TRAINING REGULATIONS

GAS METAL ARC WELDING (GMAW) NC III

METALS AND ENGINEERING SECTOR

TECHNICAL EDUCATION AND SKILLS DEVELOPMENT AUTHORITY
East Service Road, South Superhighway, Taguig City, Metro Manila

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METALS AND ENGINEERING SECTOR

GAS METAL ARC WELDING (GMAW) NC III

TRAINING REGULATIONS FOR
GAS METAL ARC WELDING (GMAW) NC III

SECTION 1 GAS METAL ARC WELDING GMAW NC III

The Gas Metal Arc Welding (GMAW) NC III Qualification consists of competencies that a person must achieve to weld alloy steel plate and alloy steel pipe components as specified by layout, blueprints, diagrams, work order, welding procedure or oral instructions using GMAW welding equipment.

This Qualification conforms with American Welding Society (AWS) D 1.1 Structural Welding Code; American Society of Mechanical Engineers (ASME) IX Boiler and Pressure Vessel Code; American Petroleum Institute (API) 1104 Code for Gas and Oil Pipeline Facilities; and International Standards Organization (ISO) 9606-1 Qualification of Welders for Steel.

The Units of Competency comprising this qualification include the following:

Code No.	BASIC COMPETENCIES
5 00 311 1 09	Lead workplace communication
5 00 311 1 10	Lead small teams
5 00 311 1 11	Develop and practice negotiation skills
5 00 311 1 12	Solve problems related to work activities
5 00 311 1 13	Use mathematical concepts and techniques
5 00 311 1 14	Use relevant technologies

Code No.	COMMON COMPETENCIES
MEE721201	Apply Safety Practices
MEE721202	Interpret Drawings and Sketches
MEE721203	Perform Industry Calculations
MEE721204	Contribute to Quality System
MEE721205	Use Hand Tools
MEE721206	Prepare Weld Materials
MEE721207	Setup Welding Equipment
MEE721208	Fit up Weld Materials
MEE721209	Repair Welds

Code No.	CORE COMPETENCIES
MEE721314	Weld Alloy Steel Plates Using GMAW
MEE721318	Weld Alloy Steel Pipes Using GMAW

A person who has achieved this Qualification is competent to be:

- Plate Welder (GMAW)
- Pipe Welder (GMAW)
- GMAW Welder (Alloy Plate)
- GMAW Welder (Alloy Pipe)

SECTION 2 COMPETENCY STANDARDS

This section gives the details of the contents of the core units of competency required in Gas Metal Arc Welding (GMAW) NC III.

BASIC COMPETENCIES

UNIT OF COMPETENCY : LEAD WORKPLACE COMMUNICATION

UNIT CODE : 500311109

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes required to lead in the dissemination and discussion of ideas, information and issues in the workplace.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Communicate information about workplace processes	1.1. Appropriate ***communication method*** is selected 1.2. Multiple operations involving several topics areas are communicated accordingly 1.3. Questions are used to gain extra information 1.4. Correct sources of information are identified 1.5. Information is selected and organized correctly 1.6. Verbal and written reporting is undertaken when required 1.7. Communication skills are maintained in all situations
2. Lead workplace discussions	2.1. Response to workplace issues are sought 2.2. Response to workplace issues are provided immediately 2.3. Constructive contributions are made to workplace discussions on such issues as production, quality and safety 2.4. Goals/objectives and action plan undertaken in the workplace are communicated
3. Identify and communicate issues arising in the workplace	3.1. Issues and problems are identified as they arise 3.2. Information regarding problems and issues are organized coherently to ensure clear and effective communication 3.3. Dialogue is initiated with appropriate personnel 3.4. Communication problems and issues are raised as they arise

RANGE OF VARIABLES

VARIABLE	RANGE
1. Methods of communication	1.1. Non-verbal gestures 1.2. Verbal 1.3. Face to face 1.4. Two-way radio 1.5. Speaking to groups 1.6. Using telephone 1.7. Written 1.8. Internet

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1. Dealt with a range of communication/information at one time 1.2. Made constructive contributions in workplace issues 1.3. Sought workplace issues effectively 1.4. Responded to workplace issues promptly 1.5. Presented information clearly and effectively written form 1.6. Used appropriate sources of information 1.7. Asked appropriate questions 1.8. Provided accurate information
2. Underpinning knowledge and attitudes	2.1. Organization requirements for written and electronic communication methods 2.2. Effective verbal communication methods
3. Underpinning skills	3.1. Organize information 3.2. Understand and convey intended meaning 3.3. Participate in variety of workplace discussions 3.4. Comply with organization requirements for the use of written and electronic communication methods
4. Resource implications	The following resources **MUST** be provided: 4.1. Variety of Information 4.2. Communication tools 4.3. Simulated workplace
5. Methods of assessment	Competency may be assessed through: 5.1. Competency in this unit must be assessed through 5.2. Direct Observation 5.3. Interview
6. Context for assessment	6.1. Competency may be assessed in the workplace or in simulated workplace environment

UNIT OF COMPETENCY : LEAD SMALL TEAMS

UNIT CODE : 500311110

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes to lead small teams including setting and maintaining team and individual performance standards.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Provide team leadership	1.1. ***Work requirements*** are identified and presented to team members 1.2. Reasons for instructions and requirements are communicated to team members 1.3. ***Team members' queries and concerns*** are recognized, discussed and dealt with
2. Assign responsibilities	2.1. Duties, and responsibilities are allocated having regard to the skills, knowledge and aptitude required to properly undertake the assigned task and according to company policy 2.2. Duties are allocated having regard to individual preference, domestic and personal considerations, whenever possible
3. Set performance expectations for team members	3.1. Performance expectations are established based on client needs and according to assignment requirements 3.2. Performance expectations are based on individual team members duties and area of responsibility 3.3. Performance expectations are discussed and disseminated to individual team members
4. Supervised team performance	4.1. ***Monitoring of performance*** takes place against defined performance criteria and/or assignment instructions and corrective action taken if required 4.2. Team members are provided with ***feedback***, positive support and advice on strategies to overcome any deficiencies 4.3. ***Performance issues*** which cannot be rectified or addressed within the team are referenced to appropriate personnel according to employer policy 4.4. Team members are kept informed of any changes in the priority allocated to assignments or tasks which might impact on client/customer needs and satisfaction 4.5. Team operations are monitored to ensure that employer/client needs and requirements are met 4.6. Follow-up communication is provided on all issues affecting the team 4.7. All relevant documentation is completed in accordance with company procedures

RANGE OF VARIABLES

VARIABLE	RANGE
1. Work requirements	1.1. Client Profile 1.2. Assignment instructions
2. Team member's concerns	2.1. Roster/shift details
3. Monitor performance	3.1. Formal process 3.2. Informal process
4. Feedback	4.1. Formal process 4.2. Informal process
5. Performance issues	5.1. Work output 5.2. Work quality 5.3. Team participation 5.4. Compliance with workplace protocols 5.5. Safety 5.6. Customer service

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1. Maintained or improved individuals and/or team performance given a variety of possible scenario 1.2. Assessed and monitored team and individual performance against set criteria 1.3. Represented concerns of a team and individual to next level of management or appropriate specialist and to negotiate on their behalf 1.4. Allocated duties and responsibilities, having regard to individual's knowledge, skills and aptitude and the needs of the tasks to be performed 1.5. Set and communicated performance expectations for a range of tasks and duties within the team and provided feedback to team members
2. Underpinning knowledge	2.1. Company policies and procedures 2.2. Relevant legal requirements 2.3. How performance expectations are set 2.4. Methods of Monitoring Performance 2.5. Client expectations 2.6. Team member's duties and responsibilities
3. Underpinning skills	3.1. Communication skills required for leading teams 3.2. Informal performance counseling skills 3.3. Team building skills 3.4. Negotiating skills
4. Resource implications	The following resources **MUST** be provided: 4.1. Access to relevant workplace or appropriately simulated environment where assessment can take place 4.2. Materials relevant to the proposed activity or task
5. Methods of assessment	Competency may be assessed through: 5.1. Direct observations of work activities of the individual member in relation to the work activities of the group 5.2. Observation of simulation and/or role play involving the participation of individual member to the attainment of organizational goal 5.3. Case studies and scenarios as a basis for discussion of issues and strategies in teamwork
6. Context for assessment	6.1. Competency assessment may occur in workplace or any appropriately simulated environment 6.2. Assessment shall be observed while task are being undertaken whether individually or in-group

