration, for the purpose of enhancing the finished weld?	No metal removal permitted from the finished weld
6. Visual Inclusions	Is the weld metal free of short, solid imperfections? (slag, flux, oxide or metallic inclusions)	Task two (PV) Incremental marking max. two defects
7. Worm Holes	Is the weld metal free of visual wormholes or cavities? (elongated cavities)	Task one (Coupon) - See International Standard ISO 5817
8. Surface or internal Porosity and Gas Pores	Is the weld metal free of porosity?	Task one (Coupon) - See International Standard ISO 5817 Task two (PV) Incremental marking max. two defects Task three (AL) - Incremental marking max. two defects Task four (SS) - Incremental marking max. two defects
9. Undercut	Is the weld joint free from undercut?	$\geq 0.5\text{mm}$
10. Overlap (Overroll)	Is the weld joint completely free of overlap (overroll)?	Not permitted
11. Lack of Penetration	Is the joint free from lack of penetration or root fusion?	Task one (Coupon)- See International Standard ISO 5817 Task three (AL) – Incremental marking Task four (SS) - Incremental marking



IMPERFECTION DESCRIPTION	EXPLANATION	LIMITS FOR IMPERFECTIONS
12. Excessive root concavity (shrinkage groove)	Is the weld penetration free of excessive root concavity "suck back"?	Task one - See International Standard ISO 5817
13. Excessive Penetration	Is the joint free of excessive penetration?	Task one (Coupon) - $\leq 2.0\text{mm}$ Task two (PV) - N/A Task three (AL) - $\leq 3.0\text{mm}$ Task four (SS) - $\leq 2.5\text{mm}$
14. Excessive Face Reinforcement (height)	Is the weld joint free of excessive face reinforcement?	Task one (Fillet) - $\leq 3.0\text{mm}$ Task one (Butt) - $\leq 2.5\text{mm}$ Task two (PV) - $\leq 2.5\text{mm}$ Task three (AL) - $\leq 1.5\text{mm}$ Task four (SS) - $\leq 1.5\text{mm}$
15. Incompletely filled groove	Is the butt weld groove completely filled?	Not Permitted
16. Linear Misalignment (high/low)	Is the joint free from linear (high/low) misalignment?	Task one - See International Standard ISO 5817 Task two (PV) - $\leq 1.0\text{mm}$ Task three (AL) - $\leq 1.0\text{mm}$ Task four (SS) - $\leq 1.0\text{mm}$
17. Fillet Weld Sizes	Are fillet sizes in accordance with specifications? (Measurement leg length)	Task one (Coupon) -0/+2mm Task two (PV) -0/+2mm Task three (AL) -0/+2mm Task four (SS) -0/+1mm
18. Full Radius Contour	Does the joint exhibit a full radius contour = to plate thickness?	Full radius contour
19. Excessive Width of Butt Weld Face	Are bead widths uniform and regular? (Measure narrowest portion vs. widest portion)	Task one (Coupon) - $\leq 2.0\text{mm}$ Task two (PV) - $\leq 2.0\text{mm}$ Task three (AL) - $\leq 1.5\text{mm}$ Task four (SS) - $\leq 1.0\text{mm}$



4.9 SKILL ASSESSMENT PROCEDURES

Procedure for performing non-destructive testing

1. Specified procedures shall be used for all non-destructive testing.
2. The welded test coupons shall be radiographed in the as welded condition. (No removal of any excess weld metal.)
3. Radiography of the test coupons shall be performed in accordance with ISO 5817.

Procedure for performing fracture tests on the Fillet welded coupon

1. Each test piece shall be positioned for breaking in accordance with ISO 9173;
2. Each coupon shall be visually assessed after breaking for lack of fusion and porosity;

Procedure for the hydrostatic pressure test

1. The Expert, whose Competitor's vessel is being tested, is allowed to witness the test;
2. Fill the vessel with water and ensure that all air is allowed to escape;
3. Plug vessel and pressurize to two bar (30psi);
4. Ensure vessel is fully dry on outside;
5. If vessel exhibits a leak – Score one point and test is complete. (see section 11);
6. If vessel exhibits no leak, continue to be pressurized to 35 bar (500psi). Allow 10 seconds to stabilize before inspection commences);
7. Hold for 60 seconds. If a leak is observed – Score one point and test is complete. (see #9) If no leak is detected increase pressure to 69 bar (1000psi). Hold for 10 seconds to stabilize before inspection commences (provided a suitable pressure pump is available);
8. Hold for a 60 seconds. If a leak is observed – Score 7.5 points. If no leak is observed - Score
9. 15 points and test is complete;
10. Drain all water from the vessel.

