TRAINING REGULATIONS

FOUNDRY PATTERNMAKING NC III

AUTOMOTIVE MANUFACTURING SECTOR

TECHNICAL EDUCATION AND SKILLS DEVELOPMENT AUTHORITY
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TABLE OF CONTENTS

AUTOMOTIVE SECTOR
(AUTOMOTIVE MANUFACTURING SUB SECTOR)

FOUNDRY PATTERNMAKING NC III

TRAINING REGULATIONS FOR
FOUNDRY PATTERNMAKING NC III

SECTION 1 FOUNDRY PATTERNMAKING NC III QUALIFICATION

The FOUNDRY PATTERNMAKING NC III Qualification consists of competencies that a person must achieve to be able to manufacture and develop corebox for shell core sand and develop and manufacture gear, conveyor screw and propeller patterns. It also include competency to develop gravity die casting mold used to produce component parts for automotive, track, and allied industries.

This Qualification is packaged from the competency map of the Automotive Industry (Manufacturing sub-sector) as shown in Annex A.

The Units of Competency comprising this Qualification include the following:

CODE NO.	BASIC COMPETENCIES
500311109	Lead workplace communication
500311110	Lead small teams
500311111	Develop and practice negotiation skills
500311112	Solve problems related to work activities
500311113	Use mathematical concepts and techniques
500311114	Use relevant technologies

CODE NO.	COMMON COMPETENCIES
ALT742201	Read, Interpret and Apply Engineering Drawings
ALT311202	Perform Mensuration and Calculation
ALT723203	Read, Interpret and Apply Specifications and Manuals
ALT723205	Perform Shop Maintenance

CODE NO.	CORE COMPETENCIES
ALT742306	Manufacture and Develop Corebox for Shell Core Sand
ALT742307	Develop And Manufacture Gear, Conveyor Screw And Propeller Patterns
ALT742308	Develop Gravity Die Casting Mold

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

- **Foundry Patternmaker (Shell Core and other Complex Pattern); or**
- **Foundry Patternmaker (Die Cast Mold)**

SECTION 2 COMPETENCY STANDARDS

This section gives the details of the contents of the basic, common and core units of competency required in FOUNDRY PATTERNMAKING 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 attitude	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. Method 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 of 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. Method 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 of 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. Method 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 of 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 Scattergrams
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 and attitude	2.1 Competency includes a thorough knowledge and understanding of the process, normal operating parameters, and product quality to recognize non-standard situations 2.2 Competency 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. Method 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 of 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 : 500311113

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. Method 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 of 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 attitude	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. Method 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

AUTOMOTIVE MANUFACTURING

UNIT TITLE : **READ, INTERPRET AND APPLY ENGINEERING DRAWINGS**.

UNIT CODE : **ALT742201**

UNIT DESCRIPTOR: This unit deals with identifying, interpreting and applying specification from engineering blue prints or drawings that provides the measurements of the product and pattern that is to be produced.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Identify and access engineering drawings/ specification	1.1 Appropriate ***engineering drawings*** are identified and accessed as per job requirements. 1.2 Version and date of drawing is checked to ensure correct specification and procedure are identified.
2. Interpret drawings	2.1 Relevant dimensions and sections of the drawings/ specifications are located in relation to the work to be conducted 2.2 Information in the manual are interpreted in accordance to industry practices
3 Apply information in the drawings & specifications	3.1 Engineering drawing is interpreted according to job requirements 3.2 Work steps are correctly identified in accordance with the specifications in the drawings. 3.3 Dimensional ***data*** and shape are applied according to the given task
4. Store drawings	4.1 The drawings and specification are stored properly to ensure prevention of damage, ready access and updating of information when required in accordance with company requirements

RANGE OF VARIABLES

VARIABLE	RANGE
1. Engineering drawings	Kinds of drawings: 1.1 Casting drawing 1.2 Machining drawing 1.3 Project plan 1.4 Technical drawing
2. Data	Data includes but not limited to 2.1 Material specifications 2.2 Process specifications 2.3 Special instructions 2.4 Machining locating points 2.5 Clamping points 2.6 Amount of draft 2.7 Surface finish

EVIDENCE GUIDE

1.Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Identified and accessed drawings/specification 1.2 Interpreted drawings 1.3 Applied information in drawings 1.4 Stored drawings
1. Underpinning knowledge and attitudes	2.1 Types of drawings used in automotive manufacturing industry 2.2 Identification of symbols used in the drawings 2.3 Identification of units of measurements 2.4 Unit conversion 2.5 Attention to details, Perseverance, Honesty
3. Underpinning skills	3.1 Reading and comprehension skills required to identify and interpret engineering drawings and specifications 3.2 Accessing information and data
4. Resource implications	The following resources **MUST** be provided: 4.1 All drawings/engineering specifications relative to automotive manufacturing 4.2 Job order, requisitions 4.3 Product sample
5 Method of assessment	Competency **MUST** be assessed through: 5.1 Observation with questioning 5.2 Interview
6 Context of assessment	6.1 Assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines 6.2 Assessment may be conducted in the workplace or a simulated environment.

UNIT OF COMPETENCY : **PERFORM MENSURATION AND CALCULATION**

UNIT CODE : **ALT311202**

UNIT DESCRIPTOR : This unit includes identifying, caring for, handling, using and maintaining measuring instruments.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Select measuring instruments	1.1 Object or component to be measured is identified 1.2 Correct specifications are obtained from relevant source 1.3 Appropriate ***measuring instrument*** is selected according to job requirements
2. Carry out measurements and calculation	2.1 Measuring tools are selected in line with job requirements 2.2 Accurate measurements are obtained to job 2.3 ***Calculation*** needed to complete work tasks are performed using the four basic process of addition (+), subtraction (-), multiplication (x) and division (/). 2.4 Calculations involving fractions, percentages and mixed numbers are used to complete workplace tasks. 2.5 Numerical computation is self-checked and corrected for accuracy 2.6 Instruments are read to the limit of accuracy of the tool.
3. Maintain measuring instruments	3.1 Measuring instruments are kept free from corrosion 3.2 Measuring instruments are not dropped to avoid damage 3.3 Measuring instruments are cleaned before and after using.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Measuring instruments	Measuring instruments includes: 1.1 Multitester 1.2 Micrometer (In-out, depth) 1.3 Vernier caliper (Out, inside) 1.4 Dial Gauge with Mag. Std. 1.5 Straight Edge 1.6 Thickness gauge 1.7 Try square 1.8 Protractor 1.9 Height gauge 1.10 Steel rule 1.11 Shrink rule
2. Calculation	Kinds of part mensuration include: 2.1 Volume 2.2 Area 2.3 Displacement 2.4 Inside diameter 2.5 Circumference 2.6 Length 2.7 Thickness 2.8 Outside diameter 2.9 Taper 2. 10 Out of roundness 2.11 Shrinkage allowance