UNIT OF COMPETENCY : DEVELOP AND PRACTICE NEGOTIATION SKILLS

UNIT CODE : 500311111

UNIT DESCRIPTOR : This unit covers the skills, knowledge and attitudes required to collect information in order to negotiate to a desired outcome and participate in the negotiation.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Plan negotiations	1.1 Information on ***preparing for negotiation*** is identified and included in the plan 1.2 Information on creating ***non verbal environments*** for positive negotiating is identified and included in the plan 1.3 Information on ***active listening*** is identified and included in the plan 1.4 Information on different ***questioning techniques*** is identified and included in the plan 1.5 Information is checked to ensure it is correct and up-to- date
2. Participate in negotiations	2.1 Criteria for successful outcome are agreed upon by all parties 2.2 Desired outcome of all parties are considered 2.3 Appropriate language is used throughout the negotiation 2.4 A variety of questioning techniques are used 2.5 The issues and processes are documented and agreed upon by all parties 2.6 Possible solutions are discussed and their viability assessed 2.7 Areas for agreement are confirmed and recorded 2.8 Follow-up action is agreed upon by all parties

RANGE OF VARIABLES

VARIABLE	RANGE
1. Preparing for negotiation	1.1 Background information on other parties to the negotiation 1.2 Good understanding of topic to be negotiated 1.3 Clear understanding of desired outcome/s 1.4 Personal attributes 1.4.1 self awareness 1.4.2 self esteem 1.4.3 objectivity 1.4.4 empathy 1.4.5 respect for others 1.5 Interpersonal skills 1.5.1 listening/reflecting 1.5.2 non verbal communication 1.5.3 assertiveness 1.5.4 behavior labeling 1.5.5 testing understanding 1.5.6 seeking information 1.5.7 self disclosing 1.6 Analytic skills 1.6.1 observing differences between content and process 1.6.2 identifying bargaining information 1.6.3 applying strategies to manage process 1.6.4 applying steps in negotiating process 1.6.5 strategies to manage conflict 1.6.6 steps in negotiating process 1.6.7 options within organization and externally for resolving conflict
2. Non verbal environments	2.1 Friendly reception 2.2 Warm and welcoming room 2.3 Refreshments offered 2.4 Lead in conversation before negotiation begins
3. Active listening	3.1 Attentive 3.2 Don't interrupt 3.3 Good posture 3.4 Maintain eye contact 3.5 Reflective listening
4. Questioning techniques	4.1 Direct 4.2 Indirect 4.3 Open-ended

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Demonstrated sufficient knowledge of the factors influencing negotiation to achieve agreed outcome 1.2 Participated in negotiation with at least one person to achieve an agreed outcome
2. Underpinning knowledge and attitude	2.1 Codes of practice and guidelines for the organization 2.2 Organizations policy and procedures for negotiations 2.3 Decision making and conflict resolution strategies procedures 2.4 Problem solving strategies on how to deal with unexpected questions and attitudes during negotiation 2.5 Flexibility 2.6 Empathy
3. Underpinning skills	3.1 Interpersonal skills to develop rapport with other parties 3.2 Communication skills (verbal and listening) 3.3 Observation skills 3.4 Negotiation skills
4. Resource implications	The following resources **MUST** be provided: 4.1 Room with facilities necessary for the negotiation process 4.2 Human resources (negotiators)
5. Methods of assessment	Competency may be assessed through: 5.1 Observation/demonstration and questioning 5.2 Portfolio assessment 5.3 Oral and written questioning 5.4 Third party report
6. Context for assessment	6.1 Competency to be assessed in real work environment or in a simulated workplace setting.

UNIT OF COMPETENCY : SOLVE PROBLEMS RELATED TO WORK ACTIVITIES

UNIT CODE : 500311112

UNIT DESCRIPTOR : This unit of covers the knowledge, skills and attitudes required to solve problems in the workplace including the application of problem solving techniques and to determine and resolve the root cause of problems.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Identify the problem	1.1. Variances are identified from normal operating parameters; and product quality 1.2. Extent, cause and nature are of the problem are defined through observation, investigation and ***analytical techniques*** 1.3. ***Problems*** are clearly stated and specified
2. Determine fundamental causes of the problem	2.1. Possible causes are identified based on experience and the use of problem solving tools / analytical techniques. 2.2. Possible cause statements are developed based on findings 2.3. Fundamental causes are identified per results of investigation conducted
3. Determine corrective action	3.1. All possible options are considered for resolution of the problem 3.2. Strengths and weaknesses of possible options are considered 3.3. Corrective actions are determined to resolve the problem and possible future causes 3.4. **Action *plans*** are developed identifying measurable objectives, resource needs and timelines in accordance with safety and operating procedures
4. Provide recommendation/s to manager	4.1. Report on recommendations are prepared 4.2. Recommendations are presented to appropriate personnel. 4.3. Recommendations are followed-up, if required

RANGE OF VARIABLES

VARIABLE	RANGE
1. Analytical techniques	1.1. Brainstorming 1.2. Intuitions/Logic 1.3. Cause and effect diagrams 1.4. Pareto analysis 1.5. SWOT analysis 1.6. Gant chart, Pert CPM and graphs 1.7. Scatter grams
2. Problem	2.1. Non – routine process and quality problems 2.2. Equipment selection, availability and failure 2.3. Teamwork and work allocation problem 2.4. Safety and emergency situations and incidents
3. Action plans	3.1. Priority requirements 3.2. Measurable objectives 3.3. Resource requirements 3.4. Timelines 3.5. Co-ordination and feedback requirements 3.6. Safety requirements 3.7. Risk assessment 3.8. Environmental requirements

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1. Identified the problem 1.2. Determined the fundamental causes of the problem 1.3. Determined the correct / preventive action 1.4. Provided recommendation to manager These aspects may be best assessed using a range of scenarios / case studies / what ifs as a stimulus with a walk through forming part of the response. These assessment activities should include a range of problems, including new, unusual and improbable situations that may have happened.
2. Underpinning knowledge	2.1. Competence includes a thorough knowledge and understanding of the process, normal operating parameters, and product quality to recognize non-standard situations 2.2. Competence to include the ability to apply and explain, sufficient for the identification of fundamental cause, determining the corrective action and provision of recommendations 2.2.1. Relevant equipment and operational processes 2.2.2. Enterprise goals, targets and measures 2.2.3. Enterprise quality, OHS and environmental requirement 2.2.4. Principles of decision making strategies and techniques 2.2.5. Enterprise information systems and data collation 2.2.6. Industry codes and standards
3. Underpinning skills	3.1. Using range of formal problem solving techniques 3.2. Identifying and clarifying the nature of the problem 3.3. Devising the best solution 3.4. Evaluating the solution 3.5. Implementation of a developed plan to rectify the problem

4. Resource implications	4.1. Assessment will require access to an operating plant over an extended period of time, or a suitable method of gathering evidence of operating ability over a range of situations. A bank of scenarios / case studies / what ifs will be required as well as bank of questions which will be used to probe the reason behind the observable action.
5. Methods of assessment	Competency may be assessed through: 5.1. Case studies on solving problems in the workplace 5.2. Observation The unit will be assessed in a holistic manner as is practical and may be integrated with the assessment of other relevant units of competency. Assessment will occur over a range of situations, which will include disruptions to normal, smooth operation. Simulation may be required to allow for timely assessment of parts of this unit of competency. Simulation should be based on the actual workplace and will include walk through of the relevant competency components.
6. Context for assessment	6.1. In all workplace, it may be appropriate to assess this unit concurrently with relevant teamwork or operation units.

UNIT OF COMPETENCY : **USE MATHEMATICAL CONCEPTS AND TECHNIQUES**

UNIT CODE : **3500311113**

UNIT DESCRIPTOR : This unit covers the knowledge, skills and attitudes required in the application of mathematical concepts and techniques.