Note: If a leak is detected, it shall be highlighted with a metal marker.



5 THE TEST PROJECT

5.1 GENERAL NOTES

Sections three and four govern the development of the Test Project. These notes are supplementary.

Whether it is a single entity, or a series of stand-alone or connected modules, the Test Project will enable the assessment of the skills in each section of the WSSS.

The purpose of the Test Project is to provide full and balanced opportunities for assessment and marking across the Standards Specification, in conjunction with the Marking Scheme. The relationship between the Test Project, Marking Scheme and Standards Specification will be a key indicator of quality.

The Test Project will not cover areas outside the Standards Specification, or affect the balance of marks within the Standards Specification other than in the circumstances indicated by Section 2.

The Test Project will enable knowledge and understanding to be assessed solely through their applications within practical work.

The Test Project will not assess knowledge of WorldSkills rules and regulations.

This Technical Description will note any issues that affect the Test Project's capacity to support the full range of assessment relative to the Standards Specification. Section 0 refers.

5.2 FORMAT/STRUCTURE OF THE TEST PROJECT

The format of the Test Project is a series of standalone modules and must be validated as defined below.

5.3 TEST PROJECT DESIGN REQUIREMENTS

General Requirements

Overall, the Test Project shall be modular.

Materials and Equipment: Welding power sources:

- 111 SMAW, MMAW, 141 GTAW, TIG: AC/DC, 300 Amps Inverter-Type with Hi-Frequency, AC-Frequency (Hz) and Pulse controls;
- 135 GMAW, MAG, 136 FCAW: DC, 350 Amps with Pulse or Synergic control.

Welding accessories

- 111 SMAW, MMAW Welding cable and electrode holder;
- 141 GTAW, TIG gun and accessories, contact tips, diffusers, shielding gas accessories, regulator, hoses, remote variable amperage controls, foot or hand-operated, hose for purging;
- 135 GMAW, MAG gun and accessories, contact tips, diffusers, shielding gas accessories, regulator, hoses, etc.
- 136 FCAW gun and accessories, contact tips, diffusers, shielding gas accessories, regulator, hoses, etc.

During the Competition only the materials provided by the Competition Organizer may be used.

Practice plates for the Competition:

The Competition Organizer shall provide two sets (four pieces each) of material for each of the test

Coupons and ten pieces each (100x50mm) of aluminium and stainless steel material in the thickness of the tasks, to be used for practice plates. These plates shall be made available to the Competitor for



practice on the day set aside for testing the installations before the Competition and for adjusting the welding parameters during the Competition.

Dimensions of practice plates

The practice plates shall be the same width and thickness as the actual Test Project module pieces but they shall each be shorter by 20mm in length.

Basic materials

Steel groups according to CR ISO/TR 15608 (1999), Group one, two or three for low carbon steel; Group eight for stainless steel (300 series), and aluminium in the 5000 and 6000 series.

Plates

- High quality low carbon steel, 2mm to 20mm thick to ISO 10038;
- For pressure vessel, plates are to have through-thickness tested certification;
- Austenitic stainless steel, 1.5mm to 10mm thick e.g. 18/8 types X5CrNi 18;
- Aluminium, 1.5mm to 10mm thick e.g. 5000 or 6000 series.

Pipes

- High quality low carbon steel pipes to ISO 10038, dia. 25mm to 250mm, wall thickness 1.6mm to 10mm;
- Stainless steel and aluminium, diameter 25mm to 250mm, wall thickness 1.6mm to 6mm.

Test coupons shall be cut, milled or turned, so that they are smooth and parallel.

Module one: Test coupons

- Time: five or six hours approximately;
- Quantity: three to five specimens, either Single V-groove butt joint welds or fillet welds;
- Welding processes: See Appendix 11;
- Welding positions: See Appendix 11;
- Drawings: See Appendix 11.

