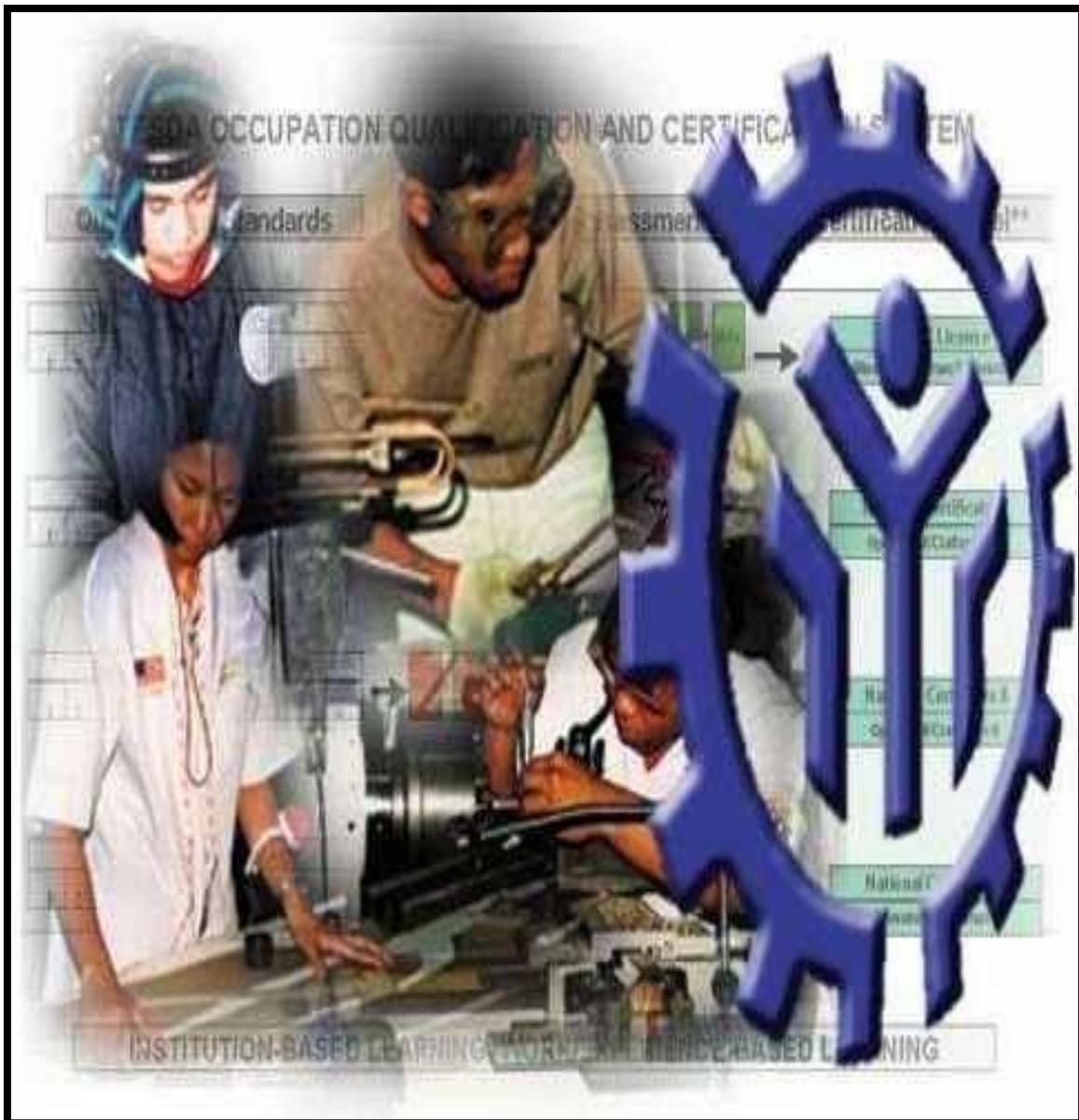


TRAINING REGULATIONS

LABORATORY AND METROLOGY/ CALIBRATION SERVICES NC III



AUTOMOTIVE

(MANUFACTURING SUB-SECTOR)

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

*Technical Education and Skills Development Act of 1994
(Republic Act No. 7796)*

Section 22, “Establishment and Administration of the National Trade Skills Standards” of the RA 7796 known as the TESDA Act mandates TESDA to establish national occupational skill standards. The Authority shall develop and implement a certification and accreditation program in which private industry group and trade associations are accredited to conduct approved trade tests, and the local government units to promote such trade testing activities in their respective areas in accordance with the guidelines to be set by the Authority.

The Training Regulations (TR) serves as basis for the:

1. Competency assessment and certification;
2. Registration and delivery of training programs; and
3. Development of curriculum and assessment instruments.

Each TR has four sections:

- Section 1 Definition of Qualification - refers to the group of competencies that describes the different functions of the qualification.
- Section 2 Competency Standards - gives the specifications of competencies required for effective work performance.
- Section 3 Training Standards - contains information and requirements in designing training program for certain Qualification. It includes curriculum design, training delivery; trainee entry requirements; tools equipment and materials; training facilities and trainer's qualification.
- Section 4 National Assessment and Certification Arrangements - describe the policies governing assessment and certification procedure.