ELEMENT	Performance Criteria ***Italicized*** terms are elaborated in the Range of Variables
1. Identify mathematical tools and techniques to solve problem	1.1 Problem areas are identified based on given condition 1.2 ***Mathematical techniques*** are selected based on the given problem
2. Apply mathematical procedure/solution	2.1 Mathematical techniques are applied based on the problem identified 2.2 Mathematical computations are performed to the level of accuracy required for the problem 2.3 Results of mathematical computation is determined and verified based on job requirements
3. Analyze results	3.1 Result of application is reviewed based on expected and required specifications and outcome 3.2 ***Appropriate action*** is applied in case of error

RANGE OF VARIABLES

VARIABLE	RANGE
1. Mathematical techniques	May include but are not limited to: 1.1 Four fundamental operations 1.2 Measurements 1.3 Use/Conversion of units of measurements 1.4 Use of standard formulas
2. Appropriate action	2.1 Review in the use of mathematical techniques (e.g. recalculation, re-modeling) 2.2 Report error to immediate superior for proper action

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Identified, applied and reviewed the use of mathematical concepts and techniques to workplace problems
2. Underpinning knowledge	2.1 Fundamental operation (addition, subtraction, division, multiplication) 2.2 Measurement system 2.3 Precision and accuracy 2.4 Basic measuring tools/devices
3. Underpinning skills	3.1 Applying mathematical computations 3.2 Using calculator 3.3 Using different measuring tools
4. Resource implications	The following resources **MUST** be provided: 4.1 Calculator 4.2 Basic measuring tools 4.3 Case Problems
5. Methods of assessment	Competency may be assessed through: 5.1 Authenticated portfolio 5.2 Written Test 5.3 Interview/Oral Questioning 5.4 Demonstration
6. Context for assessment	6.1 Competency may be assessed in the work place or in a simulated work place setting

UNIT OF COMPETENCY : **USE RELEVANT TECHNOLOGIES**

UNIT CODE : **500311114**

UNIT DESCRIPTOR : This unit of competency covers the knowledge, skills, and attitude required in selecting, sourcing and applying appropriate and affordable technologies in the workplace.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Study/select appropriate technology	1.1 Usage of different ***technologies*** is determined based on job requirements 1.2 Appropriate technology is selected as per work specification
2. Apply relevant technology	2.1 Relevant technology is effectively used in carrying out function 2.2 Applicable software and hardware are used as per task requirement 2.3 ***Management concepts*** are observed and practiced as per established industry practices
3. Maintain/enhance ~~of~~ relevant technology	3.1 Maintenance of technology is applied in accordance with the ***industry standard operating procedure***, ***manufacturer's operating guidelines*** and ***occupational health and safety procedure*** to ensure its operative ability 3.2 Updating of technology is maintained through continuing education or training in accordance with job requirement 3.3 Technology failure/ defect is immediately reported to the concern/responsible person or section for ***appropriate action***

RANGE OF VARIABLES

VARIABLE	RANGE
1. Technology	May include but are not limited to: 1.1 Office technology 1.2 Industrial technology 1.3 System technology 1.4 Information technology 1.5 Training technology
2. Management concepts	May include but not limited to: 2.1 Real Time Management 2.2 KAIZEN or continuous improvement 2.3 5s 2.4 Total Quality Management 2.5 Other management/productivity tools
3. Industry standard operating procedure	3.1 Written guidelines relative to the usage of office technology/equipment 3.2 Verbal advise/instruction from the co-worker
4. Manufacturer's operating guidelines/ instructions	4.1 Written instruction/manuals of specific technology/ equipment 4.2 General instruction manual 4.3 Verbal advise from manufacturer relative to the operation of equipment
5. Occupational health and safety procedure	5.1 Relevant statutes on OHS 5.2 Company guidelines in using technology/equipment
6. Appropriate action	6.1 Implementing preventive maintenance schedule 6.2 Coordinating with manufacturer's technician

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Studied and selected appropriate technology consistent with work requirements 1.2 Applied relevant technology 1.3 Maintained and enhanced operative ability of relevant technology
2. Underpinning knowledge and attitudes	2.1 Awareness on technology and its function 2.2 Repair and maintenance procedure 2.3 Operating instructions 2.4 Applicable software 2.5 Communication techniques 2.6 Health and safety procedure 2.7 Company policy in relation to relevant technology 2.8 Different management concepts 2.9 Technology adaptability
3. Underpinning skills	3.1 Relevant technology application/implementation 3.2 Basic communication skills 3.3 Software applications skills 3.4 Basic troubleshooting skills
4. Resource implications	The following resources **MUST** be provided: 4.1 Relevant technology 4.2 Interview and demonstration questionnaires 4.3 Assessment packages
5. Methods of assessment	Competency must be assessed through: 5.1 Interview 5.2 Actual demonstration 5.3 Authenticated portfolio (related certificates of training/seminar)
6. Context of assessment	6.1 Competency may be assessed in actual workplace or simulated environment

COMMON COMPETENCIES

UNIT OF COMPETENCY : APPLY SAFETY PRACTICES

UNIT CODE : MEE721201

UNIT DESCRIPTOR : This unit covers the competencies required to apply safety practices in the workplace.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Identify hazardous area	1.1 *Hazards* are identified correctly in accordance with OHS principles. 1.2 Safety signs and symbols are identified and adhered to.
2. Use protective clothing and devices	2.1 Appropriate *protective clothing and devices* correctly selected and used in accordance with OHS requirements or industry/company policy
3. Perform safe handling of tools, equipment and materials	3.1 Safety procedures for pre-use check and operation of tools and equipment followed in accordance with industry/ company policies. 3.2 Tools, equipment and materials handled safely in accordance with OHS requirements and industry/ company policies.
4. Perform first aid	4.1 First aid treatment of *injuries* are carried out according to recommended procedures
5. Use fire extinguisher	5.1 Fire extinguisher selected and operated correctly according to the *type of fire*.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Hazards	1.1 Cluttered tools and materials 1.2 Slippery floors (caused by oil, grease or any liquid) 1.3 Exposed electrical wires 1.4 Sharp edges 1.5 Machine without guards or with exposed moving parts
2. Protective clothing and devices	Protective clothing and devices may include but is not limited to: 2.1 safety glasses/goggles 2.2 safety shoes 2.3 overalls 2.4 cap 2.5 gloves
3. Injuries	Injuries may include: 3.1 burns/scalds 3.2 fractures 3.3 cuts and abrasions 3.4 poisoning 3.5 foreign bodies in the eye 3.6 concussion 3.7 shock
4. Type of fires	Fires involving or caused by: 4.1 common combustibles (wood, cloth, paper, rubber and plastic) 4.2 flammable liquids (gasoline, oil, solvents, paints, etc.) 4.3 energized electrical equipment (wiring, fuse boxes, circuit breakers, appliances, etc. 4.4 combustible metals (magnesium, sodium, etc.)

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 identified hazardous area 1.2 used protective clothing and devices 1.3 handled tools, equipment and materials properly 1.4 performed first aid 1.5 used fire extinguisher
2. Underpinning knowledge and attitude	2.1 Shop safety signs, symbols and alarms 2.2 Safety precautionary measures 2.3 Housekeeping 2.4 Machine tools 2.5 First aid 2.6 Engineering materials 2.7 Fire extinguishers
3. Underpinning skills	3.1 Operating machine tools 3.2 Handling tools and materials 3.3 Communicating with superiors and co-workers 3.4 Interpreting instructions
4. Resource implications	The following resources must be provided 4.1 Tools, equipment and facilities appropriate to processes or activity 4.2 Materials relevant to the proposed activity
5. Method of assessment	Competency must be assessed through: 5.1 Demonstration 5.2 Written or oral short answer questions 5.3 Practical exercises
6. Context for assessment	• Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETENCY : INTERPRET DRAWINGS AND SKETCHES

UNIT CODE : MEE721202

UNIT DESCRIPTOR : This unit covers the competencies required to read and interpret drawings and sketches.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Identify standard alphabet of lines	1.1 Alphabet of lines are identified 1.2 Uses of the alphabet of lines are explained
2. Identify orthographic/ isometric views	2.1 Orthographic and isometric *drawing* are identified 2.2 Orthographic and isometric views are explained
3. Interpret standard drawing symbols, dimensional tolerances and notations	3.1 Drawing symbols are interpreted according to drawing standards 3.2 Dimensional *tolerances*, notations are interpreted according to specifications

RANGE OF VARIABLES

VARIABLE	RANGE
1. Drawing	Drawing technique include 1.1 Perspective 1.2 Exploded view 1.3 Hidden view technique Projections 1.4 First angle projections 1.5 Third angle projections
2. Tolerance	2.1 General tolerance 2.2 Angular tolerance 2.3 Geometric tolerance

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate interpreted technical drawings and sketches.
2. Underpinning knowledge	2.1 Alphabet of lines 2.2 Projections 2.3 Drawing symbols 2.4 Dimensioning techniques 2.5 Tolerances
3. Underpinning skills	3.1 Communication skills (reading and comprehension) 3.2 Computation skills
4. Resource implications	The following resources must be provided 4.1 Working drawing or plans or sketches 4.2 Measuring tools 4.3 Drawings, sketches or blueprint 4.4 Specimen parts/components
5. Method of assessment	Competency must be assessed through: 5.1 direct observation 5.2 written or oral short answer questions 5.3 demonstration 5.4 project/work sample 5.5 portfolio
6. Context for assessment	• Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETENCY : PERFORM INDUSTRY CALCULATIONS

