Model Curriculum

QP Name: Automotive Forging Technician

QP Code: ASC/Q4501

QP Version: 2.0

NSQF Level: 4

Model Curriculum Version: 1.0

Automotive Skills Development Council | 153, Gr Floor, Okhla Industrial Area, Phase – III, Leela Building, New Delhi – 110020

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Training Parameters

Sector	Automotive
Sub-Sector	Manufacturing
Occupation	Forging Operation
Country	India
NSQF Level	4
Aligned to NCO/ISCO/ISIC Code	NCO-2015/7221.0301
Minimum Educational Qualification and Experience	10th Class + 1 year ITI with 4 years of experience OR 10th Class + 2 year ITI with 3 year of experience OR 12th Class with 3 Years of experience
Pre-Requisite License or Training	NA
Minimum Job Entry Age	18 years
Last Reviewed On	29/07/2021
Next Review Date	29/07/2026
NSQC Approval Date	29/07/2021
QP Version	2.0
Model Curriculum Creation Date	29/07/2021
Model Curriculum Valid Up to Date	29/07/2026
Model Curriculum Version	1.0
Minimum Duration of the Course	400 Hours 00 Minutes
Maximum Duration of the Course	400 Hours 00 Minutes

Program Overview

This section summarizes the end objectives of the program along with its duration.

Training Outcomes

At the end of the program, the learner should have acquired the listed knowledge and skills.

- Interpret drawing/work instructions/SOPs for identification of raw material, tools and equipment required for the forging operations.
- Carry out pre-forging activities such as lifting of workpiece, inspection of tools and equipment etc.
- Carry out forging and post-forging operations.
- Work effectively and efficiently as per schedules and timelines.
- Implement safety practices.
- Optimize the use of resources to ensure less wastage and maximum conservation.

Compulsory Modules

The table lists the modules and their duration corresponding to the Compulsory NOS of the QP.

NOS and Module Details	Theory Duration	Practical Duration	On-the-Job Training Duration (Mandatory)	On-the-Job Training Duration (Recommended)	Total Duration
Bridge Module					
Module 1: Introduction to the role of an Automotive Forging Technician	8:00	0:00			8:00
ASC/N9803 – Organize work and resources (Manufacturing) NOS Version No. – 1.0 NSQF Level – 3	**16:00**	**24:00**			**40:00**
Module 2: Organize work and resources according to safety and conservation standards	16:00	24:00			40:00
ASC/N9802 – Interact effectively with colleagues, customers and others NOS Version No. – 1.0 NSQF Level - 3	**12:00**	**20:00**			**32:00**
Module 3: Communicate effectively and efficiently	12:00	20:00			32:00
ASC/N4501 – Prepare for forging operations NOS Version No. – 2.0 NSQF Level - 4	**24:00**	**32:00**			**56:00**
Module 4: Prepare for forging operations	24:00	32:00			56:00
ASC/N4502 – Perform forging operations NOS Version No. – 2.0 NSQF Level - 4	**40:00**	**104:00**			**144:00**

Module 5: Perform forging operations	40:00	104:00			144:00
ASC/N4503 – Perform post-forging operations NOS Version No. – 2.0 NSQF Level - 4	**40:00**	**80:00**			**120:00**
Module 6: Perform post-forging operations	40:00	80:00			120:00
Total Duration	**140:00**	**260:00**			**400:00**

Module Details

Module 1: Introduction to the role of an Automotive Forging Technician

Bridge module

Terminal Outcomes:

- Discuss the role and responsibilities of an Automotive Forging Technician.

Duration: *<08:00>*	**Duration**: *<00:00>*
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• List the role and responsibilities of an Automotive Forging Technician. • Discuss the job opportunities of an Automotive Forging Technician in an automobile industry. • Explain about Indian automotive market. • List various automobile Original Equipment Manufacturers (OEMs) and different products/ models manufactured by them. • Discuss the standards and procedures involved in the different processes of forging. • Identify the standard checklists and schedules recommended by OEM.	
Classroom Aids:	
Whiteboard, marker pen, projector	
Tools, Equipment and Other Requirements	

Module 2: Organize work and resources according to safety and conservation standards

Mapped to ASC/N9803, v1.0

Terminal Outcomes:

- Employ appropriate ways to maintain safe and secure working environment.
- Perform work as per the quality standards.
- Apply conservation practices at the workplace.