The Competitor shall submit the test coupons fully assembled to the Experts for stamping prior to welding.

The fillet weld coupon shall consist of two (2) pieces each 12mm in thickness, one piece 125mm wide in length and the other 100mm wide, 250mm in length.

The fillet weld coupon shall have a leg dimension of 10mm, with an allowable tolerance of (+2mm – 0mm). The fillet welds must be completed with a minimum of two runs and a maximum of three runs.

The weld must be multi run with a maximum of three runs. Single run or welds with more than three Runs will NOT be allocated any marks for that coupon.

One test plate coupon shall consist of two (2) pieces, each 10mm in thickness, 100mm wide and 250mm in length.

The second test plate coupon shall consist of two (2) pieces, each 16mm x 150mm x 250mm.



When welding the 16 mm test coupon, hold point will be as follows:

1. If GMAW (MAG) is drawn for the root pass, a stop/start will be required in the centre 75mm of the plate;
2. If any semi- automatic processes (GMAW/MA/FCAW) are drawn for the fill and cap passes, a stop/start in the centre 75mm of the cap pass only will be required. A weave or the last pass of a multi-pass stringer bead cap is considered for the stop and restart.

GTAW (141) shall not be used on the 16mm test coupon.

GMAW (MAG) is the only semi -automatic process to be used for root pass runs. FCAW (136) shall not be considered for making root passes.

The pipe test coupon shall consist of two (2) pieces of 114.3mm dia x 8.56mm wall (4" SCH 80) carbon steel pipe.

The fillet weld coupon shall contain a stop start in the middle 75mm of the joint. The stop start shall be located in either root or capping run to be decided by a jury vote at the Competition.

The stop/start to be inspected and verified by stamping.

Each of the two plate coupons shall be welded with a different process. If a combination process joint is selected from the table for the 16mm coupon as listed in appendix 11 this rule shall not apply.

The pipe coupon shall be welded with the process or processes selected from the table listed in Appendix 11.

Restarting

For all test plates, 20mm at the start and finish will not form part of the inspection or marking process.

The preparation for all butt weld test coupons shall be milled or turned at 30° to a featheredge. (No root face) See Appendix 11.2 for test coupon drawings.

Module two: Pressure vessel

Description: A completely enclosed plate/pipe structure, which shall encompass all four of the process listed and all weld positions as described in this Technical Description.

- Time: seven to eight hours approximately;
- Size: Overall dimensional space, approximately 350mmx350mmx400mm;
- Plate thickness: 6,8 and 10mm;
- Pipe wall thickness 3 to 10mm;
- Pressure test minimum normally 1000psi (69 bar).

The pressure vessel shall not weigh more than 35kg in the welded condition.

The Experts reserve the right to amend the design test pressure of any pressure vessel prior to the start of the Competition.



Module three: Aluminium structure

Description: A partially enclosed structure of aluminium, which shall be welded with TIG (141).

- Time: two or three hours approximately;
- Size: Overall dimensional space approximately 200mm x 200mm x 250mm;
- Aluminium plate/pipe material thickness 1.5 to 3mm.

All seams shall be welded in one run/pass with filler metal. The deposit of second run with or without filler will result in NO marks being awarded for the entire structure.

HOLD POINT: All directed stop starts shall be inspected by an Expert and stamped before This Test Project module may be sawn in half, if necessary, to enable weld penetration inspection and marking.

Module four: Stainless Steel structure

Description: A partially enclosed structure of stainless, which shall be welded with TIG (141).

- Time: two or three hours approximately;
- Size: Overall dimensional space approximately 150mm x 150mm x 200mm;
- Stainless steel plate/pipe material thickness 1.5 to 3mm.

All seams shall be welded in one run/pass with filler metal. The deposit of second run with or without filler will result in no marks being awarded for the entire structure

This Test Project module may be sawn in half, where necessary, to enable weld penetration inspection and marking to be carried out.