UNIT CODE : MEE721203

UNIT DESCRIPTOR : This unit covers the competencies required to perform basic calculations using the four fundamental operation.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Perform four fundamental operations.	1.1 Simple calculations involving whole numbers, mixed numbers, fraction and decimal are performed using *four fundamental operations.*
2. Perform conversion of units	2.1 *Units* are converted to the required figure using the given formulae 2.2 *English measurements are converted to metric measurements according to procedure.*
3. Perform calculations on algebraic expressions	3.1 Simple calculations are performed on algebraic expressions using four fundamental operations. 3.2 Simple transposition of formulae are carried out to isolate the variable required, involving the four fundamental operations. 3.3 Where appropriate, formulae are constructed to enable problems to be solved. 3.4 Equations involving on unknown solved correctly.
4. Compute percentage and ratio	4.1 Percentages are computed using appropriate formula. Ratio and proportion are computed using appropriate formula.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Four fundamental operations	1.1 Addition 1.2 Subtraction 1.3 Multiplication 1.4 Division
2. Units	2.1 Fractions 2.2 Mixed numbers 2.3 decimal

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate performed calculations: 1.1 using four fundamental operations 1.2 involving fractions and mixed numbers 1.3 involving fractions and decimals 1.4 on algebraic expressions 1.5 involving ratio and proportion
2. Underpinning knowledge and attitude	2.1 English and metric system of measurements 2.2 Four fundamental operations 2.3 Method of transposing formulae 2.4 Equation formulation
3. Underpinning skills	3.1 Performing calculations using pen and paper or with the use of calculator
4. Resource implications	The following resources must be provided 4.1 Tools and facilities appropriate to processes or activity 4.2 Materials relevant to the proposed activity
5. Method of assessment	Competency must be assessed through: 5.1 written or oral short answer questions 5.2 practical exercises
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETENCY : CONTRIBUTE TO QUALITY SYSTEM

UNIT CODE : MEE721204

UNIT DESCRIPTOR : This unit involves competence required to inspect work against specification and standards and apply quality standards to work.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Inspect work done	1.1 Appropriate inspections are conducted to ensure company ***quality systems and procedures*** are maintained/ followed. 1.2 Job specifications/work order and quality standards are identified. 1.3 Faults/Defects are identified and rectified according to company procedures.
2. Apply quality standards to work	2.1 Inspections are conducted throughout the manufacturing processes to ensure quality standards are maintained. 2.2 Appropriate quality standards are applied throughout the production/fabrication process. 2.3 All activities are coordinated throughout the workplace to ensure efficient quality work 2.4 outcomes. Records of work quality are maintained according to the company requirements.
3 Protect company property and customer interests	3.1 Possible damage to ***company property*** is avoided by adherence to company quality 3.2 procedures. Quality of work is reviewed to ensure customer requirements and company standards are met.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Quality system and procedures	Quality system and procedures may be contained in: 1.1 work instructions 1.2 safe work procedures 1.3 product specifications 1.4 equipment maintenance schedules 1.5 technical procedures adopted or specifically prepared standards 1.6 company/industry rules
2. Company property	Company properties includes : 2.1 production and/or fabrication equipment 2.2 hand and power tools 2.3 OH&S paraphernalia 2.4 facilities

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 inspected work done against specification 1.2 applied quality standards to work 1.3 protected company property and customer interests
2. Underpinning knowledge and attitude	2.1 Communication/feedback methods-written and verbal 2.2 Company systems, processes and work quality requirements 2.3 Work inspection techniques 2.4 Quality assurance principles 2.5 Safety precautionary measures 2.6 Handling materials, tools and equipment
3. Underpinning skills	3.1 Problem solving skills 3.2 Communicating with superiors and co-workers 3.3 Interpreting job specification and work order
4. Resource implications	The following resources must be provided 4.1 Tools, equipment and facilities appropriate to processes or activity 4.2 Materials relevant to the proposed activity
5. Method of assessment	Competency must be assessed through: 5.1 Demonstration 5.2 Written or oral short answer questions 5.3 Practical exercises
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT OF COMPETENCY : USE HAND TOOLS

UNIT CODE : MEE721205

UNIT DESCRIPTOR : This unit covers the competencies required to use hand tools.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Select hand tools	1.1 ***Hand tools*** selected are appropriate to the requirements of the ***task***. 1.2 Unsafe or defective tools are identified and marked for repair according to procedure.
2. Use hand tools	2.1 Hand tools are used to produce the desired outcomes to job specifications. 2.2 Task performed in accordance with company or industry safety procedure.
3. Maintain hand tools	3.1 ***Routine maintenance*** of hand tools is undertaken according to standard operating procedures, principles and techniques. 3.2 Hand tools are stored in designated location in accordance with manufacturer's instruction/standard operating procedure.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Hand tools	Hand tools includes but not limited to: 1.1 Hacksaws 1.2 Hammers (ball peen, chipping) 1.3 Punches 1.4 Screwdrivers 1.5 Wrenches 1.6 Scrapers 1.7 Chisels 1.8 Gouges 1.9 Files 1.10 Clamps
2. Task	Tasks may include: 2.1 Adjusting 2.2 Dismantling 2.3 Assembling 2.4 Finishing of item or components
3. Routine maintenance	Routine maintenance may include: 3.1 Cleaning 3.2 Lubricating 3.3 Tightening 3.4 Simple tool repair 3.5 Hand sharpening

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Selected and used hand tools appropriate to the job 1.2 Performed routine maintenance and storage of hand tools
2. Underpinning knowledge and attitude	2.1 Types and uses of hand tools 2.2 Hand tool defects 2.3 Procedure, principles and techniques in maintenance of hand tools
3. Underpinning skills	3.1 Handling tools and materials 3.2 Communicating with superiors and co-workers 3.3 Interpreting instructions
4. Resource implications	The following resources must be provided 4.1 Tools, equipment and facilities appropriate to the process or activity 4.2 Materials relevant to the proposed activity
5. Method of assessment	Competency must be assessed through: 5.1 Demonstration 5.2 Written or oral short answer questions 5.3 Practical exercises
6. Context for assessment	Competency may be assessed in the workplace or in simulated workplace environment.

UNIT TITLE : PREPARE WELD MATERIALS

UNIT CODE : MEE721206

DESCRIPTOR : This unit covers the skills, knowledge and attitudes in preparing welding materials.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the range of Variables
1. Set up cutting equipment	1.1 Cutting equipment should be operational and should conform to acceptable OH&S standards 1.2 Set up cutting equipment is appropriate for operation intended
2. Cut and prepare edge of materials	2.1 *Materials* are *cut* based on specified dimension/*specifications*. 2.2 Task is performed in accordance with company or industry requirements and safety procedure.
3. Clean surfaces and edges	3.1 Surfaces are *cleaned* to required specifications. 3.2 Task is performed in accordance with company or industry requirements and *safety procedure*
4. Prepare welding consumables	4.1 Consumables are prepared in accordance with required specifications 4.2 Welding consumables are prepared in accordance with manufacturer's instructions
5. Prepare welding safety and protective equipment	5.1 PPE should conform to acceptable OH&S requirement and standards

RANGE OF VARIABLE

VARIABLE	RANGE
1. Materials and consumables	1.1 Mild steel 1.2 Carbon steel 1.3 Alloy steel (level III & IV) 1.4 Cutting gases 1.5 Gouging electrodes 1.6 Grinding/cutting discs 1.7 Run on/run off, backing plates/ring 1.8 Cutting accessories
2. Cut	Cut material using 2.1 Oxy-acetylene gas cutting equipment (manual and /or automatic) 2.2 Plasma cutting equipment 2.3 Shearing machine 2.4 Disc cutter
3. Specification	Specifications based on 3.1 Welding codes 3.2 Reference Industry standards 3.3 Client specification
4. Cleaned	Surfaces and edges are cleaned by 4.1 Grinding or sanding 4.2 Filing 4.3 Chemical washing (Degreaser)
5. Safety procedures	5.1 Wearing of required PPE 5.2 Securing oxy-acetylene tanks before, during and after use 5.3 Checking oxy-acetylene hose for gas leaks 5.4 Switch off equipment after use 5.5 Checking electrical equipment and devices