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(MANUFACTURING SUB-SECTOR)

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TRAINING REGULATIONS

FOR

LABORATORY AND METROLOGY/CALIBRATION SERVICES NC III

SECTION 1 LABORATORY AND METROLOGY/CALIBRATION SERVICES NC III QUALIFICATION

The LABORATORY AND METROLOGY/CALIBRATION SERVICES NC III Qualification consists of competencies that a person must achieve to perform laboratory and metrology/calibration services work specifically on using comparison and basic measuring devices. It also include competency in measure components using coordinate measuring machines and use graphical techniques and perform simple statistical computations

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
ALT315311	Use Comparison and Basic Measuring Devices
ALT315312	Measure Components Using Coordinate Measuring Machines
ALT315313	Use Graphical Techniques and Perform Simple Statistical Computations

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

- **Laboratory and Metrology/Calibration Senior Technician**

SECTION 2 COMPETENCY STANDARDS

This section gives the details of the contents of the basic, common and core units of competency required in LABORATORY AND METROLOGY/CALIBRATION SERVICES 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 <i>Italicized terms</i> 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

<p>1. Critical aspects of competency</p>	<p>Assessment requires evidence that the candidate:</p> <ul style="list-style-type: none"> 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
<p>2. Underpinning knowledge</p>	<ul style="list-style-type: none"> 2.1 Organization requirements for written and electronic communication methods 2.2 Effective verbal communication methods
<p>3. Underpinning skills</p>	<ul style="list-style-type: none"> 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
<p>4. Resource implications</p>	<p>The following resources MUST be provided:</p> <ul style="list-style-type: none"> 4.1 Variety of Information 4.2 Communication tools 4.3 Simulated workplace
<p>5. Method of assessment</p>	<p>Competency may be assessed through:</p> <ul style="list-style-type: none"> 5.1 Competency in this unit must be assessed through 5.2 Direct Observation 5.3 Interview
<p>6. Context of assessment</p>	<ul style="list-style-type: none"> 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 <i>Italicized terms</i> 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

<p>1. Critical aspects of competency</p>	<p>Assessment requires evidence that the candidate:</p> <ul style="list-style-type: none"> 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
<p>2. Underpinning knowledge</p>	<ul style="list-style-type: none"> 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
<p>3. Underpinning skills</p>	<ul style="list-style-type: none"> 3.1 Communication skills required for leading teams 3.2 Informal performance counseling skills 3.3 Team building skills 3.4 Negotiating skills
<p>4. Resource implications</p>	<p>The following resources MUST be provided:</p> <ul style="list-style-type: none"> 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
<p>5. Method of assessment</p>	<p>Competency may be assessed through:</p> <ul style="list-style-type: none"> 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
<p>6. Context of assessment</p>	<ul style="list-style-type: none"> 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 <i>Italicized terms</i> are elaborated in the Range of Variables
1. Plan negotiations	1.1 Information on <i>preparing for negotiation</i> is identified and included in the plan 1.2 Information on creating <i>non verbal environments</i> for positive negotiating is identified and included in the plan 1.3 Information on <i>active listening</i> is identified and included in the plan 1.4 Information on different <i>questioning techniques</i> 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 Good understanding of topic to be negotiated 1.2 Clear understanding of desired outcome/s 1.3 Personal attributes 1.4 1.4.1 self awareness 1.4.2 self esteem 1.4.3 objectivity 1.4.4 empathy 1.4.5 respect for others Interpersonal skills 1.5 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 Analytic skills 1.6 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 competencies 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 <i>Italicized terms</i> 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 <i>analytical techniques</i> 1.3 <i>Problems</i> 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 <i>Action plans</i> 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

<p>1. Critical aspects of competency</p>	<p>Assessment requires evidence that the candidate:</p> <ol style="list-style-type: none"> 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 <p>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.</p>
<p>2. Underpinning knowledge</p>	<ol style="list-style-type: none"> 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 <ol style="list-style-type: none"> 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
<p>3. Underpinning skills</p>	<ol style="list-style-type: none"> 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	<p>Competency may be assessed through:</p> <p>5.1 Case studies on solving problems in the workplace</p> <p>5.2 Observation</p> <p>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.</p>
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 <i>Italicized terms</i> 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 <i>Italicized terms</i> 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 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	<p>Assessment requires evidence that the candidate:</p> <ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 3.1 Relevant technology application/implementation 3.2 Basic communication skills 3.3 Software applications skills 3.4 Basic troubleshooting skills
4. Resource implications	<p>The following resources MUST be provided:</p> <ul style="list-style-type: none"> 4.1 Relevant technology 4.2 Interview and demonstration questionnaires 4.3 Assessment packages
5. Method of assessment	<p>Competency must be assessed through:</p> <ul style="list-style-type: none"> 5.1 Interview 5.2 Actual demonstration 5.3 Authenticated portfolio (related certificates of training/seminar)
6. Context of assessment	<ul style="list-style-type: none"> 6.1 Competency may be assessed in actual workplace or simulated environment

**COMMON COMPETENCIES
(AUTOMOTIVE MANUFACTURING-PARTS 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
	<i>Italicized</i> 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