EVIDENCE GUIDE

1. Critical aspect of competency	Assessment requires evidence that the candidate: 1.1 Selected measuring instruments 1.2 Carried-out measurements and calculations. 1.3 Maintained measuring instruments
2. Underpinning knowledge and attitudes	2.1 Types of Measuring instruments and its uses 2.2 Safe handling procedures in using measuring instruments 2.3 Four fundamental operation of mathematics 2.4 Formula for Volume, Area, Perimeter and other geometric figures
3. Underpinning skills	3.1 Caring and Handling measuring instruments 3.2 Calibrating and using measuring instruments 3.3 Performing calculation by Addition, Subtraction, Multiplication and Division 3.4 Visualizing objects and shapes 3.5 Interpreting formula for volume, area, perimeter and other geometric figures
4. Resource implications	The following resources **MUST** be provided: 4.1 Workplace location 4.2 Measuring instrument appropriate to servicing processes 4.3 Instructional materials relevant to the propose activity
5. Method of assessment	Competency **MUST** be assessed through: 5.1 Observation with questioning 5.2 Written or oral examination 5.3 Interview 5.4 Demonstration with questioning
6. Context of assessment	6.1 Competency elements must be assessed in a safe working environment 6.1 Assessment may be conducted in a workplace or simulated environment

UNIT TITLE : **READ, INTERPRET AND APPLY SPECIFICATION AND MANUALS**

UNIT CODE : **ALT723203**

UNIT DESCRIPTOR: This unit deals with identifying, interpreting and applying service specification manuals, maintenance procedure manuals and periodic maintenance manual.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Identify and access manual/ specification	1.1 Appropriate ***manuals*** are identified and accessed as per job requirements. 1.2 Version and date of manual is checked to ensure correct specification and procedure are identified.
2. Interpret manuals	2.1 Relevant sections, chapters of manuals/specifications are located in relations to the work to be conducted 2.2 Information and procedure in the manual are interpreted in accordance to industry practices
3 Apply information in manual	3.1 Manual is interpreted according to job requirements 3.2 Work steps are correctly identified in accordance with manufacturer specification 3.3 Manual data is applied according to the given task 3.4 All correct sequencing and adjustments are interpreted in accordance with information contained on the manual or specifications
4. Store manuals	4.1 Manual or specification are stored appropriately to ensure prevention of damage, ready access and updating of information when required in accordance with company requirements

RANGE OF VARIABLES

VARIABLE	RANGE
1. Manuals	Kinds of manuals: 2.1 Manufacturer's specification manual 2.2 Repair manual 2.3 Maintenance Procedure Manual 2.4 Periodic Maintenance Manual

EVIDENCE GUIDE

1.Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Identified and accessed manual/specification 1.2 Interpreted manuals 1.3 Applied information in manuals 1.4 Stored manuals
2. Underpinning knowledge and attitudes	2.1 Types of manuals used in automotive industry 2.2 Identification of symbols used in the manuals 2.3 Identification of units of measurements 2.4 Unit conversion
3. Underpinning skills	3.1 Reading and comprehension skills required to identify and interpret automotive manuals and specifications 3.2 Accessing information and data
4 Resource Implications	The following resources must be provided: 4.1 All manuals/catalogues relative to Automotive 4.2 Job order, requisitions 4.3 Actual vehicle or simulator
5 Method of assessment	Competency must be assessed through: 5.1 Observation with questioning 5.2 Interview
6 Context of assessment	6.1 Assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines 6.2 Assessment may be conducted in the workplace or a simulated environment.

UNIT OF COMPETENCY : **PERFORM SHOP MAINTENANCE**

UNIT CODE : **ALT723205**

UNIT DESCRIPTOR : This unit deals with inspecting and cleaning of work area including tools, equipment and facilities. Storage and checking of tools/ equipment and disposal of used supplies/materials are also incorporated in this competency.

ELEMENT	PERFORMANCE CRITERIA ***Italicized terms*** are elaborated in the Range of Variables
1. Inspect/clean tools and work area	1.1 Cleaning solvent used as per workshop/tools ***cleaning requirement***
	1.2 ***Work area*** is checked and cleaned
	1.3 Wet surface/spot in work area is wiped and dried
2. Store/arrange tools and shop equipment	2.1 Tools/equipment are checked and stored in their respective shelves/location
	2.2 Corresponding labels are posted and visible
	2.3 Tools are safely secured and logged in the records
3. Dispose wastes/used lubricants	3.1 Containers for used lubricants are visibly labeled
	3.2 Wastes/used lubricants are disposed as per workshop SOP
4. Report damaged tools/equipment	4.1 Complete inventory of tools/equipment is maintained
	4.2 Damaged tools/equipment/facilities are identified and repair recommendation is given
	4.3 Reports prepared has no error/discrepancy

RANGE OF VARIABLES

VARIABLE	RANGE
1. Work area	Work areas include: 1.1 Workshop areas for servicing/repairing light and/or heavy vehicle and/or plant transmissions and/or outdoor power equipment 1.2 Open workshop/garage and enclosed, ventilated office area 1.3 Other variables may include workshop with: • Mess hall • Wash room • Comfort room
2. Cleaning requirement	2.1 Cleaning solvent 2.2 Inventory of supplies, tools, equipment, facilities 2.3 List of mechanics/technicians 2.4 Rags 2.5 Broom 2.6 Mop 2.7 Pail 2.8 Used oil container 2.9 Oiler 2.10 Dust/waste bin
3. Manuals	3.1 Vehicle/plant manufacturer specifications 3.2 Company operating procedures 3.3 Industry/Workplace Codes of Practice 3.4 Product manufacturer specifications 3.5 Customer requirements 3.6 Industry Occupational Health and Safety
4. Company standard operating procedure	Wearing of Personal protective equipment include: 4.1 Gloves 4.2 Apron 4.3 Goggles 4.4 Safety shoes