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Perform edge preparation in accordance with WPS and safety procedures 1.2 Use edge preparation equipment and tools in accordance with the requirements or manufacturer's instructions
2. Underpinning knowledge	2.1 Interpretation of plans and drawings 2.2 Selection of appropriate method of edge preparation 2.3 Selection of appropriate cutting equipment, accessories and supplies 2.4 Operation of cutting equipment such as mechanical, gas and plasma 2.5 Operation of grinding equipment 2.6 Safety procedures for cutting and grinding
3. Underpinning skills	3.1 Measuring and communication skills 3.2 Set up of cutting equipment such as mechanical, gas and plasma 3.3 Cutting techniques 3.4 Grinding techniques 3.5 Observance of safety procedures
4. Resource implications	The following resources must be provided: 4.1 Relevant documentation such as WPS and working drawing 4.2 Supplies and materials 4.3 Cutting equipment and facilities 4.4 Grinding equipment and facilities 4.5 Measuring tools 4.6 PPE 4.7 Stand-by fire fighting equipment
5. Method of assessment	Competency must be assessed through: 5.1 Observation/evaluation 5.2 Oral questioning 5.3 Inspection of prepared edges
6. Context of assessment	Competency to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

UNIT TITLE : SET UP WELDING EQUIPMENT

UNIT CODE : MEE721207

DESCRIPTOR : This unit covers the skills, knowledge and attitudes in preparing equipment for welding.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1.1 Set up welding machine	1.1 Requirements for welding is determined from job requirements, welding procedures and specifications and/or technical drawings. 1.2 *Welding machine* is set up in accordance with job requirements, welding procedures and specifications, technical drawings and manufacturer's instructions. 1.3 Welding machine should be connected to an independent power supply and wired up or set to the *polarity* indicated in the welding procedures /specifications or as recommended by the manufacturer. 1.4 Current, voltage, and wire feed settings is fine-tuned or adjusted consistent with job requirements to produce acceptable weld. 1.5 Task is completed without causing damage to the tools, equipment and materials and injury to self and others.
2. Set up welding accessories	2.1 Welding machine *accessories* and consumables are identified from job requirements, welding procedures and specifications. 2.2 Welding machine accessories and consumables are set up in accordance with job requirements, welding procedures and specifications and/or manufacturer's instructions. 2.3 Spools firmly locked to holder, rollers adjusted to correct tension. 2.4 Purging hoses, damps, flow meter, regulators, torches and guns are properly installed where needed. 2.5 Gas tanks properly secured where needed.
3. Set up welding positioners, jigs and fixtures	3.1 Braces, stiffeners, rails and other jigs are provided and in conformity with job requirements. 3.2 Work items/materials are protected from strong winds, drafts and rainfall
4. Set up pre-heating tools/equipment as required	4.1 Pre-heating *equipment* appropriate to the job requirement and specifications 4.2 Equipment operated in conformance with the manufacturer's instructions.

RANGE OF VARIABLE

VARIABLE	RANGE
1. Welding machine	Types, kind and uses of GMAW welding machines 1.1 Alternating current (AC) 1.2 Direct current (DC) 1.3 Constant current 1.4 Constant voltage
2. Polarity	Application and uses 2.1 Direct current – electrode positive (reverse polarity) 2.2 Direct current – electrode negative (straight polarity) 2.3 Alternating current
3. Accessories	3.1 welding guns 3.2 regulators and flow meters 3.3 gas hoses and adaptors 3.4 gas cylinders and gas heaters 3.5 filters, gas nozzle and insulators 3.6 contact tips 3.7 wire feeders and wire cutter 3.8 cable liners and gas diffusers
4. Gases	4.1 Pure inert gas (argon, etc.) 4.2 Mixed gases 4.3 Pure CO2

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate 1.1 Set up and install welding machine, accessories, welding positioners, jigs and fixtures and pre-heating equipment within allotted time and in accordance with OH&S rules and accessible and convenient location. 1.2 Applied housekeeping and 5S practices
2. Underpinning knowledge	2.1 Types and uses of welding equipment and accessories 2.2 Power requirement and capacity of welding machine and its accessories 2.3 Operating capacity of welding machine and accessories 2.4 Basic electricity 2.5 Shop safety, housekeeping and 5S procedures
3. Underpinning skills	3.1 Setting and operating welding machine and accessories 3.2 Communication skills 3.3 Recognizing operational abnormalities and faults in welding machine and accessories 3.4 Fine tuning of welding machine and accessories for optimum operation 3.5 Minor repairs/maintenance of welding machine and accessories 3.6 Use of PPE
4. Resource implications	The following resources must be provided: 4.1 Appropriately ventilated work area/shop with welding facilities, machines and accessories 4.2 PPE
5. Method of assessment	Competency must be assessed through: 5.1 Observation/evaluation 5.2 Oral questioning
6. Context of assessment	Competency to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

UNIT TITLE : FIT UP WELD MATERIALS

UNIT CODE : MEE721208

DESCRIPTOR : This unit covers the skills, knowledge and attitudes in fitting up welding materials.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Perform tack welding	1.1 *Tack welding* is performed in accordance with the requirements of WPS and client's specifications. 1.2 Tack welding is performed *visually and dimensionally acceptable*. 1.3 *Backing* plate, stiffener, running plate installed as required. 1.4 Joints are free from rust, paints, grease and other foreign materials prior to fit up or tacking.
2. Check gap and alignment	2.1 *Root gap* is performed in accordance with the requirements of WPS. 2.2 *Alignment* within the range of acceptability of code and standard. 2.3 Fitted materials visually free from stresses
3. Set up welding positioner	3.1 Weld specimen positioned and secured according to the requirements.

RANGE OF VARIABLE

VARIABLE	RANGE
1. Tack welding	Kinds of tacking 1.1 Bridge tacking 1.2 Permanent tacking 1.3 Temporary tacking
2. Visually and dimensionally acceptable	2.1 Acceptable tack welds 2.2 Fully fused to the base metal 2.3 Free from defects and discontinuities 2.4 Evenly distributed
3. Root gap	3.1 WPS requirements 3.2 Client requirements
4. Backing materials	4.1 Stiffeners 4.2 Backing plate 4.3 Strong back
5. Alignment	5.1 Codes and specifications 5.2 Client requirements

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate 1.1 performed tack welding 1.2 checked gap and alignment 1.3 set up welding positioners
2. Underpinning knowledge	2.1 Fit up tolerances 2.2 Mensuration 2.3 WPS 2.4 Welding materials and consumables 2.5 Drawing and plan interpretation 2.6 Welding codes (symbols) 2.7 Identification of weld defects 2.8 Fit up
3. Underpinning skills	3.1 Applying weld techniques 3.2 Handling welding materials and consumables 3.3 Rectifying weld defects 3.4 Measuring skills 3.5 Communication skills 3.6 Pre-heating technique 3.7 Observance of safety procedures
4. Resource implications	The following resources must be provided: 4.1 Drawing and plans 4.2 Appropriately ventilated work area/shop with welding facilities, machines and accessories 4.3 PPE
5. Method of assessment	Competency must be assessed through: 5.1 Observation/evaluation 5.2 Oral questioning
6. Context of assessment	Competency to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

UNIT TITLE : REPAIR WELDS

UNIT CODE : MEE721209

DESCRIPTOR : This unit covers the skills, knowledge and attitudes in repairing welds.