Competition specific instructions

Welding machines, tools and equipment usage

- It is a requirement that the Competition Organizer supplies welding machines that can be used in basic modes of operation;
- Welding machines may be used to their full technical potential;
- It is a requirement that the Competition Organizer makes available detailed operation manuals to all participating countries/regions at least six (6) months prior to the Competition;
- The welding machines provided shall have the capability to be operated using both standard amperage control and remote amperage control. Remote variable amperage devices shall be made available;

Remote hand-held and foot controls switching controls must be provided.

Grinding and the use of abrasive materials and equipment:

- Material removal is not permitted on any of the root penetration or cap weld surfaces. "Cap pass" shall be defined as the final layer of the weld that meets the weld size, grooves and fillets.

Restarts may be prepared before welding over them.

- Grinding the surfaces of the fillet coupon material before welding is permitted but the machined preparation angle shall remain at 90 degrees.

Wire brushing:

- Wire brushing, manual or powered, may be used on all weld surfaces of the test plates/pipes (Module one) and the pressure vessel (Module two).

Wire brushing is NOT permitted on any of the completed welds of the aluminium project (Module three) or the stainless steel project (Module four).



Backing bars/plates and restraining devices

- No copper (Cu) chill plates or ceramic backing tapes/bars are to be used in the Competition;
- Purging equipment may only be used with the Gas Tungsten Arc Welding process on the stainless steel project;
- Restraining devices shall not be used during welding of the test plates. Such devices include:
 - Clamps, jigs, fixtures or steel plates, tack welded to the test plates;
- Welding of the test plates is to be carried out without the aid of restraining devices; this is so the Experts can assess the control of distortion;
- Only standard fixture or positioning aids (positioners), supplied by the Competition Organizer may be used when welding the test coupons. Depending on the selected projects they shall at all times be welded and ground 100% on the workbench. Only when instructed can a Competitor grind a coupon while still located in the positioner.

Weld cleaning of GTAW (TIG) projects

- The weld faces on the aluminium and stainless steel GTAW (TIG) projects are to be presented in the "as welded" condition. Cleaning, grinding, steel wool, wire brushing or chemical cleaning is NOT permitted on any of the welds.

Tack welds

- The maximum length of any one tack weld is 15mm;
- For pressure vessel tacking, 15mm tacks may be combined about the X, Y and Z axis;
- When assembling the pressure vessel, the Competitor may use any of the welding processes listed in this Technical Description that drawing for tack welding and in any position;
- No tack welds shall be made on the inside of the pressure vessel project.

HOLD POINT: An Expert shall inspect the inside of the vessel to ensure that there are NO internal tacks before enclosing the vessel. Inspection will be confirmed by stamping.

Tacking of the fillet coupons is as follows:

- One tack at each end of the test coupon;
- One 25mm tack weld placed within the centre 50mm of the coupon to the rear of the weld area and tasks are to be fully assembled prior to submission for stamping;
- When tacking the test coupons, i.e. fillet welds, test pipe, and test plates, the Competitor may use any of the welding processes listed in this Technical Description.

Welding of test plates/pipes

- Once welding has commenced, the test plates may not be separated and then re-tacked. Re-tacking may only take place, if root welding has not commenced.

HOLD POINT: The test pipe coupon shall be secured in the positioner provided and mark the in 12 o'clock position before welding commences. This is to be confirmed by stamping and will also act as a reference point for any inspection or testing.

If a Competitor welds a coupon with the incorrect process or in the incorrect position, no further inspection and testing will be carried out and no marks are awarded to that coupon.

If any of the joint configurations on the pressure vessel i.e. butt, fillet or outside corners are welded with the incorrect process or in the incorrect position, that joint configuration shall not be visually assessed and no marks are awarded.

Aluminium or stainless steel structures

If any of the joints are welded in the incorrect position, no further inspection shall be carried out and no marks are awarded for the complete structure.

After tacking, inspection and verification by stamping there can be no further material removal, no grinding or filing shall be carried out on the structure.



A Competitor who is seen to be carrying out an operation that compromises any of rules or guidelines of this technical description will be notified immediately, to carry out no further work on the project until the matter is brought to a conclusion. The Competitor shall not be penalized by any time penalty during any investigation.

5.4 TEST PROJECT DEVELOPMENT

The Test Project MUST be submitted using the templates provided by WorldSkills International (www.worldskills.org/expertcentre). Use the Word template for text documents and DWG template for drawings.