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate: 1.1 Cleaned workshop tools/facilities 1.2 Maintained equipment, tools and facilities 1.3 Disposed wastes and used lubricants/fluid as per required procedure
2. Underpinning knowledge and attitudes	2.1 5 S or TQM 2.2 Service procedures 2.3 Relevant technical information 2.4 Safe handling of equipment and tools 2.5 Vehicle safety requirements 2.6 Workshop policies 2.7 Personal safety procedures 2.8 Fire extinguishers and prevention 2.9 Storage/disposal of hazardous/flammable materials 2.10 Positive Work Values (Perseverance, Honesty, Patience, Attention to Details)
3. Underpinning skills	3.1 Handling/Storing of tools/equipment/supplies and material 3.2 Cleaning grease/lubricants 3.3 Disposing of wastes and fluid 3.4 Preparing inventory of s/m and tools and equipment 3.5 Monitoring of s/m and tools/equipment
4. Resource implications	The following resources **MUST** be provided: 4.1 Workplace: Real or simulated work area 4.2 Appropriate Tools & equipment 4.3 Materials relevant to the activity
5. Method of assessment	Competency **MUST** be assessed through: 5.1 Written/Oral Questioning 5.2 Demonstration
6. Context of assessment	6.1 Competency must be assessed on the job or in a simulated environment. 6.2 The assessment of practical skills must take place after a period of supervised practice and repetitive experience.

CORE COMPETENCIES

UNIT OF COMPETENCY : **MANUFACTURE AND DEVELOP COREBOX FOR SHELL CORE SAND**

UNIT CODE : **ALT742306**

UNIT DESCRIPTOR : This unit covers manufacturing and developing metal corebox for shell core sand. The corebox can be adapted to horizontal or vertical stripping set-up.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Determine job requirement	1.1 Drawings, instructions, specifications are interpreted and understood. 1.2 Appropriate shell ***machine*** model is selected according to core drawing and corebox construction drawing 1.3 Corebox and component ***material*** is selected according to core drawing and corebox construction drawing. 1.4 Corebox and component for casting are requested in accordance with standard operating procedure 1.5 Corebox component part for fabrication and purchase is requested in accordance with standard operating procedure.
2. Lay-out corebox.	2.1 Corebox is laid-out showing ***cavity features*** according to corebox construction drawing 2.2 ***Method of construction*** / machining is discussed with machine shop or tool and die section.
3. Manufacture corebox and component.	3.1 Corebox and component is marked out and machining job initiated to meet specification. 3.2 Machining is checked periodically for compliance to requirement. 3.3 Corebox cavities are machined using acceptable machine shop / tool and die ***fabrication technique*** and procedures. 3.4 Cavities are finished, utilizing appropriate hand or hand held power tools. 3.5 Corebox and component are assembled according to specification and acceptable corebox locating technique and procedure. 3.6 Components are revised to adapt corebox including electrical, pneumatic and hydraulic controls.
4. Develop corebox	4.1 Corebox mounted to core machine bolster according to standard operating procedure. 4.2 Operational dry-run of coremachine / corebox is undertaken to ensure compatibility. 4.3 Trial coremaking by heating up the corebox, loading of sand, activating water cooling system is undertaken and ***machine parameters*** are adjusting based on machine setup procedure

	and corebox requirements. 4.4 Core is inspected / evaluated for conformance to ***core quality requirements***. 4.5 Adjustment on machine / corebox component and parameters initiated until the satisfactory core is produced according to core quality requirement.
5. Record data.	5.1 Test data is recorded (start to end) to include machine parameters corebox adjustment, shell sand used and other relevant information. 5.2 Task is completed in accordance with Occupational Health & Safety (OH & S) requirements

RANGE OF VARIABLE

VARIABLE	RANGE
1. Machine	1.1 Vertical strip setup. 1.2 Horizontal strip setup.
2. Material	2.1 Gray cast iron for core cavities, brackets, stripping plates, burner plates, blow-plates. 2.2 Tool steel for stripping pins, guide pins and bushings, blow-tubes, dowels.
3. Cavity features	3.1 Taper 3.2 Core print 3.3 Center/outline of cavities 3.4 Ejector holes 3.5 Contraction factor 3.6 Center of rotation and 3.7 Desired width, length and thickness
4. Method of construction	4.1 Segmented 4.2 Loose 4.3 One-halve of fixed and movable die 4.4 Doweled and bolted.
5. Fabrication technique	5.1 EDM 5.2 Heat-treatment of parts 5.3 End milling 5.4 Face milling 5.5 Drill/tap 5.6 Die grinding 5.7 Hand polishing 5.8 Fitting 5.9 Marking off 5.10 Template checking.
6. Machine parameter	6.1 Air blow pressure 6.2 Blow time 6.3 Corebox temperature (fixed/movable) 6.4 Cure time 6.5 Roll over device vibration timer 6.6 Clamping pressure 6.7 Ejection mark.
7. Core quality requirements	7.1 Color 7.2 Thickness of shell 7.3 Weight of core 7.4 Friable parts 7.5 Completeness 7.6 Core ejection marks 7.7 Stickers.

EVIDENCE GUIDE

1. Critical aspect of competency	Assessment requires evidence that the candidate 1.1 Determined job requirements. 1.2 Laid out corebox. 1.3 Manufactured corebox and component. 1.4 Developed corebox 1.5 Recorded data.
2 Underpinning knowledge and attitudes	2.1 Formulae / mathematical techniques required for manufacturing and development of production corebox 2.2 Contraction, taper, clearances, machining allowances, etc 2.3 Tolerance and construction values typically used in the manufacture and development of production corebox 2.4 Characteristics of metals and alloys and their application in the manufacture / development of production corebox 2.5 Production molding, coremaking and casting technique. 2.6 Tooling required for castings 2.7 Appropriate technique, tools and equipments to measure, marked out and produce corebox 2.8 Method of corebox construction including machining provision and clamping arrangement 2.9 Shell core machine nomenclature and operational sequence. 2.10 Corebox checking technique 2.11 Assembly technique of corebox to shell machine 2.12 Hazard and control measures associated with development / manufacturing and production of corebox 2.13 Use of personal protective equipments 2.14 Safe work practice and procedures 2.15 Observant/Attentive to details 2.16 Patience 2.17 Honesty 2.18 Courtesy
3 Underpinning skills	3.1 Determining job requirements from written instruction, standard operating procedures, sketches, shop / product drawings, and other applicable reference document. 3.2 Planning and sequencing operation. 3.3 Deciding corebox construction method. 3.4 Checking and clarifying task related information. 3.5 Selecting appropriate materials to suite the corebox fabrication and coremaking process. 3.6 Joining and fixing component part. 3.7 Operate shell machine and setup parameters. 3.8 Inspecting and analyzing core defects and initiate countermeasure. 3.9 Checking core boxes and component parts. 3.10 Checking machine operational capability. 3.11 Assemble corebox to core machine. 3.12 Accomplish test report and entering familiar information into pro-forma and standard workplace form.