ELEMENTS	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Mark/locate weld defects	1.1 Identified *weld defects* marked/located according to recommended practice 1.2 Weld defects are located and marked according to procedures
3. Prepare tools and equipment	2.1 *Tools and equipment* are prepared based on job requirements and provision of wind barriers. 2.2 Task is performed in accordance with company or industry requirements and safety procedure
3. Remove defects	3.1 Weld defects are *removed/excavated* in accordance with approved industry procedures or client requirements. 3.2 Removal of non-defective welds is minimized and cleaned. 3.3 Visual and dye-penetrant test is performed to verify the extent of removal of defects, where applicable 3.4 Welding inspector is informed to verify the extent of defect removal. 3.5 Task is performed in accordance with company or industry requirement and safety procedure
4. Perform re-welding	4.1 Re-welding is performed in accordance with approved repair procedure. 4.2 Task is performed in accordance with company or industry requirement and safety procedure 4.3 Re-welding is performed with no new weld defects or damages occurred 4.4 Weld visually checked after re-welding for acceptability

RANGE OF VARIABLE

VARIABLE	RANGE
1. Weld defects	1.1 Porosity 1.2 Root undercut 1.3 and solid material inclusion 1.4 Concavity/convexity 1.5 Degree of reinforcement 1.6 Burn Through 1.7 Crater cracks 1.8 Cracks 1.9 Lack of Fusion (tie-in) 1.10 Pinholes/Blowholes 1.11 Under Fill 1.12 Excess/incomplete penetration 1.13 Overlap 1.14 Misalignment 1.15 Distortion
2. Tools and equipment	2.1 Welding machine and accessories 2.2 Gouging outfit and accessories 2.3 Portable grinder 2.4 Chipping hammer 2.5 Files 2.6 Extension cord and lightings 2.7 Barriers 2.8 Dye-penetrant kit
3. Removed/excavated	Defects removed by 3.1 Grinding 3.2 Arc/air Gouging 3.3 Cutting (mechanical, gas) 3.4 Plasma gouging

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate repaired weld defects within the approved weld repair procedures
2. Underpinning knowledge	2.1 Interpretation of weld repair procedures and WPS 2.2 Causes and identification of weld defects 2.3 Materials and consumables 2.4 Welding Equipment and Tools 2.5 Welding Codes (symbols) 2.6 Repair techniques 2.7 Selection and use of PPE
3. Underpinning skills	3.1 Operating weld defect removal tools and equipment 3.2 Applying correct weld techniques 3.3 Measuring skills 3.4 Communication skills 3.5 Rectifying weld defects 3.6 Handling welding tools and equipment 3.7 Handling materials and consumables 3.8 Identifying weld defects
4. Resource implications	The following resources must be provided: 4.1 Weld defect removal and repair facilities and equipment 4.2 Supplies and materials 4.3 PPE 4.4 Relevant documentation such as WPS and approved repair procedure
5. Method of assessment	Competency must be assessed through: 5.1 Observation and interview 5.2 Performance record
6. Context of assessment	Competency to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

CORE COMPETENCIES

UNIT OF COMPETENCY : **Weld alloy steel plates using GMAW**

UNIT CODE : **MEE721114**

DESCRIPTOR : This unit covers the skills, knowledge and attitudes Required in welding alloy steel plates in 1F-4F and 1G-3G positions using GMAW process.

ELEMENTS	PERFORMANCE CRITERIA *Italicized terms* are elaborated in the Range of Variables
1. Perform root pass	1.1 Root pass is performed in accordance with *WPS* and/or client specifications. 1.2 Task is performed in accordance with company or industry requirement and safety procedure. 1.3 Weld is visually checked for *defects* and repaired, as required 1.4 Weld is visually acceptable in accordance with applicable codes and standards
2. Clean root pass	2.1 Root pass is cleaned and free from defects and discontinuities 2.2 Task is performed in accordance with approved WPS
3. Weld subsequent/ filling passes	3.1 Subsequent/ filling passes is performed in accordance with approved WPS 3.2 Weld is visually checked for defects and repaired, as required 3.3 Weld is visually acceptable in accordance with applicable codes and standards
4. Perform capping	4.1 Capping is performed in accordance with WPS and/or client specifications 4.2 Weld is visually checked for defects and repaired, as required 4.3 Weld is visually acceptable in accordance with applicable codes and standards

RANGE OF VARIABLE

VARIABLE	RANGE
1. WPS	WPS Requirements 1.1 Welding positions 1.1.1 1F-4F 1.1.2 1G-3G 1.2 Material thickness 1.2.1 1.6mm and above 1.3 Type of material 1.3.1 Alloy-steel plates 1.4 Consumables 1.4.1 filler wire (diameter) 1.4.2 shielding gas (CO_2 or other available mixed gas) 1.5 Travel speed 1.6 Current setting (polarity, amperage, voltage) 1.7 Shielding gas flow rate 1.8 Welding accessories 1.9 Types of metal transfer 1.10 Joint preparation
2. Defects	2.1 Porosity 2.2 Undercut 2.3 Arc Strike 2.4 Elongated intrusion 2.5 Concavity/convexity 2.6 Degree of reinforcement 2.7 Burn Through 2.8 Crater cracks 2.9 Cracks 2.10 Lack of Fusion 2.11 Pinholes/Blowholes 2.12 Under Fill 2.13 Overlap 2.14 Misalignment 2.15 Distortion

EVIDENCE GUIDE

1 Critical aspects of competency	Assessment requires evidence that the candidate welded alloy steel plates using GMAW in 2G and 3G positions to acceptable standards following approved WPS.
2 Underpinning knowledge	2.1 Drawing/Plan/WPS interpretation 2.2 Materials and consumables 2.2.1 Filler wire for alloy-steel materials 2.2.2 Shielding gases 2.3 Welding Equipment and Tools 2.4 Basic Mathematics (MDAS) 2.5 Welding Codes 2.6 Interpretation of weld defects
3 Underpinning skills	3.1 Measuring skills 3.2 Communication skills 3.3 Rectifying weld defects 3.4 Applying welding techniques for GMAW 3.5 Handling welding tools and equipment 3.6 Handling materials 3.7 Philippine OH&S Rules and/or client's safety procedure
4 Resource implications	The following resources must be provided: 4.1 GMAW facilities and equipment 4.2 Supplies and materials 4.3 PPE 4.4 Fumes extractor 4.5 Relevant documentation such as WPS and working drawing 4.6 Stand-by fire fighting equipment
5 Method of assessment	Competency must be assessed through: 5.1 Performance test (demonstration) and oral questioning 5.2 Portfolio
6 Context of assessment	Competency to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

UNIT OF COMPETENCY : **Weld alloy-steel pipes using GMAW**

UNIT CODE : **MEE721118**

DESCRIPTOR : This unit covers the skills, knowledge and attitudes in welding alloy-steel pipes using GMAW process.

ELEMENTS	PERFORMANCE CRITERIA *Italicized terms* are elaborated in the Range of Variables
1. Perform root pass (backing material)	1.1 Root pass is performed in accordance with *WPS* and/or client specifications. 1.2 Weld is visually checked for *defects* and repaired, as required 1.3 Weld is visually acceptable in accordance with applicable codes and standards
2. Clean root pass	2.1 Root pass is cleaned and free from defects and discontinuities 2.2 Task is performed in accordance with approved WPS
3. Weld subsequent/ filling passes	3.1 Subsequent/ filling passes is performed in accordance with approved WPS 3.2 Weld is visually checked for defects and repaired, as required 3.3 Weld is visually acceptable in accordance with applicable codes and standards
4. Perform capping	4.1 Capping is performed in accordance with WPS and/or client specifications 4.2 Weld is visually checked for defects and repaired, as required 4.3 Weld is visually acceptable in accordance with applicable codes and standards

RANGE OF VARIABLE

VARIABLE	RANGE
1. WPS	WPS Requirements 1.1 Welding positions 1.1.1 2G and 5G and/or 6G 1.2 Wall thickness 1.2.1 1.6mm and above 1.3 Type of material 1.3.1 Alloy-steel pipes 1.3.2 Diameter 25.4mm (1 inch) and above 1.4 Type and size of electrode wire 1.5 Travel speed 1.6 Current setting (polarity, amperage, voltage) 1.7 Backing materials (weld metal, backing ring or ceramics) 1.8 Welding accessories 1.8.1 Transformer Rectifier Type 1.8.2 Wire feeder 1.9 Modes of metal transfer 1.9.1 globular 1.9.2 spray 1.9.3 pulsating 1.9.4 short-circuiting 1.10 Joint preparation
2. Defects	2.1 Porosity 2.2 Undercut 2.3 Arc Strike 2.4 Spatters 2.5 Wire and solid material inclusion 2.6 Concavity/convexity 2.7 Degree of reinforcement 2.8 Burn Through 2.9 Crater cracks 2.10 Cracks 2.11 Lack of Fusion (tie-in) 2.12 Pinholes/Blowholes 2.13 Under Fill 2.14 Overlap 2.15 Misalignment 2.16 Distortion

EVIDENCE GUIDE

1 Critical aspects of competency	Assessment requires evidence that the candidate welded alloy-steel pipes using GMAW process in 2G and 5G and/or 6G positions to acceptable standards following the approved WPS.
2 Underpinning knowledge	2.1 Drawing/Plan/WPS interpretation 2.2 Materials and consumables 2.2.1 Electrode wire 2.2.2 Shielding gases (mixed gases) 2.3 GMAW Welding Equipment and Tools 2.3.1 GMAW mode of metal transfer 2.3.2 GMAW welding accessories 2.4 Basic Mathematics (MDAS) 2.5 Welding Codes (symbols) 2.6 Interpretation of weld defects and GMAW equipment malfunctions
3 Underpinning skills	3.1 Measuring skills 3.2 Communication skills 3.3 Rectifying weld defects 3.4 Applying welding techniques for GMAW 3.5 Handling welding tools and equipment 3.6 Handling materials and consumables and checking purity of shielding gas 3.7 Ability to perform root pass with GTAW or SMAW process
4 Resource implications	The following resources must be provided: 4.1 GMAW facilities and equipment 4.2 Supplies and materials 4.3 Fumes extractor 4.4 PPE 4.5 Relevant documentation such as WPS and working drawing 4.6 Stand-by fire fighting equipment
5 Method of assessment	Competency must be assessed through: 5.1 Observation and interview 5.2 Demonstration and interview 5.3 Written test 5.4 Portfolio (work records, certificates, awards, endorsements, etc…)
6 Context of assessment	Competency to be assessed while a task is being undertaken in the workplace or in a simulated workplace setting.