Duration: *<16:00>*	**Duration**: *<24:00>*
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• List the potential workplace related risks and hazards, their causes and preventions. • Identify PPE to be used at workplace. • Identify various warning signs used at the workplace. • Describe appropriate strategies to deal with emergencies and accidents at the workplace. • Outline the organizational structure to be followed to report about health, safety and security breaches to the concerned authorities. • Discuss the importance of keeping work area clean and tidy. • Discuss the significance of conforming to basic hygiene practices such as washing hands, using alcohol based hand sanitizers or soap. • Discuss organizational hygiene and sanitation guidelines and ways of reporting breaches/gaps if any to the concerned authorities. • Discuss the ways of dealing with stress and anxiety. • Discuss how to complete the given work within the stipulated time period. • Explain how to maintain a proper balance between team and individual goals. • Explain 5S guidelines at workplace. • List the various materials used at the workplace. • Explain organisational recommended procedure for storage of tools, equipment and material after completion of work. • Explain the ways to optimize usage of resources. • Discuss various methods of waste management and its disposal.	• Apply appropriate safety practices to ensure safety of people at the workplace • Display the correct way of wearing and removing PPE such as face masks, hand gloves, face shields, PPE suits, etc. • Demonstrate the use of fire extinguisher. • Apply basic first aid procedure in case of emergencies. • Perform routine cleaning of tools, equipment and machines. • Employ various techniques for checking malfunctions in the equipment as per Standard Operating Procedure (SOP). • Show how to sanitize and disinfect one's work area regularly. • Demonstrate the correct way of washing hands using soap and water. • Demonstrate the correct way of sanitizing hands using alcohol-based hand rubs. • Demonstrate how to evacuate the workplace in case of an emergency. • Demonstrate sorting of materials, tools and equipment and spare parts after completion of work. • Demonstrate the steps involved in storage of tools, equipment and material after completion of work. • Perform basic checks to identify any spills and leaks and that need to be plugged /stopped. • Demonstrate different disposal techniques depending upon types of waste. • Employ different ways to check if equipment/machines are functioning as per requirements and report malfunctioning, if observed. • Employ ways for efficient utilization of material and water.

• List the different categories of waste for the purpose of segregation • Differentiate between recyclable and non-recyclable waste • State the importance of using appropriate colour dustbins for different types of waste. • Discuss common practices for conserving electricity at workplace. • Discuss the common sources of pollution and ways to minimize it.	
Classroom Aids:	
Whiteboard, marker pen, projector	
Tools, Equipment and Other Requirements	
• Housekeeping material: Cleaning agents, cleaning cloth, waste container, dust pan and brush set, liquid soap, hand towel, fire extinguisher • Safety gears: Safety shoes, ear plug, goggles, gloves, helmet, first-aid kit	

Module 3: Communicate Effectively and Efficiently

Mapped to ASC/N9802, v1.0

Terminal Outcomes:

- Use effective communication and interpersonal skills.
- Apply sensitivity while interacting with different genders and people with disabilities.

Duration: *<12:00>*	**Duration**: *<20:00>*
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Explain the organizational structure for communicating with colleagues, seniors and others. • Discuss the ways to adjust the communication styles to reflect sensitivity towards gender and persons with disability (PwD). • Explain the importance of respecting personal space of colleagues. • State the procedure to receive work instructions and report problems to the supervisor. • List the various organizational policies and procedures to be followed at the workplace. • Describe different ways to rectify commonly occurring errors. • Explain the importance of complying with the instructions/guidelines and procedures while performing tasks related to the job specifications. • Discuss the importance of PwD and gender sensitization.	• Employ different means of communication depending upon the requirement while interacting with others. • Demonstrate using new ways to maintain good relationships with colleagues and supervisor. • Prepare a sample report to send the work status to the supervisor. • Demonstrate how to communicate with different genders and persons with disability (PwD) in a sensitive manner.
Classroom Aids:	
Whiteboard, marker pen, projector	
Tools, Equipment and Other Requirements	
Sample of escalation matrix, organisation structure.	

Module 4: Prepare for forging operations

Mapped to ASC/N4501, v2.0

Terminal Outcomes:

- Identify tools and equipment required for forging process.
- Perform the steps to carry out pre-forging activities such as lifting of workpiece, collection and inspection of tools and equipment etc.