	3.13 Conduct necessary layout making, measurement to corebox / component parts. 3.14 Coordinating with other section. 3.15 Communication with other section.
4 Resource implications	The following resources **MUST** be provided: 4.1 Workplace: Real or simulated work area. 4.2 Manuals / catalogues relative to this unit. 4.3 Job order, requisitions 4.4 Materials, tools, equipment and facilities relevant to the unit.
5 Method of assessment	Competency **MUST** be assessed through: 5.1 Observation with questioning 5.2 Portfolio 5.3 Third Party Report
6 Context of assessment	6.1 Assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines 6.2 Assessment may be conducted in the workplace or a simulated environment.

UNIT OF COMPETENCY : **DEVELOP AND MANUFACTURE GEAR, CONVEYOR SCREW AND PROPELLER PATTERNS**

UNIT CODE : **ALT742307**

UNIT DESCRIPTOR : This unit covers laying-out and manufacture gear, conveyor screw and propeller pattern. Gear patterns may be segmented or any other method used to minimize timber shrinkage or warpage and to achieve the required strength. Conveyor or propeller screw may be built up using predetermined thickness-timber either over a mandrel or a layout. Patterns may be set-up or a joint board or plated for ease of molding.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Determine job requirements	1.1 Drawings, instructions and specifications are interpreted and understood. 1.2 ***Material*** is selected in accordance with the drawings, instructions and/or specifications. 1.3 Molding, cast techniques and foundry processes are identified in determining the type of pattern required.
2. Lay out pattern gear, conveyor screw and propeller pattern	2.1 ***Pattern parameters*** are ***calculated*** in accordance with the drawings, instructions and/or specifications. 2.2 Pattern is laid out showing ***pattern characteristics*** in accordance with the drawings, instructions and/or specifications. 2.3 Jigs and fixtures are developed and fabricated to aid the manufacture of the pattern form as required.
3. Manufacture gear, conveyor screw and propeller pattern	3.1 Materials are marked out and construction is developed to meet specifications. 3.2 Pattern or pattern component parts are produced to size and shape and checked for compliance with specifications using acceptable wood pattern making techniques, procedures and utilizing appropriate hand and hand held power. 3.3 Pattern component parts are joined or fixed as required, according to specifications, using acceptable pattern making techniques and procedures. 3.4 Pattern is marked, color coded and / or tagged in compliance with specifications or standard operating procedures.

RANGE OF VARIABLE

VARIABLE	RANGE
1. Material	1.1 Hardwood 1.2 Softwood 1.3 Epoxy resins 1.4 Composites.
2. Pattern parameters	2.1 Pitch circles 2.2 Pressure angles 2.3 Tooth form 2.4 Left- and right-hand flight helix 2.5 Pitch axial dimensions 2.6 Angles, tapers, clearances 2.7 Contraction allowances appropriate to developing various types of gear, conveyor and propeller forms.
3. Calculated	Calculated values to determine: 3.1 Contraction rates 3.2 Pitch 3.3 Proportions 3.4 Profiles as well as general engineering calculations.
4. Pattern characteristics	4.1 Tapers 4.2 Machining allowances 4.3 Core prints and 4.4 Method of construction

EVIDENCE GUIDE

1. Critical aspect of competency	Assessment requires evidence that the candidate 1.1 Determined job requirements 1.2 Laid-out pattern gear, conveyor screw and propeller pattern 1.3 Manufactured gear, conveyor screw and propeller pattern
2. Underpinning knowledge and attitudes	2.1 Timber, epoxy resin and composite product knowledge including features, characteristics and applications. 2.2 Molding and casting techniques for cast gears, conveyor screws and marine propellers. 2.3 Tooling required for casting / molding. 2.4 Methoding techniques. 2.5 The use and application of jigs and fixtures. 2.6 Methods of construction. 2.7 Techniques, tools and equipment to measure, mark out and produce gear, conveyor screw and propeller patterns. 2.8 Mathematical calculations and formulae required to manufacture patterns / core boxes – contraction, taper, pitch, profiles, clearances, machining allowances. 2.9 Identification coding and numbering. 2.10 Pattern checking techniques. 2.11 Moldability i.e. surface finish, face taper, convex or concave perspectives, undercuts etc. 2.12 Use and application of personal protective equipments. 2.13 Safe work practices and procedures. 2.14 Hazards and control measures associated with developing and manufacturing gear, conveyor screw and propeller patterns 2.15 Safe work practice and procedures 2.16 Observant/Attentive to details 2.17 Patience 2.18 Honesty 2.19 Courtesy
3. Underpinning skills	3.1 Determining job requirements from written instructions, standard operating procedures, sketches, drawings and other applicable reference documents. 3.2 Planning and sequencing operations. 3.3 Checking and clarifying task related information. 3.4 Selecting appropriate materials to suit the molding/casting techniques and foundry process. 3.5 Laying out the pattern / core boxes and mold. 3.6 Operating woodworking equipment 3.7 Constructing patterns / core boxes and mold. 3.8 Joining and fixing component parts. 3.9 Checking patterns and molds. 3.10 Calculating contraction rates / pitch / proportions / profiles. 3.11 Calculating mold cooling H2O volume

	3.12 Calculating gating / risering system 3.13 Preparation of mold coating 3.14 Application of mold coating 3.15 Pre-heating of mold 3.16 Undertaking relevant engineering calculations
4. Resource implications	The following resources **MUST** be provided: 4.1 Manuals/catalogues relative to Patternmaking 4.2 Job order, requisitions slip for materials 4.3 Materials, tools and equipment relevant to the activity 4.4 Incoming material receiving effort. 4.5 Quality handbook procedure for melting.
5.Method of assessment	Competency **MUST** be assessed through: 5.1 Observation with questioning 5.2 Portfolio 5.3 Third Party Report
6.Context of assessment	6.1 Assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines 6.2 Assessment may be conducted in the workplace or a simulated environment.