SECTION 3 TRAINING STANDARDS

These guidelines are set to provide the Technical and Vocational Education and Training (TVET) providers with information and other important requirements to consider when designing training programs for GAS METAL ARC WELDING (GMAW).

This includes information on curriculum design; training delivery; trainee entry requirements; tools and equipment; training facilities; and trainers qualification, among others.

3.1 CURRICULUM DESIGN

Course Title: **GAS METAL ARC WELDING** **NC Level III**

Suggested Nominal Training Hours: 20 hrs. (Basic Competencies)
56 hrs. (Common Competencies)
72 hrs. (Core Competencies)

Course Description:

This course is designed to enhance the knowledge, skills and attitudes of trainees in Gas Metal Arc Welding in accordance with industry standards. It covers core competencies such as Welding alloy steel plates and pipes using GMAW.

BASIC COMPETENCIES

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1. Lead workplace communication	1.1 Communicate information about workplace processes. 1.2 Lead workplace discussions. 1.3 Identify and communicate issues arising in the workplace	• Group discussion • Role Play • Brainstorming	• Observation • Interviews
2. Lead small teams	2.1 Provide team leadership. 2.2 Assign responsibilities among members. 2.3 Set performance expectation for team members. 2.4 Supervise team performance	• Lecture • Demonstration • Self-paced (modular)	• Demonstration • Case studies
3. Develop and practice negotiation skills	3.1 Identify relevant information in planning negotiations 3.2 Participate in negotiations 3.3 Document areas for agreement	• Direct observation • Simulation/ role playing • Case studies	• Written test • Practical/ performance test

4. Solve workplace problem related to work activities	4.1 Explain the analytical techniques. 4.2 Identify the problem. 4.3 Determine the possible cause/s of the problem.	• Direct observation • Simulation/role playing • Case studies	• Written test • Practical/ performance test
5. Use mathematical concepts and techniques	5.1 Identify mathematical tools and techniques to solve problem 5.2 Apply mathematical procedures/solution 5.3 Analyze results	• Direct observation • Simulation/role playing • Case studies	• Written test • Practical/ performance test
6. Use relevant technologies	6.1 Identify appropriate technology 6.2 Apply relevant technology 6.3 Maintain/enhance relevant technology	• Direct observation • Simulation/role playing • Case studies	• Written test • Practical/ performance test

COMMON COMPETENCIES

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1. Apply Safety Practices	1.1 Identify hazardous areas 1.2 Use protective clothing and devices 1.3 Perform safe handling of tools, equipment and materials 1.4 Perform first aid 1.5 Use fire extinguisher	• Lecturette • Practical application	• Oral questioning • Written • Demonstration
2. Interpret working drawings and sketches	2.1 Identify standard alphabet of lines 2.2 Identify orthographic/ isometric views 2.3 Interpret standard drawing symbols, dimensional tolerances and notations	• Lecturette • Practical application	• Oral questioning • Written
3. Perform Industry calculations	3.1 Perform four fundamental operations 3.2 Perform conversion of units 3.3 Perform calculations on algebraic expressions 3.4 Compute percentage and ratio	• Lecturette • Practical application	• Oral questioning • Written test

4. Contribute to quality system	4.1 Inspect work done 4.2 Apply quality standards to work 4.3 Protect company property and customer interest	• Lecturette • Practical application	• Oral questioning • Written • Demonstration
5. Use hand tools	5.1 Select hand tools 5.2 Use hand tools 5.3 Maintain hand tools	• Lecturette • Practical application	• Oral questioning • Written Demonstration
6. Prepare Weld Materials	6.1 Set-up cutting equipment 6.2 Cut and prepare edge of materials 6.3 Clean surfaces and edges 6.4 Prepare welding consumables 6.5 Prepare welding safety and protective equipment	• Lecturette • Practical application	• Observation • Demonstration and oral questioning • Written test
7. Set-up Welding Equipment	7.1 Set up welding machine 7.2 Set up welding accessories 7.3 Set up welding positioners, jigs and fixtures	• Lecturette • Demonstration	• Observation and oral questioning • Demonstration and oral questioning • Written test
8. Fit up Weld Materials	8.1 Perform tack welding 8.2 Check gap and alignment 8.3 Set up welding positioner	• Lecturette • Demonstration	• Observation and oral questioning • Demonstration and oral questioning • Written test
9. Repair Welds	9.1 Mark/locate weld defects 9.2 Prepare tools and equipment 9.3 Remove defects 9.4 Perform re-welding	• Lecturette • Demonstration	• Observation and oral questioning • Demonstration and oral questioning • Written test

CORE COMPETENCIES

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1. Weld Alloy Steel Plates Using GMAW	1.1 Perform multiple pass fillet weld in different positions (1F-4F) 1.2 Perform multiple pass groove weld in different positions (1G-3G)	• Lecturette • Demonstration	• Observation and oral questioning • Demonstration and oral questioning • Written test
2. Weld Alloy Steel Pipes Using GMAW	2.1 Perform groove weld on pipe in different positions (2G-5G and /or 6G)	• Lecturette • Demonstration	• Observation and oral questioning • Demonstration and oral questioning • Written test

3.2 TRAINING DELIVERY

The delivery of training should adhere to the design of the curriculum. Delivery should be guided by the 10 basic principles of competency-based TVET.

- The training is based on curriculum developed from the competency standards;
- Learning is modular in its structure;
- Training delivery is individualized and self-paced;
- Training is based on work that must be performed;
- Training materials are directly related to the competency standards and the curriculum modules;
- Assessment is based in the collection of evidence of the performance of work to the industry required standard;
- Training is based both on and off-the-job components;
- Allows for recognition of prior learning (RPL) or current competencies;
- Training allows for multiple entry and exit; and
- Approved training programs are Nationally Accredited

The competency-based TVET system recognizes various types of delivery modes, both on and off-the-job as long as the learning is driven by the competency standards specified by the industry. The following training modalities may be adopted when designing training programs:

- The dualized mode of training delivery is preferred and recommended. Thus programs would contain both in-school and in-industry training or fieldwork components. Details can be referred to the Dual Training System (DTS) Implementing Rules and Regulations.
- Modular/self-paced learning is a competency-based training modality wherein the trainee is allowed to progress at his own pace. The trainer just facilitates the training delivery.
- Peer teaching/mentoring is a training modality wherein fast learners are given the opportunity to assist the slow learners.
- Supervised industry training or on-the-job training is an approach in training designed to enhance the knowledge and skills of the trainee through actual experience in the workplace to acquire specific competencies prescribed in the training regulations.
- Distance learning is a formal education process in which majority of the instruction occurs when the students and instructor are not in the same place. Distance learning may employ correspondence study, audio, video or computer technologies.