5.4.1 Who develops the Test Project or modules

The Test Project/modules are developed and submitted by skill Experts (submission is optional for first time Experts).

5.4.2 How and where is the Test Project or modules developed

The Test Project/modules are developed independently, however, discussion, collaboration and Communication is encouraged through the Discussion Forum.

5.4.3 When is the Test Project developed

The Test Project is developed according to the following timeline:

TIME	ACTIVITY
At the previous Competition	Experts develop and propose Test Project modules. A panel of Experts validates each proposal and a vote for modules two to four is conducted for the selection of the modules to be used at the following competition. Experts indicate their preferred test coupon for the following Competition. The preferred coupons are listed as possible coupons for the following Competition
Issue of projects two, three and four	The selected Test Project modules two to four will be circulated immediately after the previous Competition
At the Competition	Test coupons (module one) are selected at random from the list in Appendix nine and Competitors are notified immediately on Familiarization Day (C-2). Experts select the position and process for root pass, fill and cap passes. This constitutes the 30% change

5.5 TEST PROJECT VALIDATION

It must be demonstrated that the Test Project/modules can be completed within the material, equipment, knowledge and time constraints. This will be demonstrated by including the following information with submissions for any Test Project module for selection:

- A separate cutting list for all the required materials for the Test Project modules shall be included to assist the Competition Organizers;
- A photograph of the welded stainless steel and aluminium structures;
- A photograph of the pressure vessel under pressure test with the pressure attained visible, 1000psi (69 bar);
- Any additional instructions for Competitors to aid in the completion of the project.



5.6 TEST PROJECT SELECTION

The Test Coupons for the Competition shall be selected from a standard list at Appendix 11. This standard list will detail the position of the coupon, the process for the root pass and the process for the fill and cap passes. Each Expert present at the preceding Competition shall nominate one test coupon of their preference from the standard list, and that coupon will then be eligible for selection at the next Competition.

All Test Project modules shall comply with the Technical Description. An Expert panel will validate each project submitted for selection prior to voting using the following project checklist.

Project submission is optional for first-time Experts.

Welding project selection criteria

SUBMITTED BY _____	PRESSURE VESSEL	ALUMINIUM STRUCTURE	STAINLESS STEEL STRUCTURE
Project Drawings ISO A Weld symbols as per AWS Electronic format			
Project Drawings ISO E Weld symbols as per ISO 2533 Electronic Format			
Material/Cutting list			
Photograph of completed tasks			
Pressure Vessel weight		NA	NA
Project Major Dimensions			
Additional instructions on drawings			

Module one - Test Coupons

The Test Coupons for the Competition will be selected from the standard list at Appendix 11 by ballot.

Those coupons nominated at the preceding Competition will be drawn at random just prior to the Competitor familiarization period. The Competitors shall be informed of the selection at the earliest opportunity on Familiarization Day (C-2).



Modules two, three and four - Pressure Vessel, Aluminium Structure and Stainless Steel Structure

The pressure vessel, aluminium structure and stainless steel structure shall be selected by a vote at the preceding Competition by those Experts who are eligible to vote. Any Expert (except first-time Experts) who fails to submit a Test Project module for proposal shall not be eligible to vote on the project selection.

Each module is to be selected individually and not as a complete package.

Time will be made available after the Test Project modules have been validated for selection, for those Experts who have projects to submit, to display the drawings and details of their submissions and to brief the remaining Experts on the details of their projects. The Welding Experts will then review the submissions and those who are eligible to vote will do so under the supervision of the Chief Expert.

The Test Project modules selected shall be submitted without delay to be held by the WorldSkills Technical Director until they are circulated on the WSI website as per paragraph 3.7.

The modules listed below are to be completed in the following order. Test order in module one is to be determined before C-2.

- Module one - Fillet weld (Day one)
Visual assessment, Destructive testing and competency and assembly assessment
- Module one - 10mm Test plate (Day one)
Visual assessment, Radiographic testing, competency and assembly assessment.
- Module one - 16mm Test Plate (Day one)
Visual assessment, Radiographic testing, competency and assembly assessment
- Module one - Test Pipe (Day one to two)
Visual assessment, Non-destructive testing and Competency and assembly assessment.
- Module two - Pressure Vessel (Day one to three)
Visual assessment, Pressure test and Competency and assembly assessment.
- Module three - Aluminium Structure (Day three to four)
Visual assessment and Competency and assembly assessment.
- Module four - Stainless Steel Structure (Day four)
Visual assessment and Competency and assembly assessment.