UNIT OF COMPETENCY : **DEVELOP GRAVITY DIE CASTING MOLD**

UNIT CODE : **ALT742308**

UNIT DESCRIPTOR : This unit covers developing a gravity die casting mold (permanent / semi-permanent) used to produce component parts for automotive, track, and allied industries.

ELEMENT	PERFORMANCE CRITERIA ***Italicized*** terms are elaborated in the Range of Variables
1. Identify job requirement	1.1 Product drawings, instruction and specifications are interpreted and fully understand. 1.2 Appropriate ***mold materials*** are selected as per method of molding and specifications. 1.3 Mold fabrication technique, molding of components, casting technique and foundry process are identified to determine the ***type of mold*** required.
2. Prepare mold construction plan	2.1 ***Planning of mold***, fabrication of components, casting technique is applied as required. 2.2 Molding process is selected as per mold plan and standard operating procedures. 2.3 Casting parameters is laid-out as per standard operating procedures. 2.4 Pouring system, riser size, ***mold cooling system*** is calculated as per standard operating procedures.
3. Fabricate mold	3.1 Mold materials are identified and secured/ procured according to standard operating procedures. 3.2 Mold and component parts are produced to size and shape and checked for compliance with specifications using acceptable machining techniques, procedures and utilizing appropriate hand and hand-help power tools. 3.3 Mold component parts are joined or fixed as required according to specification and acceptable mold making techniques and procedures. 3.4 Mold cooling system checked for compliance with specification. 3.5 Clay molding of casting is produced from the mold to check configuration and surface finish of the mold as per standard operating procedures.

4. Conduct trial casting	4.1 Samples for aesthetic inspection are produced and dimensional inspection is performed as per specification requirement. 4.2 Mold is prepared for application of appropriate ***mold coating*** as per standard operating procedures. 4.3 Mold is mounted and secured to casting machine as per standard operating procedures. 4.4 Mold / machine is prepared for pouring of molten metal as per standard operating procedures. 4.5 Task completed using personal protective equipment in accordance with safe work practices and procedures.
5. Inspect mold	5.1 Mold is inspected for related defects as per standard operating procedures. 5.2 Dimensions are checked and mold is rectified, if needed, as per standard operating procedures. 5.3 Section thickness is measured and checked for compliance with specification. 5.4 Conformance report is submitted as per company/shop requirement and standard operating procedures.

RANGE OF VARIABLE

VARIABLE	RANGE
1. Mold material	1.1 Gray cast iron for the halves or quadrants. 1.2 Tool steel for bottom mold. 1.3 Gray cast iron for center mold.
2. Type of mold	Types of mold includes, but not limited to 2.1 Center pouring mold 2.2 Side pouring mold 2.3 Semi-permanent mold with sand core. 2.4 With loose piece.
3. Planning of mold	The following should be considered in planning 3.1 Quantity of casting to be produced. 3.2 Type of metal to be cast 3.3 Casting cycle time. 3.4 Complexity of the casting. 3.5 Casting machine loading
4. Mold cooling system	4.1 Water cooling 4.2 Air cooling
5. Mold coating	5.1 Preheating of mold (110° – 150°C) 5.2 Coating application/ technique (spraying) 5.3 Coating type 5.3.1 Insulating type 5.3.2 Lubricating type

EVIDENCE GUIDE

1. Critical aspect of Competency	Assessment requires evidence that the candidate 1.1 Identified job requirement. 1.2 Prepared mold construction plan. 1.3 Fabricated mold. 1.4 Conducted trial casting. 1.5 Inspection mold.
2. Underpinning Knowledge and attitudes	2.1 Casting process of non-ferrous alloys 2.2 Metal, resin, and composite product knowledge including characteristics and application 2.3 Molding and casting techniques for ferrous metal 2.4 Machining and tool / die making process 2.5 Principles of permanent mold coating and application 2.6 Patterns and tooling required to fabricate metal mold 2.7 Method and technique of permanent mold fabrication 2.8 Use of jig / fixture 2.9 Bench work for metal mold 2.10 Mold checking technique 2.11 Casting inspection technique 2.12 Casting defect, cause and countermeasure 2.13 Use and application of personal protective equipments 2.14 Safe work practice and procedures 2.15 Hazards and control measures associated with developing and manufacturing permanent mold 2.19 Safe work practice and procedures 2.20 Observant/Attentive to details 2.21 Patience 2.22 Honesty 2.16 Courtesy
3. Underpinning skills	3.1 Determining job requirements from written instructions, standard operating procedures, sketches, drawings and other applicable reference documents 3.2 Planning and sequencing operations 3.3 Checking and clarifying task related information 3.4 Selecting appropriate materials to suit the molding/casting techniques and foundry process 3.5 Laying out the pattern / core boxes and mold 3.6 Constructing patterns / core boxes and mold 3.7 Joining and fixing component parts 3.8 Checking patterns and molds 3.9 Calculating contraction rates / pitch / proportions / profiles 3.10 Calculating mold cooling water (H2O) volume 3.11 Calculating gating / risering system 3.12 Preparation of mold coating 3.13 Application of mold coating 3.14 Pre-heating of mold

4. Resource implications	The following resources **MUST** be provided: 4.1 Manuals/catalogues relative to mold making 4.2 Job order, requisitions slip for materials 4.3 Materials, tools and equipment relevant to the activity 4.4 Incoming material receiving effort. 4.5 Quality handbook procedure for melting.
5.Method of assessment	Competency **MUST** be assessed through: 5.1 Observation with questioning 5.2 Portfolio 5.3 Third Party Report
6.Context of assessment	6.1 Assessment must be undertaken in accordance with the endorsed TESDA assessment guidelines 6.2 Assessment may be conducted in the workplace or a simulated environment.