<p>1. Critical aspects of competency</p>	<p>Assessment requires evidence that the candidate:</p> <ul style="list-style-type: none"> 1.1 Identified and accessed drawings/specification 1.2 Interpreted drawings 1.3 Applied information in drawings 1.4 Stored drawings
<p>2. Underpinning knowledge and attitudes</p>	<ul style="list-style-type: none"> 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
<p>3. Underpinning skills</p>	<ul style="list-style-type: none"> 3.1 Reading and comprehension skills required to identify and interpret engineering drawings and specifications 3.2 Accessing information and data
<p>4. Resource implications</p>	<p>The following resources MUST be provided:</p> <ul style="list-style-type: none"> 4.1 All drawings/engineering specifications relative to automotive manufacturing 4.2 Job order, requisitions 4.3 Product sample
<p>5 Method of assessment</p>	<p>Competency MUST be assessed through:</p> <ul style="list-style-type: none"> 5.1 Observation with questioning 5.2 Interview
<p>6 Context of assessment</p>	<ul style="list-style-type: none"> 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 <i>Italicized</i> 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 <i>measuring instrument</i> 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 <i>Calculation</i> 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	<p>Assessment requires evidence that the candidate:</p> <ul style="list-style-type: none"> 1.1 Selected measuring instruments 1.2 Carried-out measurements and calculations. 1.3 Maintained measuring instruments
2. Underpinning knowledge and attitudes	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<p>The following resources MUST be provided:</p> <ul style="list-style-type: none"> 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	<p>Competency MUST be assessed through:</p> <ul style="list-style-type: none"> 5.1 Observation with questioning 5.2 Written or oral examination 5.3 Interview 5.4 Demonstration with questioning
6. Context of assessment	<ul style="list-style-type: none"> 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 <i>Italicized</i> 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: 1.1 Manufacturer's specification manual 1.2 Repair manual 1.3 Maintenance Procedure Manual 1.4 Periodic Maintenance Manual

EVIDENCE GUIDE

<p>1. Critical aspects of competency</p>	<p>Assessment requires evidence that the candidate:</p> <ul style="list-style-type: none"> 1.1 Identified and accessed manual/specification 1.2 Interpreted manuals 1.3 Applied information in manuals 1.4 Stored manuals
<p>2. Underpinning knowledge and attitudes</p>	<ul style="list-style-type: none"> 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
<p>3. Underpinning skills</p>	<ul style="list-style-type: none"> 3.1 Reading and comprehension skills required to identify and interpret automotive manuals and specifications 3.2 Accessing information and data
<p>4 Resource Implications</p>	<p>The following resources must be provided:</p> <ul style="list-style-type: none"> 4.1 All manuals/catalogues relative to Automotive 4.2 Job order, requisitions 4.3 Actual vehicle or simulator
<p>5 Method of assessment</p>	<p>Competency must be assessed through:</p> <ul style="list-style-type: none"> 5.1 Observation with questioning 5.2 Interview
<p>6 Context of assessment</p>	<ul style="list-style-type: none"> 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 <i>Italicized terms</i> are elaborated in the Range of Variables
1. Inspect/clean tools and work area	1.1 Cleaning solvent used as per workshop/tools <i>cleaning requirement</i> 1.2 <i>Work area</i> 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: <ul style="list-style-type: none"> • 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	<p>Assessment requires evidence that the candidate:</p> <ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<p>The following resources MUST be provided:</p> <ul style="list-style-type: none"> 4.1 Workplace: Real or simulated work area 4.2 Appropriate Tools & equipment 4.3 Materials relevant to the activity
5. Method of assessment	<p>Competency MUST be assessed through:</p> <ul style="list-style-type: none"> 5.1 Written/Oral Questioning 5.2 Demonstration
6. Context of assessment	<ul style="list-style-type: none"> 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 : USE COMPARISON AND BASIC MEASURING DEVICES

UNIT CODE : ALT315311

UNIT DESCRIPTOR : This unit covers sorting items using basic comparison measuring equipment, and maintaining the equipment. Measurements are conducted in a production environment or at a work station.
Work is undertaken autonomously or as part of teamwork. All comparative measurements are undertaken to standard operating procedures and to regulatory and legislative requirements

ELEMENT	PERFORMANCE CRITERIA
1. Identify job requirements	<p>1.1 Job sheets or equivalent instructions are interpreted without error and in accordance with company standard operating procedures.</p> <p>1.2 Determine what measuring equipment is needed</p>
2. Set comparative measuring devices	<p>2.1 Measuring equipment is set to specifications using manufacturer guidelines or standard operating procedures and techniques.</p>
3. Use comparison and/or basic measuring devices	<p>3.1 Basic measuring devices are identified and used to undertake required comparisons or measurements using standard operating procedures.</p> <p>3.2 Checking or sorting of items is undertaken using comparison and/or basic measuring device according to standard operating procedures.</p> <p>3.3 Measurements are documented and reported as per company standard operating procedures.</p>
4. Maintain comparison and/or basic measuring devices	<p>4.1 Basic care and storage is maintained according to manufacturers' standards or standard operating procedures.</p>