5.7 TEST PROJECT CIRCULATION

The Test Project is circulated via the website as follows:

The drawings and associated information for three modules shall be made available via the WorldSkills International immediately after the previous Competition.

The test coupons nominated for the next Competition shall be made available as part of this Technical Description. The specific selection will take place until at the next Competition.

5.8 TEST PROJECT COORDINATION (PREPARATION FOR COMPETITION)

Coordination of the Test Project will be undertaken by the Chief Expert and Deputy Chief Expert.



5.9 TEST PROJECT CHANGE AT THE COMPETITION

At the Competition, the Experts shall select the position and process for root pass, fill and cap passes from the standard list at Appendix 11. This change to the project shall provide the 30% project design change as required by WorldSkills.

Other changes to the remaining tasks are allowed at the discretion of the Experts if required.

This may include process/weld position changes but NOT changes to the material to be supplied by the Competition Organizer.

5.10 MATERIAL OR MANUFACTURER SPECIFICATIONS

Specific material and/or manufacturer specifications required to allow the Competitor to complete the Test Project will be supplied by the Competition Organizer and are available from www.worldskills.org/infrastructure located in the Expert Centre.



6 SKILL MANAGEMENT AND COMMUNICATION

6.1 DISCUSSION FORUM

Prior to the Competition, all discussion, communication, collaboration, and decision making regarding the skill competition must take place on the skill specific Discussion Forum (<http://forums.worldskills.org>). Skill related decisions and communication are only valid if they take place on the forum. The Chief Expert (or an Expert nominated by the Chief Expert) will be the moderator for this Forum. Refer to Competition Rules for the timeline of communication and competition development requirements.

6.2 COMPETITOR INFORMATION

All information for registered Competitors is available from the Competitor Centre (www.worldskills.org/competitorcentre).

This information includes:

- Competition Rules
- Technical Descriptions
- Marking Schemes
- Test Projects
- Infrastructure List
- Health and Safety documentation
- Other Competition-related information

6.3 TEST PROJECTS [AND MARKING SCHEMES]

Circulated Test Projects will be available from www.worldskills.org/testprojects and the Competitor Centre (www.worldskills.org/competitorcentre).

6.4 DAY-TO-DAY MANAGEMENT

The day-to-day management of the skill during the Competition is defined in the Skill Management Plan that is created by the Skill Management Team led by the Chief Expert. The Skill Management Team comprises the Jury President, Chief Expert and Deputy Chief Expert. The Skill Management Plan is progressively developed in the six months prior to the Competition and finalized at the Competition by agreement of the Experts. The Skill Management Plan can be viewed in the Expert Centre (www.worldskills.org/expertcentre).



7 SKILL-SPECIFIC SAFETY REQUIREMENTS

Refer to Host Country/Region Health and Safety documentation for Host Country/Region regulations.

Competitors at a minimum shall use during the Competition the following personal protective equipment. All safety equipment must comply with Host Country Health and Safety requirements.

- Safety Glasses;
- Body protection – flame retardant material;
- Foot protection – from dropping objects;
- Hand Protection – heat and arc radiation;
- Face protection – Head or Hand welding shield;
- Hearing Protection;
- Clear face shield (grinding, may be integrated in the welding head shield);
- Fume and particle protection.



8 MATERIALS AND EQUIPMENT

8.1 INFRASTRUCTURE LIST

The Infrastructure List details all equipment, materials and facilities provided by the Competition Organizer.

The Infrastructure List is available at www.worldskills.org/infrastructure.

The Infrastructure List specifies the items and quantities requested by the Experts for the next Competition. The Competition Organizer will progressively update the Infrastructure List specifying the actual quantity, type, brand, and model of the items. Items supplied by the Competition Organizer are shown in a separate column.

At each Competition, the Experts must review and update the Infrastructure List in preparation for the next Competition. Experts must advise the Technical Director of any increases in space and/or equipment.