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 Foundry Pattern Making NC III.

3.1 CURRICULUM DESIGN

Course Title: **Foundry-Patternmaking** NC Level: **NC III**

Nominal Training Duration: **20 Hours** (Basic Competencies)
20 Hours (Common Competencies)
72 Hours (Core Competencies)

Course Description:

This course is designed to enhance the knowledge, skills and attitudes of an individual in the field of foundry-pattern making in accordance with industry standards. It covers core competencies such as; manufacture and develop corebox for shell core sand and develop and manufacture gear, conveyor screw and propeller patterns. It also include competency to develop gravity die casting mold used to produce component parts for automotive, track, and allied industries.

Basic competencies such as: Lead workplace communication; Lead small teams; Develop and practice negotiation skills; Solve problems related to work activities; Use mathematical concepts and techniques and Use relevant technologies are included.

It also includes common competencies such as: Read, Interpret and Apply Engineering Drawings; Perform Mensuration and Calculation Read; Interpret and Apply Specifications and Manuals and; Perform Shop Maintenance.

To obtain this, all units prescribed for this qualification must be achieved.

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. Read, Interpret and Apply Engineering Drawings	1.1 Identify and access engineering drawings/ specification 1.2 Interpret drawings 1.3 Apply information in the drawings & specifications 1.4 Store drawings	• Lecture/ Demonstration • Dual training	• Direct observation • Interview
2. Perform Mensuration and Calculation	2.1 Select measuring instrument and carry out measurement and calculations.	• Lecture/ Demonstration • Simulation • Exercises	• Written test • Oral questioning • Direct observation

	2.3 Maintain measuring instruments		
3. Read, Interpret and Apply Specifications and Manual	3.1 Identify/accessed manuals and interpret data and specification 3.2 Apply information accessed in manual 3.3 Store manual	• Lecture/ Demonstration • Dual training • Distance Learning	• Written test • Direct observation • Project method • Interview
4. Perform Shop Maintenance	4.1 Inspect/clean tools and work area 4.2 Store/arrange tools and shop equipment 4.3 Dispose wastes/used lubricants 4.4 Report damaged tools/equipment	• Lecture/ Demonstration • Dual training • Self paced (modular) • Simulation	• Written test • Direct observation • Demonstration • Interview

CORE COMPETENCIES

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1 Manufacture and develop corebox for shell core sand	1.1 Determine job requirements 1.2 Lay out core box' 1.3 Manufacture core box and components 1.4 Core machine component 1.5 Develop core box 1.6 Record data	• Lecture • Dual Training • Discussion	• Observation with questioning • Portfolio • Third party report
2. Develop and Manufacture Gear, Conveyor, Screw and Propeller Pattern	2.1 Determine job requirements 2.2 Lay out pattern gear, conveyor screw and propeller pattern 2.3 Manufacture gear, conveyor screw and propeller pattern	• Lecture/ Demonstration • Dual Training • Distance learning	• Written examination • Direct Observation • Project method • Interview
3. Develop Gravity Die Casting Mold	3.1 Identify job requirement 3.2 Prepare mold construction plan 3.3 Fabricate mold 3.4 Conduct trial casting 3.5 Inspect mold	• Lecture • Dualized training • Discussion	• Observation and questioning • Portfolio • Third party

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 learner-centered and should accommodate individualized and self-paced learning strategies;
- 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 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 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, or audio, video or computer technologies.
- Project-Based Instruction is an authentic instructional model or strategy in which students plan, implement and evaluate projects that have real world applications.

3.3 TRAINEE ENTRY REQUIREMENTS

This section specifies the qualifications of trainees and educational experience. Other requirements like health and physical requirements are also stated. Passing entry written examinations may also be indicated if necessary.

- With experience in basic machining
- Ability to communicate both orally and in written; and
- Physically and mentally fit
- Must possess the Foundry-Patternmaking National Certificate (NC) II

3.4 LIST OF TOOLS, EQUIPMENT AND MATERIALS FOUNDRY PATTERNMAKING NC III

Recommended list of tools, equipment and materials for the training of 12 trainees for Foundry Patternmaking NC III

TOOLS		EQUIPMENT		MATERIALS	
QTY		**QTY**		**QTY**	
2 sets	Box wrench	1 unit	Wood lathe	12 pcs	Plywood (1/2 thk)
2 sets	Open end wrench	1 unit	Band saw	12 pcs	Plywood (1/4 thk)
2 sets	Socket wrench	1 unit	Circular saw	24 pcs	Lumber 1”x4”x12”
2 pcs	Adjustable wrench	1 unit	Planer	24 pcs	Lumber 2”x4”x12”
2 sets	Screwdriver (+)	1 unit	Disc grinder	24 pcs	Lumber 2”x6”x12”
2 sets	Screwdriver (-)	1 unit	Wood router	24 pcs	Lumber 2”x2”x12”
2 pcs	Plier (side cutting)	1 unit	Portalble drill (12mm)	12 pcs	Laminate 4”x8”x1/8”
2 pcs	Plier (long nose)	1 unit	Bench drill	12 pcs	Card board 4”x8”x1/8”
2 pcs	Mechanical plier	1 unit	Pedestal tool grinder	12 pcs	Marker pen (red)
2 pcs	Ballpein hammer	2 set	Work bench	12 pcs	Marker pen (black)
4 pcs	Wood mallet	4 sets	Clamp	3 cans	Lay-out blue
4 pcs	Claw hammer	4 sets	Wood clamp	6 ft	Steelwire 6mm dia
1 set	Feeler gauge	4 set	C-clamp 300mm	24 pcs	Ball pen
2 pcs	Hammer (plastic faced)	2 units	Storage cabinet	4 gallons	Rugby adhesive
1 set	Number punch	2 units	Open shelf cabinet	4 gallons	Wood putty (2-system)
1 set	Alphabet punch	1 pc	Anvil	4 gallons	Wood filler (fula tite)
1 set	Straight drill			24 sheets	Sand paper #120
8 sets	Tap / die (M-8			24	Sand paper #160