RANGE OF VARIABLES

VARIABLE	RANGE
1. Basic measuring devices	Linear measuring devices measuring to within 1mm graduation – may include 1.1 Rules 1.2 Tapes & retractable tapes 1.3 Vernier caliper, micrometer
2. Comparisons	2.1 Comparison of Length, Angle, shape and Size 2.2 Comparisons of Temperature, Pressure and Weight 2.3 Comparisons of Voltage, Resistance and Amperage
3. Comparison measuring devices	3.1 Go/no-go devices 3.2 Thread angle and taper gauges 3.3 Overlay indicators 3.4 Templates 3.5 Digital devices 3.6 Pre-set verniers and micrometers 3.7 Temperature gauges 3.8 Pressure gauges 3.9 Measuring gauges 3.10 Profile Comparators

EVIDENCE GUIDE

1. Critical aspects of competency	Assessment requires evidence that the candidate used comparison and basic measuring devices.
2. Underpinning knowledge and attitudes	<ul style="list-style-type: none"> 2.1 Use and application of various comparison or measurement devices 2.2 Procedures for the correct use of devices 2.3 Procedures for maintaining and storing devices 2.4 Hazards and control measures associated with conducting measurements, including housekeeping 2.5 Safe work practices and procedures
3. Underpinning skills	<ul style="list-style-type: none"> 3.1 Using device in accordance with standard operating procedures 3.2 Storing and maintaining devices 3.3 Using basic numeracy skills for undertaking comparison measurements 3.4 Following oral instructions and written standard operating procedures
4. Resource implications	<p>The following resources MUST be provided:</p> <ul style="list-style-type: none"> 4.1 Workplace area: Real or simulated 4.2 Access to all tools, equipment, materials and documentation required 4.3 Any relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials.
5. Method of assessment	<p>Competency MUST be assessed through:</p> <ul style="list-style-type: none"> 5.1 Observation with questioning 5.2 Portfolio 5.3 Third party report
6. Context of assessment	<ul style="list-style-type: none"> 6.1 Competency must be assessed on the job or in a simulated environment.

UNIT OF COMPETENCY : **MEASURE COMPONENTS USING COORDINATE MEASURING MACHINES (CMM)**

UNIT CODE : **ALT315312**

UNIT DESCRIPTOR : This unit applies where the operator is following established processes, practices and standard operating procedures and is responsible for providing dimensional detail required for adjustment or checking of the manufacturing process. Work is carried out autonomously using predetermined standards of quality and safety. Operators would be expected to have competence in basic setting and adjusting of machines.

ELEMENT	PERFORMANCE CRITERIA <i>Italicized</i> terms are elaborated in the Range of Variables
1. Identify job requirements	1.1 Job sheets or equivalent instructions are interpreted without error and in accordance with company standard operating procedures.
2. Load components	2.1 Pre-start checks are undertaken to standard operating procedures. 2.2 Appropriate safety procedures are observed and safety equipment is checked for operation according to job requirements. 2.3 Appropriate fixture/clamping device are selected according to job requirements. 2.4 Component and fixtures are loaded and clamped in accordance with standard operating procedures.
3. Validate/calibrate precision measuring equipment	3.1 Calibration of precision measuring equipment is assessed to manufacturers' specifications and/or standard operating procedures. 3.2 Equipment is calibrated according to physical standards using appropriate calibration devices, equipment, techniques based on predetermined procedures. 3.3 Equipment is recommissioned in accordance with standard operating procedures for precision measuring.
4. Set probes	4.1 Probe configuration is checked in accordance with 3 Set probes standard operating procedures. 4.2 Pre-measurement manual hits are taken for manual alignment in accordance with standard operating procedures.
5. Measure components	5.1 Part program is selected as required, run and verified according to standard operating procedures. 5.2 Components measurement is performed according to standard operating procedures. 5.3 Results are interpreted and non-conforming/out of tolerance measurements are identified and reported. 5.4 Part program is correctly shut down and components are removed according to standard operating procedures. 5.5 Coordinate measuring machine , accessories and surrounds are left in a clean, safe condition.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Probe	1.1 Solid trigger probes 1.2 Electronic trigger probes
2. Measurements	Are limited to those which can be measured directly and do not require to be constructed mathematically such as: 2.1 Length 2.2 Squareness 2.3 Flatness 2.4 Angle 2.5 Roundness 2.6 Clearances or any other measurements that can be read off 2.7 Analog measuring device
3. Coordinate measuring machine	3.1 Manual machines 3.2 Machines fitted with microprocessors