At each Competition, the Technical Observer must audit the Infrastructure List that was used at that Competition.

The Infrastructure List does not include items that Competitors and/or Experts are required to bring and items that Competitors are not allowed to bring – they are specified below.



8.2 MATERIALS, EQUIPMENT AND TOOLS SUPPLIED BY COMPETITORS IN THEIR TOOLBOX

Non-consumable materials, equipment and tools to be supplied by the Competitor.

The Competitor shall bring tools and equipment in a toolbox and is encouraged to bring other new tools and devices that are being used in today's industry.

The following list as a minimum shall be supplied by the Competitor:

- Welding safety glasses;
- Grinding goggles;
- Welders helmet, speed lenses are permitted;:
- Safety boots with protective toes;
- Ear protection;
- Hand angle grinder with guard, maximum 125mm (5inch);
- Wire brush wheels to suit grinder;
- Fire retardant clothing;
- Chipping hammer (slag hammer);
- Inter-weld run cleaning, blade scrapers;
- Chisels;
- Scriber;
- Files;
- Wire brushes;
- Hammer;
- Weld gauge (fillet gauge);
- Metric steel ruler (tape measure);
- Square;
- Chalk/soapstone;
- Dividers;
- G-clamps and/or c-clamps and quick gripping devices;
- Power transformer (if required) and extension leads;
- Competitors may use their own SMAW, (MMAW), GTAW (TIG), GMAW (MAG) and FCAW hand pieces/torches, provided they are compatible with the Competition Organizer's equipment;
- The Competitor's equipment shall comply with safety regulations;
- Should any Competitor supplied equipment fail or become unserviceable during the competition, no additional time allowance shall be made;
- Other personal hand tools;
- All working clothes and all tools shall comply with Host Country safety regulations. Alignment aids for setting up test samples may be used, provided they are removed prior to welding.

8.3 MATERIALS, EQUIPMENT AND TOOLS SUPPLIED BY EXPERTS

Not applicable.



8.4 MATERIALS AND EQUIPMENT PROHIBITED IN THE SKILL AREA

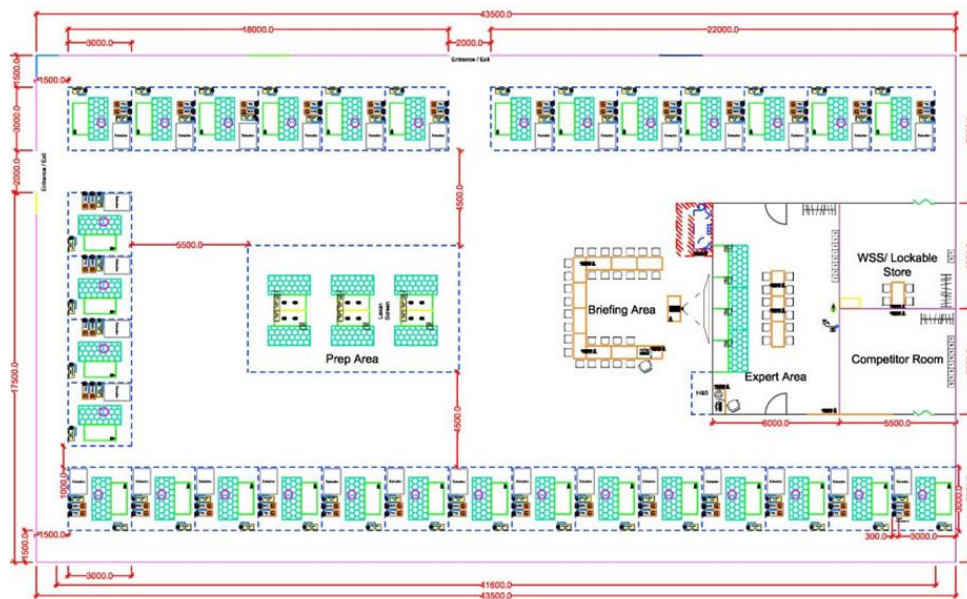
Any material that may be used to assemble a project or part of a project is not allowed to be brought to the Competition.

No additional consumables or practice materials are allowed to be brought to the Competition. Only items in section 8.2 are allowed.