3.3 TRAINEE ENTRY REQUIREMENTS

Trainees or students wishing to gain entry into these course should possess the following requirements:

- completed training in SMAW NC III and NC IV or a holder of GMAW NC II
- can communicate either oral and written
- physically and mentally fit
- can perform basic mathematical computation

3.4 LIST OF TOOLS, EQUIPMENT AND MATERIALS

Recommended list of tools and materials per trainee for **GAS METAL ARC WELDING - NC III**

TOOLS (for 25 trainees)		**EQUIPMENT (for 25 trainees)**		**MATERIAL (per trainee)**	
Qty.	Description	Qty.	Description	Qty.	Description
25 pcs.	Chipping Hammer	12 units	GMAW/Mig Welding machine, Mig gun and accessories	1 reel	Mig wire, ER309
75 pcs.	Steel brush	12 pcs.	Welding positioners	38 pcs.	Mild steel plate 3.2mm X 50mm X 150mm
12 pcs.	Plier/tongs	12 units	Portable disc grinder	40 pcs	Mild steel plate 10mm X 100mm X 150mm
20 pcs.	Files-bastard cut	1 unit	Exhaust fan	21 prs (or equiv jts)	6” dia. Sch. 40 A-53 Gr. B
25 pcs.	Welding Mask	2 units	Work bench w/ bench vice on 4 corners	38 pcs.	Cutting disc 3/32” x 5/8” x 4” dia.
25 sets	Leather apron/jacket	2 sets	Oxy-acetylene/Oxy-LPG cutting outfit	19 pcs.	Grinding disc 1/4” x 5/8” x 4” dia.
50 sets	Leather gloves, long	1 unit	Pedestal /bench grinding machine	5 cyl.	CO2
5 pcs.	Safety goggles, wide vision, clear	1 unit	Industrial fan	1 cyl.	oxygen

5 pcs.	Oxy-acetylene goggles			1 cyl.	LPG / Acetylene
12 pcs.	Try square 300 mm. long			3 pcs.	Dark glass
12 pcs.	Steel square 300 mm. long			46 pcs.	Lens clear glass
12 pcs.	Files-half round			10 pcs.	Metal chalk
5 pcs.	Fillet gauge				
1 pc.	Wire Cutter				
1 pc.	Hand Hacksaw				

3.5 TRAINING FACILITIES

GAS METAL ARC WELDING - NC III

The welding workshop must be of concrete structure. Based on class size of 25 students/trainees the space requirements for the teaching/learning and circulation areas are as follows:

TEACHING/LEARNING AREAS	SIZE IN METERS	AREA IN SQ. METERS	QTY	TOTAL AREA IN SQ. METERS
Welding Booth	2 X 1.5	**3**	**5**	**15**
Grinding Booth*	2 X 1.5	3	2	6
Materials/Preparation Area*	2 X 2	4		4
Bench work Area*	1.5 X 2.5	4	2	8
Tool Room & S/M Storage Area*	4 X 5	20		20
Learning Resource Area*	5 X 9	45		45
Wash Area /Comfort Room *(male & female)* *	2.5 X 4	10		10
Total				108
Circulation Area**				32
Total Workshop Area				**140**

** This area can also be used by other welding courses.*
*** Area requirement is equivalent to 30% of the total teaching/learning areas*

3.6 TRAINERS QUALIFICATIONS FOR GMAW WELDER

TRAINER QUALIFICATION (TQ III)

- Must be a holder of GMAW NC III
- Must have completed training in SMAW NC III
- Must have undergone training on Training Methodology III (TM III)
- Must be physically and mentally fit
- *Must have at least 2 years job/industry experience
- Must be a civil service eligible (for government position or appropriate professional license issued by the Professional Regulatory Commission)

* Optional. Only when required by the hiring institution

Reference: TESDA Board Resolution No. 2004 03

3.7 INSTITUTIONAL ASSESSMENT

Institutional Assessment is to be undertaken by trainees to determine the achievement of units of competency. A certificate of achievement is issued for each unit of competency.

SECTION 4 NATIONAL ASSESSMENT AND CERTIFICATION ARRANGEMENTS

4.1 To attain the National Qualification of GMAW III, the candidate must demonstrate competence in all the units of competency listed in Section 1. Successful candidates shall be awarded a National Certificate signed by the TESDA Director General.

4.2 Assessment shall focus on the core units of competency, weld alloy steel plates and weld alloy steel pipes using GMAW.The basic and common units shall be integrated or assessed concurrently with the core units.

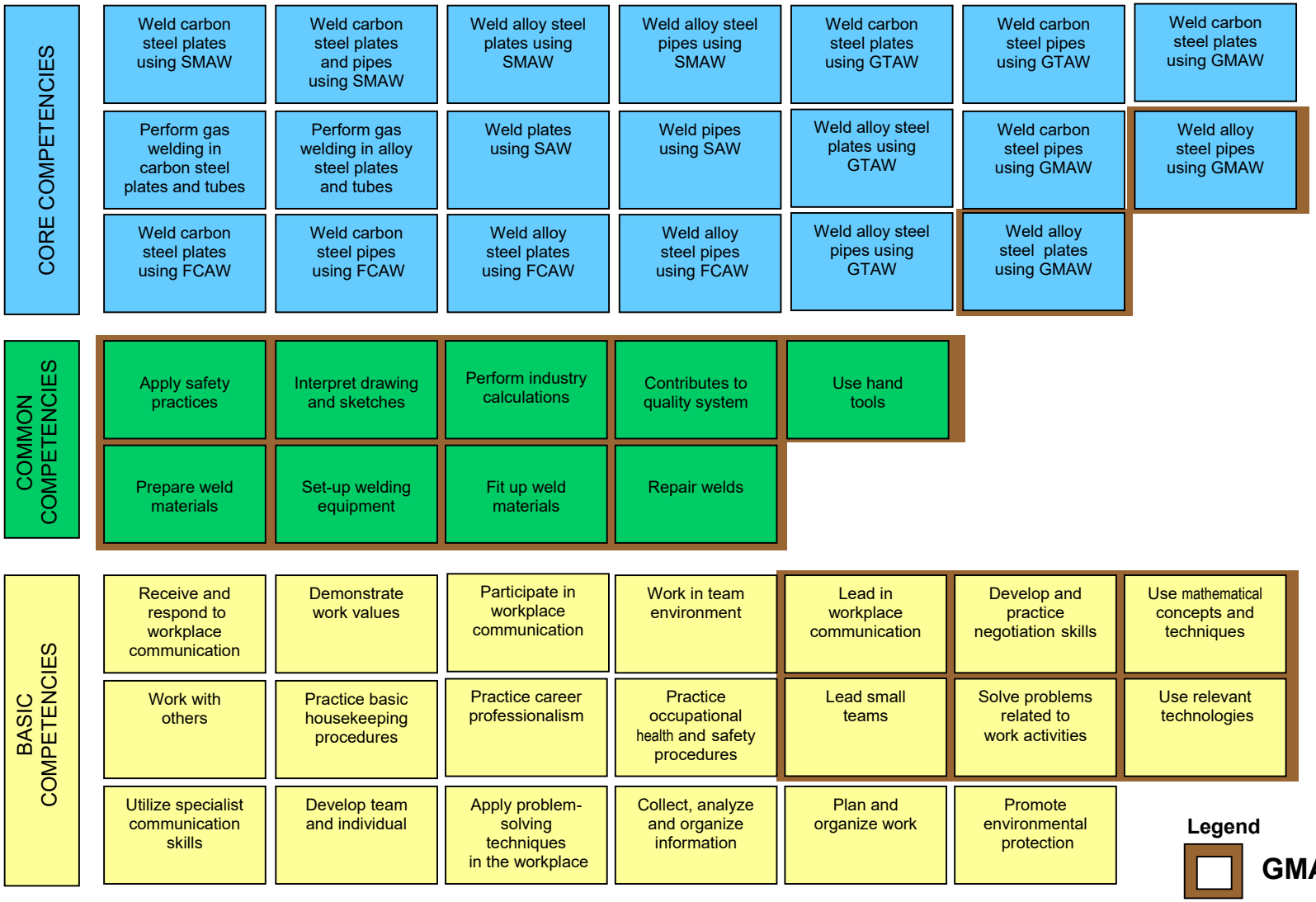
4.3 The following are qualified to apply for assessment and certification:

4.3.1 Graduates of formal, non-formal and informal including enterprise-based training programs.

4.3.2 Experienced workers (wage employed or self employed)

4.4 The guidelines on assessment and certification are discussed in detail in the "Procedures Manual on Assessment and Certification" and "Guidelines on the Implementation of the Philippine TVET Qualification and Certification System (PTOQS)".

Competency Map
Metals and Engineering Sector
(WELDING)



DEFINITION OF TERMS

1) **base metal** – the metal that is to be worked or welded

2) **weld bead –** a deposit of filler metal from a single welding pass

3) **weld defect–** an irregularity that spoils the weld appearance or impairs the effectiveness of the weld or weldment by causing weakness or failure

4) **weld line –** the junction of weld metal and the base metal, or the junction of base metal parts when filler metal is not used

5) **weldment –** an assembly or structure whose component parts are joined by welding

6) **welding –** joining two metals by applying heat to melt and fuse them, with or without filler metal

7) **welding electrode** – the current-carrying rod used to strike an arc between rod and metal

8) **welding rod –** filler metal in the form of a rod or heavy wire

9) **welding torch –**a gas mixing and burning tool for the welding of metal

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