EVIDENCE GUIDE

<p>1. Critical aspects of competency</p>	<p>Assessment requires evidence that the candidate:</p> <ul style="list-style-type: none"> 1.1 Identified job requirements 1.2 Loaded components 1.3 Had set probes 1.4 Measured components
<p>2. Underpinning knowledge and attitudes</p>	<ul style="list-style-type: none"> 2.1 Information on job sheets or equivalent 2.2 Pre-start checks in using coordinate measuring machine (CMM) 2.3 Hazards and control measures associated with operating a CMM, including housekeeping 2.4 Usage and application of personal protective equipment (PPE) 2.5 Safe work practices and procedures 2.6 Fixtures/clamping devices and their uses 2.7 Storage location and procedures 2.8 Fixing/clamping methods 2.9 Procedures for undertaking pre-measurement manual hits for manual alignment 2.10 Procedures for checking probe configuration 2.11 Procedures for running and verifying part program 2.12 Methods/techniques for interpreting results 2.13 Procedures for reporting results and recommendations for adjustment 2.14 Procedures for shutting down part program 2.15 Procedures to safely remove and handle components 2.16 Required cleaning tasks and the importance of cleaning the CMM 2.17 Effects of contamination 2.18 Perseverance, Attention to details and Honesty
<p>3. Underpinning skills</p>	<ul style="list-style-type: none"> 3.1 Reading and following routine, familiar information for loading, setting probes and measuring components 3.2 Identifying and following pre-start check procedure 3.3 Following safety procedures 3.4 Selecting specified fixture/clamping device 3.5 Positioning and clamping components 3.6 Taking manual hits and determining probe alignment 3.7 Verifying probe/s configuration to specifications 3.8 Selecting and activating part programs as required where machine is fitted with microprocessors 3.9 Verifying and confirming correct program operation 3.10 Applying correct measuring techniques 3.11 Reporting out of tolerance measurements 3.12 Shutting down the part program 3.13 Removing and handling components 3.14 Cleaning machine and site 3.15 Following verbal instructions 3.16 Orally reporting routine information
<p>4. Resource implications</p>	<p>The following resources MUST be provided:</p> <ul style="list-style-type: none"> 4.1 Workplace: Real or simulated work area 4.2 Access to all tools & equipment materials and documentations 4.3 Relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials
<p>5. Method of assessment</p>	<p>Candidate MUST be assessed through:</p> <ul style="list-style-type: none"> 5.1 Observation with questioning 5.2 Portfolio

	5.3 Third party report
6. Context of assessment	6.1 This unit may be assessed on-the-job, off-the-job or a combination of both on-and off-the-job. 6.2 Where assessment occurs off-the job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.

UNIT OF COMPETENCY : USE GRAPHICAL TECHNIQUES AND PERFORM SIMPLE STATISTICAL COMPUTATIONS

UNIT CODE : ALT315313

UNIT DESCRIPTOR : This unit covers interpreting and constructing graphs and charts from given or determined data, and performing basic statistical calculations. Application of the Graphs and charts may be applied to information from competency various work contexts, quality processes, production and market trends and other engineering applications. A range of devices may be used to assist with calculations.

ELEMENT	PERFORMANCE CRITERIA <i>Italicized</i> terms are elaborated in the Range of Variables
1. Read and construct graphs	1.1 Complex information is extracted from graphical from given or determined representation. 1.2 Data is analyzed with respect to emerging trends. 1.3 Graphs are constructed as required from data and drawn with respect to scale and accepted method. 1.4 Significant features of graphical representation are understood such as limit lines, gradients (straight line graphs), intercepts, maximum and minimum values. 1.5 A wide variety of graphs are constructed as required including histograms, control charts, straight line graphs and parabolic graphs.
2. Perform basic statistical computation	2.1 Mean, median and mode are calculated from given calculations data. 2.2 Standard deviation is calculated. 2.3 Application of standard deviation and limits to process improvement techniques is understood.

RANGE OF VARIABLES

VARIABLE	RANGE
1. Process improvement	Techniques in which error rates are mathematically calculated and recorded such as: 1.1 Three sigma 1.2 Six sigma

EVIDENCE GUIDE

1. Critical aspects of competency	<p>Assessment requires evidence that the candidate:</p> <p>1.1 Read and construct graph</p> <p>1.2 Performed basic statistical computation</p>
2. Underpinning knowledge and attitudes	<p>2.1 Trend(s) indicated by changes in gradient of a graph</p> <p>2.2 Procedures for drawing the line of best fit for the coordinates plotted</p> <p>2.3 Standard form of equations relating to straight lines and parabolic curves</p> <p>2.4 Gradient, intercepts, maximum and minimum values and limit lines for straight line and parabolic curves</p> <p>2.5 Function of control charts</p> <p>2.6 Meaning of the terms mean, median and mode</p> <p>2.7 Meaning of the term standard deviation</p> <p>2.8 Significance of 1, 2 and 3 sigma limits</p> <p>2.9 Safe work practices and procedures</p> <p>2.10 Characteristics of straight line, parabolic and hyperbolic curves</p> <p>2.11 Procedures for determining the slope/rate of change of a curve</p>
3. Underpinning skills	<p>3.1 Checking for conformance to specifications</p> <p>3.2 Undertaking numerical operations, geometry and calculations/formulae within the scope of this unit</p>
4. Resource implications	<p>The following resources MUST be provided:</p> <p>4.1 Workplace: Real or simulated work area</p> <p>4.2 Access to all tools & equipment materials and documentations</p> <p>4.3 Relevant workplace procedures, product and manufacturing specifications, codes, standards, manuals and reference materials</p>
5. Method of assessment	<p>Candidate MUST be assessed through:</p> <p>5.1 Observation with questioning</p> <p>5.2 Portfolio</p> <p>5.3 Third party report</p>
6. Context of assessment	<p>6.1 This unit may be assessed on-the-job, off-the-job or a combination of both on-and off-the-job.</p> <p>6.2 Where assessment occurs off-the-job, that is the candidate is not in productive work, then an appropriate simulation must be used where the range of conditions reflects realistic workplace situations.</p>

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 LABORATORY AND METROLOGY/CALIBRATION SERVICES NC III.