8.5 PROPOSED WORKSHOP AND WORKSTATION LAYOUTS

Workshop layouts from previous competitions are available at www.worldskills.org/sitelayout.

Example workshop layout:





9 VISITOR AND MEDIA ENGAGEMENT

Following is a list of possible ways to maximize visitor and media engagement for this skill.

- Try a trade;
- Display screens;
- Test Project descriptions and displays;
- Enhanced understanding of Competitor activity;
- Competitor profiles;
- Career opportunities;
- Daily reporting of competition status.



10 SUSTAINABILITY

- Recycling;
- Use of 'green' materials;
- Use of completed Test Projects after Competition.



11 APPENDIX

11.1 SELECTION OF TEST PLATE AND PIPE PROJECTS

The horizontal row which has a country/region code in the right hand column is eligible for selection for the 2015 Competition.

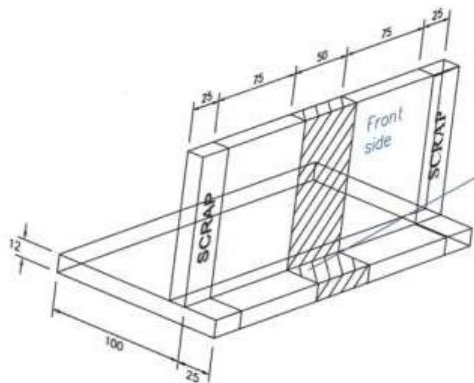
SELECTION OF THE TEST PLATE AND PIPE PROJECTS			SELECTED FOR 2015
Test Pipe 1A			
Positions	Root Pass	Fill and Cap	Member
6G HL-045	SMAW 111	SMAW 111	CA
2G PA	GTAW 141	SMAW 111	AT
5G PF	GTAW 141	GMAW 135	IR
PC 2G	GMAW 135	FCAW 136	NL
Test Plate 1B 10mm			
Positions	Root Pass	Fill and Cap	Member
3G PF	GMAW 135	FCAW 136	NO
3G PF	SMAW 111	SMAW 111	BR and CO
3G PF	SMAW 111	GMAW 135	OM
4G PE	SMAW	SMAW	USA



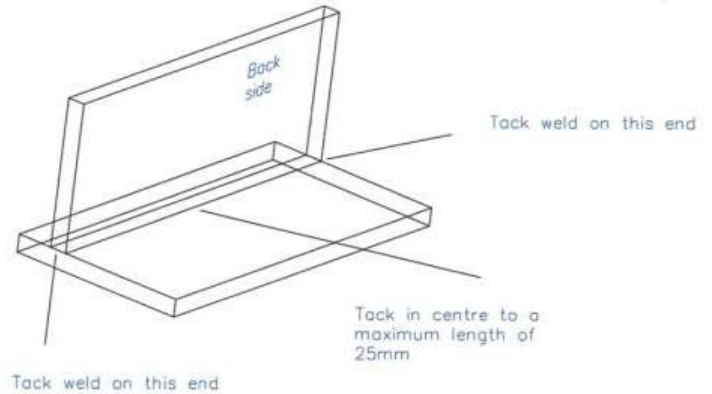
TEST PLATE 1C 16MM			
Positions	Root Pass	Fill and Cap	Member
3G PF	GMAW 135	FCAW 136	IE
PA 1G	SMAW 111	FCAW 136	DE
3G PF	GMAW 135	FCAW 136	SE and PT
2G PC	SMAW 111	GMAW	BE
Fillet weld test 12mm – two coupons to be selected			
Positions	Process		Member
3F PF	SMAW 111		IN and KW
2F PB	SMAW 111		IS
1F PA	GMAW 135		FI
2F PB	FCAW 136		AE



11.3 FILLET WELD SPECIMEN



Stop/start in the middle
50mm section on the root
run.



Instructions:

Deposit a fillet weld on the front side of the plate with a 10mm ± 1 leg length. Weld to be deposited with a minimum of 2 runs and a maximum of 3 runs. Edge preparation must remain at 90° to the plate face. No gap allowed.

Material

1 off 250mm x 125mm x 12mm CS plate
1 off 250mm x 100mm x 12mm CS plate