	up to M-20)			sheets	
2 sets	Tap / die handle			24 sheets	Sand paper #60
2 pcs	Hack saw			4meters	Disc sander (wood)
2 pcs	Straight edge (1000 mm long)				Engineering drawing
2 pcs	Tri-square (300mm long)				Machine numeral
1 pc	Adjustable protractor				Catalogues
2 pcs	Steel rule (3 meters)				Brochure
2 pcs	Cross cut saw				Paint brush
2 pcs	Rasp file (heefround)			1 liter	Paint (Blue, Orange, Red, Black)
2 pcs	Rasp file (rectangle)				
2 pcs	Rasp file (round)				
2 pcs	File (coarse) heefround				
2 pcs	File (fine) heefround				
2 pcs	File (coarse) rectangle				
2 pcs	File (fine) rectangle				
2 pcs	File (coarse) round				
2 pcs	File (fine) round				
2 pcs	File (coarse) square				
2 pcs	File (fine) square				
2 pcs	File (coarse) Triangle				
2 pcs	File (fine) Triangle				
2 sets	Vernier caliper (300)				
2 sets	Vernier caliper (250)				
2 sets	Depth gage (300)				
1 set	Vernier height gage (1000mm)				
1 set	Vernier height gage (500mm)				

2 sets	Wood turning tools				
3 pcs	Divider (300mm)				
2 pcs	Trammel point				
3 pcs	Divider (200mm)				
2 pcs	Straight edge (510mm)				
2 pcs	Jack plane (long) – Katam				
2 pcs	Jack plane (short) – Katam				
4 pcs	Chisel 1 ½" wide				
4 pcs	Chisel 1" wide				
4 pcs	Chisel 1/2 " wide				
4 pcs	Chisel ¼" wide				

3.5 TRAINING FACILITIES
FOUNDRY PATTERNMAKING NC III

Based on a class size of 12 students/trainees

SPACE REQUIREMENT	SIZE IN METERS	AREA IN SQ. METERS	TOTAL AREA IN SQ. METERS
• Building (permanent)	26.00 x 28.00	728.00	728.00
• Trainee Working Space	3.50 x 3.50 per student / trainee	12.25 per student	147
• Lecture room	9.00 x 10.00	90.00	90.00
• Learning resource center	5.00 x 8.00	40.00	40.00
• Facilities / Equipment / Circulation area**	-	-	300.00

***** Area requirement is equivalent to 30% of the total teaching/learning areas***

3.6 TRAINER'S QUALIFICATIONS FOR AUTOMOTIVE MANUFACTURING SUB SECTOR

FOUNDRY PATTERNMAKING NC III
TRAINER QUALIFICATION (TQ II)

- Must be a holder of FOUNDRY PATTERN MAKING NC III
- Must have undergone training on Training Methodology II (TM II) [1]
- Must be computer literate
- Must be physically and mentally fit
- Must have at least 2 years job/industry experience[2]
- Must be a civil-service eligible or holder of appropriate professional license issued by the Professional Regulatory Commission (for government positions only)

[1] This shall be changed to ":Must be a holder of Trainer Qualification Level II (TQII) or equivalent" upon promulgation by the TESDA Board of the TQ/AQ training regulations

[2] Optional. Only when required by the hiring institution

Reference: TESDA Board Resolution No. 2004 03

3.7 INSTITUTIONAL ASSESSMENT

Institutional assessment is undertaken by trainees to determine their 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 Foundry Patternmaking NC III, the candidate must demonstrate competence in all the units listed in Section 1. Successful candidates shall be awarded a National Certificate signed by the TESDA Director General.

4.2 The qualification of Foundry Patternmaking NC III may be attained through demonstration of competence through a single comprehensive project-type assessment covering all required units of competency of the qualification.

4.4.1 **Fabricate/Develop Corebox for Shell Cores, Gear or Conveyor Screw or Propeller Patterns and Gravity Die Casting Mold**

- Manufacture and Develop Corebox for Shell Core Sand
- Develop and Manufacture Gear, Conveyor Screw and Propeller Patterns
- Develop Gravity Die Casting Mold

4.3 Assessment shall focus on the core units of competency. The basic and common units shall be integrated or assessed concurrently with the core units.

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

4.4.1 Holder of Foundry Patternmaking NC II or equivalent qualification; or

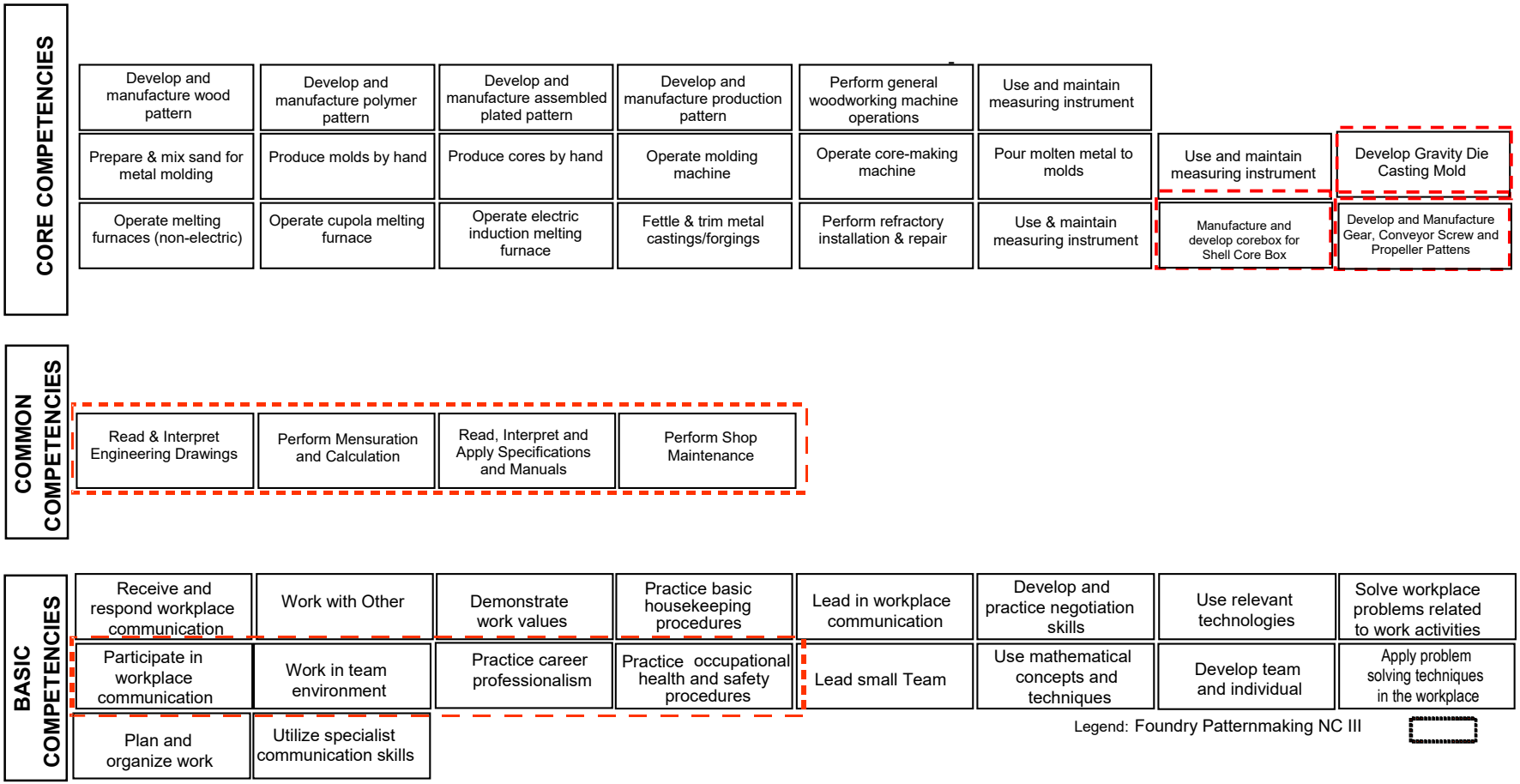
4.4.2 Graduates of formal, non-formal and informal including enterprise-based training programs.