3.1 CURRICULUM DESIGN

Course Title: **LABORATORY AND METROLOGY/CALIBRATION SERVICES**

Level: **NC III**

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

Course Description:

This course is designed to equip individual with competency to perform laboratory and metrology/calibration services work specifically on using comparison and basic measuring devices. It also include competency in measure components using coordinate measuring machines and use graphical techniques and perform simple statistical computations

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	<ul style="list-style-type: none"> • Group discussion • Role Play • Brainstorming 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Lecture • Demonstration • Case studies • Modular 	<ul style="list-style-type: none"> • Written examination • Direct Observation
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	<ul style="list-style-type: none"> • Lecture • Role play • Practical exercises 	<ul style="list-style-type: none"> • Written test • Demonstration

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.	<ul style="list-style-type: none"> • Direct observation • Simulation/role playing • Case studies 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Lecture • Self-paced instruction • Group discussion • Practical work approach • Research study 	<ul style="list-style-type: none"> • Written test • Demonstration • Oral interview
6. Use relevant technologies	6.1 Identify appropriate technology 6.2 Apply relevant technology 6.3 Maintain/enhance relevant technology	<ul style="list-style-type: none"> • Lecture • Self-paced instruction • Group discussion • Film showing 	<ul style="list-style-type: none"> • Written test • Interview

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	<ul style="list-style-type: none"> • Lecture/ Demonstration • Dual training 	<ul style="list-style-type: none"> • Direct observation • Interview
2. Perform Mensuration and Calculation	2.1 Select measuring instrument 2.2 Carry out measurement and calculations. 2.2 Maintain measuring instruments	<ul style="list-style-type: none"> • Lecture • Demonstration • Practical exercises • Simulation 	<ul style="list-style-type: none"> • Written test • Oral questioning • Direct observation •
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	<ul style="list-style-type: none"> • Lecture/ Demonstration • Dual training • Distance Learning 	<ul style="list-style-type: none"> • Written/Oral questioning • 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	<ul style="list-style-type: none"> • Lecture/ Demonstration • Self-paced instruction • Dual training • Simulation 	<ul style="list-style-type: none"> • Written test • Direct observation • Interview • Practical exercises • Demonstration

CORE COMPETENCIES

Unit of Competency	Learning Outcomes	Methodology	Assessment Approach
1. Use comparison and basic measuring devices	1.1 Identify job requirements 1.2 Set comparative measuring devices 1.3 Use comparison and/or basic measuring devices 1.4 Maintain comparison and/or basic measuring devices	<ul style="list-style-type: none"> • Lecture • Demonstration • Dualized training • Discussion 	<ul style="list-style-type: none"> • Direct Observation • Portfolio • Third party report
2. Measure components using coordinate measuring machines	2.1 Identify job requirements 2.2 Load components 2.3 Validate/calibrate precision measuring equipment 2.4 Set probes 2.5 Measure components	<ul style="list-style-type: none"> • Lecture • Demonstration • Dualized training • Discussion 	<ul style="list-style-type: none"> • Direct Observation • Portfolio • Third party report
3. Use graphical techniques and perform simple statistical computations	3.1 Read and construct graphs 3.2 Perform basic statistical computation	<ul style="list-style-type: none"> • Lecture • Demonstration • Dualized training • Discussion 	<ul style="list-style-type: none"> • Observation with questioning • Portfolio • Third party report

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 background in basic mensuration
- Ability to communicate both orally and in writing;
- Physically and mentally fit; and
- Must possess the LABORATORY AND METROLOGY/CALIBRATION SERVICES NC II.

3.4 LIST OF TOOLS, EQUIPMENT AND MATERIALS LABORATORY AND METROLOGY/CALIBRATION SERVICES NC II

Recommended list of tools, equipment and materials for the training of 25 trainees for LABORATORY AND METROLOGY/CALIBRATION SERVICES NC III

TOOLS		EQUIPMENT		MATERIALS	
QTY		QTY		QTY	
25 units	Line graduated rules	2 units	Oil Free Compressor	20 L.	Solvent Naptha
25 units	Line graduated Bar standard	1 unit	Air Conditioner	30 pcs.	Sandpaper (Asstd. Grit)
25 units	Vernier caliper	2 units	Air Handling Equipment		Grit# 1200
6 units	Outside Micrometer	3 units	Surface Plate		Grit# 600
5 units	Inside micrometer	1 set	Dial indicator with gage stand or comparator base		Grit# 400
6 pcs.	Bore gauges	3 units	Coordinate measuring machine		Grit# 360
2 units	Master setting gages				Grit# 280
1 unit	Gage block standard for square, rectangular and round				Grit# 180
2 units	Height gage			2 kilos.	White rag (De Hilo)
4 units	Sine bar				
2 units	Depth indicator gage				
15 pcs.	Rubber glove				
15 pcs.	Cotton glove				
15 pcs.	Nylon glove				
15 pcs.	Goggle				
15 pcs.	Gas mask				
15 pcs.	Safety shoe				
15 pcs.	Apron				

1 yard	Filter Cloth (200 mesh)				
	Go/no-go devices				
	Thread angle and taper gauges				
	Temperature gauges				
	Pressure gauges				
	Measuring gauges				
	Overlay indicators				
	Templates				
	Digital devices				
	Pre-set Vernier and micrometers				

TRAINING FACILITIES
LABORATORY AND METROLOGY/CALIBRATION SERVICES NC III

Based on a class size of 25 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	2.0 x 1.5 per student/trainee	3.0 per student	75.00
• 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**	-	-	280.00

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

3.6 TRAINER’S QUALIFICATIONS FOR AUTOMOTIVE SECTOR
MANUFACTURING SUB-SECTOR

LABORATORY AND METROLOGY/CALIBRATION SERVICES NC III
TRAINER QUALIFICATION (TQ II)

Must be a holder of LABORATORY AND METROLOGY/CALIBRATION SERVICES 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 experience²
- 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 LABORATORY AND METROLOGY/CALIBRATION SERVICES 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 Individual aspiring to be awarded the qualification of LABORATORY AND METROLOGY/CALIBRATION SERVICES NC III must acquire Certificates of Competency (COC) in all the following core units of the Qualification. Candidates may apply for assessment in any accredited assessment center.

- 4.2.1. Use Comparison and Basic Measuring Devices
- 4.2.2. Measure Components Using Coordinate Measuring Machines
- 4.2.3. Use Graphical Techniques and Perform Simple Statistical Computations

- 4.3 Upon accumulation and submission of all COCs acquired for the relevant units of competency comprising a qualification, an individual shall be issued the corresponding National Certificate.

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

- 4.5 The following are qualified to apply for assessment and certification:

- 4.4.1. Holder of LABORATORY AND METROLOGY/CALIBRATION SERVICES 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)

- 4.6 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)*.

COMPETENCY MAP AUTOMOTIVE PARTS MANUFACTURING

ANNEX A

CORE COMPETENCIES	Develop and Manufacture Wood Pattern	Develop and Manufacture Polymer Pattern	Develop and Manufacture Assembled Plated Pattern	Develop and Manufacture Production Pattern	Perform General Woodworking Machine Operations	Use and Maintain Measuring Instrument	Machine Parts	Perform Precision Assembly	
	Prepare & Mix Sand for Metal Molding	Produce Molds by Hand	Produce Cores by Hand	Operate Molding Machine	Operate Core-Making Machine	Pour Molten Metal to Molds	Prepare Sand Mixture for Heavy Casting	Produce Blow Molded Products	Change Equipment Dies
	Operate Melting Furnaces (non-electric)	Operate Cupola Melting Furnace	Operate Electric Induction Melting Furnace	Fettle & Trim Metal Castings/Forgings	Perform Refractory Installation & Repair	Perform Hand Molding to Produce Heavy Casting	Pour Molten Metal to Heavy Castings	Produce Injection Molded Products	Prepare and Start Equipment for Production
	Melt Aluminum-Silicon Alloys for Safety Tested	Melt Metals Using Coreless Induction Furnace	Melt Automotive Gray Iron Castings in Cupola	Manufacture and develop corebox for Shell Core Box	Develop and Manufacture Gear, Conveyor Screw and	Develop Gravity Die Casting Mold	Perform Press Machine Setting	Perform Mechanical Shearing Operation	
	Use Comparison and Basic Measuring Devices	Measure Components Using Coordinate Measuring Machines	Use Graphical Techniques and Perform Simple Statistical Computations	Apply Quality Systems	Conduct Product and/or Process Capability Studies	Maintain/Supervise the Application of Quality Procedures	Perform Mechanical Press Forming Operation		
	Perform Hand Forging	Perform Hammer Forging	Perform Basic Incidental Heat/Quenching, Tempering and Annealing	Hand Forge Complex Shapes	Hammer Forge Complex Shapes	Perform Drop and Upset Forging	Select Heat Treatment Process	Perform Heat Treatment Process	
	Perform Engineering Measurement	Perform Precision Mechanical Measurement	Calibrate Measuring Equipment	Select and Control Inspection Processes and Procedures	Perform Inspection	Perform Basic Statistical Quality Control	Use Improvement Processes in Team Activities		
	Prepare Molds for Composites Production	Prepare Materials for Formulae	Assemble Materials and Equipment for Production	Operate injection Molding Equipment	Operate Blow Molding Equipment	Monitor Process Operations	Finish Products and Components		
COMMON COMPETENCIES	Read & Interpret Engineering Drawings	Perform Mensuration and Calculation	Read, Interpret and Apply Specifications and Manuals	Perform Shop Maintenance					
BASIC COMPETENCIES	Receive and respond workplace communication	Work with Other	Demonstrate work values	Practice basic housekeeping procedures	Lead in workplace communication	Develop and practice negotiation skills	Use relevant technologies	Solve workplace problems related to work activities	
	Participate in workplace communication	Work in team environment	Practice career professionalism	Practice occupational health and safety procedures	Lead small Team	Use mathematical concepts and techniques	Develop team and individual	Apply problem solving techniques in the workplace	
	Plan and organize work	Utilize specialist communication skills							