4.4.3 Experienced workers (wage employed or self-employed)

4.5 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 (PTQCS)*

ANNEX A

COMPETENCY MAP- AUTOMOTIVE SECTOR
MANUFACTURING SUB-SECTOR



DEFINITION OF TERMS (FOUNDRY)

1. Alloy	An **alloy** is a homogeneous blend of two or more elements at least one of which is a metal, and where the resulting material as metallic properties.
2. Carbon Dioxide Process	**Carbon Dioxide Process** consist of mixing a clean dry silica sand with a silicate binder, compacting the mixture to shape and hardening it by passing carbon dioxide gas.
3. Casting	**Casting** is the term used to describe both the process and the product when molten metal is poured and solidified in a mold.
4. Chemical Analysis	**Analytical chemistry** is the science that seeks ever improved means of measuring the chemical composition of natural and artificial materials.
5. Cope	In a two-part mold, the **cope** is the name given to the top half of the pattern, flask, mold, or core.
6. Core	The **core** is a sand shape that is inserted into the mold to produce the internal features of a casting, such as, holes or passages for water-cooling.
7. Core Box	A **core box** is the mold or die used to produce casting cores.
8. Core Print	The **core print** is the region added to the pattern, core, or mold that is used to locate and support the core within the mold.
9. Draft	**Draft** is the taper on a pattern or casting that permits it to be withdrawn from the mold.
10. Drag	The **drag** is the bottom part of the two-part mold.
11. Dross	**Dross** is a mass of solid impurities floating on a molten metal bath. It appears usually on the melting of low melting point metals or alloys such as aluminum, copper, magnesium or each alloys.
12. Fettle / Finishing	The process of cleaning the casting, removal of excess metal, grinding and inspection operation which may be required for some casting process.

13. Flask	The **flask** is the box that contains the molding aggregate.
14. Foundry	A **Foundry** is a factory which produces metal castings from either ferrous or non-ferrous alloys.
15. Furnace	**Furnaces** are refractory lined vessels that contain the material to be melted and provide the energy to melt it.
16. Gate	**Gate** is controlled entrances to the mold cavity.
17. Gating System	**Gating system** is the network of channels used to deliver the molten metal to the mold cavity.
18. Green Sand	The term **Green Sand** refers to that molded sand mixture which is allowed to remain moist and is used in casting ferrous and non-ferrous metals.
19. Melting	The process includes melting the charge, refining the melt, adjusting the melt chemistry and tapping into a transport vessel. Refining is done to remove deleterious gasses and elements from the molten metal. Material is added during the melting process to bring the final chemistry within a specific range specified by industry and/or internal standards. During the tap, final chemistry adjustments are made.
20. Molding	Is the process of making the mold cavity with a necessary allowances such as shrinkage, machining, taper, and surface finish. Usually it is done with green sand as the molding medium.
21. Mold Cavity	The **mold cavity** is the shaped hole into which the molten metal is poured and solidified to produce the desired casting.
22. Parting Line	**Parting Line** or Parting Surface is the interface that separates the cope and drag halves of a mold, flask, or pattern. The same part can also be found in some core making processes.
23. Pattern	The **pattern** is the approximate copy of the final casting. The molding material (sand for sand molds) is then packed around the pattern and the pattern is removed to produce the mold cavity.

24. Pattern Shrinkage Allowance	Dimensions added to the pattern to compensate for the solid shrinkage or contraction occurs in the solidified casting as it cools to room / ambient temperature.
25. Pouring Cup	A **Pouring Cup** or Pouring Basin is the portion of the gating system that initially receives the molten metal from the pouring vessel and controls its delivery to rest of the mold.
26. Refractories	Refers to materials that are used to make crucibles, linings for furnaces, kilns, ovens and incinerators. A practical requirement is the ability of the material to withstand temperatures above 1100^{o}C without softening.
27. Riser	A **riser** is an extra void created in the mold that will also fill with molten metal. It provides a reservoir of molten metal that flow into the mold cavity to compensate for any shrinkage during solidification.
28. Runners	**Runners** are the horizontal part of the gating system that is connected to the gate.
29. Slag	Are by-product of melting metals. They are composed of metal oxides and sulfides. The assist in melt temperature control and minimize oxidation of the liquid metal before casting.
30. Sprue	From the pouring cup, the molten metal travels down the **sprue** the vertical part of the gating system that connects with the runners.
31. Vents	**Vents** are additional channels providing an escape for the gasses that are generated within the mold.
32. Wedge Chill Test	Indicates the chilling tendencies of cast iron melt which is related to melting conditions, chemical composition and casting section thickness.

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