Legend:
Laboratory and Metrology Calibration Services NC III - - - -

DEFINITION OF TERMS

1. **Accuracy** **Accuracy** designates the degree of agreement of the measured size with its true magnitude as expressed in standard units of measurement.
2. **Caliper gauges** **Caliper gauges** are measuring device with jaws establish the length to be measured by positive contact. One of the jaws is integral with the graduated beam, the other has markings to indicate the corresponding scale position.
3. **Dial indicators** **Dial indicators** are instruments used to accurately measure a small distance. These may be used to check the variation in tolerance during the inspection process of a machined part, measure the deflection of a beam or ring under laboratory conditions, as well as many other situations where a small measurement needs to be registered or indicated.
4. **Diffraction gratings** **Diffraction gratings** are transparent plates, usually made of glass, having a large number of equally spaced parallel lines.
5. **DMC (Dimensional Mark-up Language)** **DMC (Dimensional Mark-up Language)** is the release and ongoing development and testing a global language for metrology systems interfaces.
6. **Gauge blocks** **Gauge blocks** are precision ground and lapped measuring standards. They are used as references for the setting of measuring equipment such as micrometers, sine bars, dial indicators (when used in an inspection role).
7. **Line graduated master scales** **Line graduated master scales** is the basis for the operation of optical instruments for absolute length measurements.
8. **Line graduated rules** **Line graduated rules** are available in widely different degrees of accuracy to suit diverse requirements for plain length measuring tools.
9. **Metrology** **Metrology** designates the science of all measurements that are made by comparing the dimensionally measurable conditions of solids, or of diverse physical phenomena to generally accepted units of measurement. It is a branch of technology concerned with the measurement of geometrically defined dimensions of technical parts.
10. **Micrometer** **Micrometer** is a measuring device using rotation of the threaded spindle causes controlled advance of the spindle's contact face relative to an integral reference face.
11. **Precision** **Precision** expresses the degree of repeatability of the measuring process. It designates how closely identical values are obtained when repeating the same measurement at various intervals, or duplicating them by means of different instruments.
12. **Random errors** **Random errors** are statistical fluctuations (in either direction) in the measured data due to the precision limitations of the measurement device.

- 13. Sine bar** **Sine bar** is a hardened, precision ground body with two precision ground cylinders fixed at the ends. The distance between the centers of the cylinders is precisely controlled, and the top of the bar is parallel to a line through the centers of the two rollers.
- 14. Standard deviation** **Standard deviation** is the measure of the dispersion of a set of data from its mean. The more spread apart the data is, the higher the deviation.
- 15. Tolerance** **Tolerance** is the allowable variance from a nominal value established by design engineers that is deemed non harmful to the functioning of the product.
- 16. Coordinate measuring machine** A 'coordinate measuring machine' (CMM) is a device for measuring the physical geometrical characteristics of an object. This machine may be manually controlled by an operator or it may be computer controlled. Measurements are defined by a probe attached to the third moving axis of this machine. This probe touches the part of interest and allows collecting discrete points on the object's surface.
- 17. Go/No Go Device** A **Go-NoGo gauge** (or **Go/no go**) refers to an inspection tool used to check a workpiece against its allowed tolerances. Its name derives from its use: the gauge itself has two tests; the check involves the workpiece's having to pass one test (*Go*) and 'fail' the other (*No Go*).
It is an integral part of the quality process that is used in the manufacturing industry to ensure interchangeability of parts between processes, or even between different manufacturers.
A Go NoGo gauge is a measuring tool that does not return a *size* in the conventional sense, but instead returns a *state*. The *state* is either acceptable (the part is within tolerance and may be used) or it is unacceptable (and must be rejected).
They are well suited for use in the production area of the factory as they require little skill or interpretation to use effectively and have few, if any, moving parts to be damaged in the often hostile production environment.
- 18. Probe** A very common probe was made by soldering a hard ball to the end of a shaft. This was ideal for measuring a whole range of flat, cylindrical or spherical surfaces. Other probes were ground to specific shapes, for example a quadrant, to enable measurement of special features. These probes were physically held against the workpiece with the position in space being read from a 3-Axis digital readout (DRO) or, in more advanced systems, being logged into a computer by means of a footswitch or similar device. Measurements taken by this contact method were often unreliable as machines were moved by hand and each machine operator applied different amounts of pressure on the probe or adopted differing techniques for the measurement.

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THE TECHNICAL AND INDUSTRY EXPERT PANEL LABORATORY AND METROLOGY CALIBRATION SERVICES NC III

Antonio A. Gimenez

Philippine Automotive
Federation, Inc. (PAFI)

Cesar R. Leal

Philippine Automotive
Federation, Inc. (PAFI)

Elmo N. Serbito

PAFI (Samahan ng mga
Manggagawang Supercast)

Carina J. Bondad

(Administrative Staff)

The PARTICIPANTS in the National Validation of this Training Regulation

- (Supercast Foundry & Machinery Corp. SFMC)
- Philippine Aluminum Wheels Inc. (PAWI)
- Toyota Auto Parts Phils. Inc.

Members of the TESDA Board

The MANAGEMENT and STAFF of the TESDA Secretariat
TESDA EXCOM

Qualification and Standards Office

Florante P. Inoturan

Agnes P. Panem

Abel B. Elpedes