Duration: *<24:00>*	**Duration**: *<32:00>*
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Describe different types of forging processes. • Describe basic process followed for forging of the pieces. • Describe mechanical and heat laws applicable on forging. • Discuss the information derived from the engineering drawings, work order, SOPs and instructions from supervisor. • List the input material, tools, forging apparatus, dies, stampings, lifting equipment and consumables required during forging work. • Describe the selection criteria of input material, tools, forging apparatus, dies, stampings, lifting equipment and consumables required for forging work. • Describe metallurgical properties of the material used. • Discuss the organisational process of collecting and arranging the input material (billets/bars), tools, forging apparatus, dies, stampings, lifting equipment and consumables from the store. • Summarise the steps to be performed for checking the input material, tools, forging apparatus, dies, stampings, lifting equipment and consumables before use. • Elaborate ways for cutting the billets/bars as per the work requirement. • Discuss various forging machine parameters such as temperature of the furnace, cycle time for various temperature levels & time duration during the heating, pressing, cooling etc and their impact on output. • Discuss the necessary precautions to avoid any hazard and accident during forging activities.	• Demonstrate the standard operating procedure to use input material, tools, forging apparatus, dies, stampings, lifting equipment and consumables required during forging work. • Show how to select and arrange the required input material, tools, forging apparatus, dies, stampings, lifting equipment and consumables from the store. • Apply appropriate ways to check input material, tools, forging apparatus, dies, stampings, lifting equipment and consumables before use. • Apply appropriate ways to check that dies and forging apparatus are clean and free from dust and unwanted material. • Demonstrate use of hacksaw to cut the billets/bars into smaller components as per the work requirement. • Show how to set the forging machine and its parameters as per the work instructions. • Show how to fit the die in the forging machine.

Classroom Aids:
Whiteboard, marker pen, projector
Tools, Equipment and Other Requirements
• PPT's, teaching aids, drawing / blue print, work order • **Raw Materials:** Metal billets • **Machinery:** Furnace, Compressing machine, Forging press, Trim press , Shot blasting machine, destructive and non-destructive tests equipment, eddy current testing and magnetic particle inspection apparatus etc. • **Auxiliaries:** spatulas, chippers etc. • **Measuring Tools:** Steel tape, Steel rule, Vernier calliper, Micrometer, Compass • **Cutting Tools:** Hacksaw frame adjustable, chisel, scissor, Sand paper • **Driving Tools:** Chipping hammer, wooden mallet • **Lifting devices:** Hoists, cranes, bins, part trolleys, pallet trucks • **Safety materials**: Fire extinguisher, portable welding curtains, leather safety gloves, leather aprons, safety glasses, helmet, safety shoe and first-aid kit • **Cleaning material**: Wire brush (M.S.), cleaning agents, cleaning cloth, waste container, dust pan and brush set, liquid soap, hand towel

Module 5: Perform forging operations

Mapped to ASC/N4502, v2.0

Terminal Outcomes:

- Demonstrate various forging operations such as billet heating in furnace, compression process, heating, pressing etc.
- Perform steps to carry out finishing operations such as twisting, straightening etc.

Duration: *<40:00>*	**Duration**: *<104:00>*
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Outline process flow of hot, cold and warm forging. • Discuss the process of lifting and placing the billets in the furnace as per the work instructions. • Discuss the importance of appropriate temperature levels of heating zones when the billets are passing through the furnace. • Describe compression process for reducing the diameter and increasing the length of the hot billet. • Explain methods of inspecting the quality, geometry, dimension and material of compressing machine output. • Discuss dimensions pertinent to pressing operations. • Discuss the process of segregating bad quality and good quality billets. • Discuss the importance of selecting correct program in the forging machine for operation as per the work instructions. • Discuss various pressing process parameters such as cycle time, force applied, gear and pinion movements, friction, torque etc. and their impact on output. • Elaborate ways for feeding the hot metal bars into forging presses. • Discuss the importance of monitoring process parameters during the forging process and correcting them as per the requirements. • List the steps to be performed for observing and recording machine performance. • Discuss the importance of spraying coolant on dies after each operation. • List the steps to be performed for finishing	• Show how to set the induction heater temperature for pre-heating, heating as well as post-heating process. • Perform the steps of lifting and placing the billets in the furnace manually or by using lifting tools. • Apply appropriate ways to monitor the temperature levels of heating zones when the billets are passing through the furnace. • Show how to observe the uniform heating of metal. • Perform the steps of lifting metal from the furnace and loading it into compressing machine by using lifting tools. • Demonstrate organizational specified procedure of starting the compression machine and performing the compression process. • Employ appropriate ways of inspecting and measuring the output of compressing machine for required quality standards, dimensions, geometry and material. • Show how to segregate the bad quality billets and send the good quality billets for next process. • Show how to select the program in the forging machine and modify it as per the production requirements and WI. • Demosntrate use of magnetic robots for feeding the hot metal bars into forging presses. • Show how to adjust the temperature of the die and various parameters of main press machine including blocker, finisher and trimmer as per the output requirement. • Read the measurement gauges to monitor the process parameters and maintain the

operations such as twisting, straightening etc.	quality standards. • Apply appropriate ways to monitor the forging operations and record the operational data as per the control plan. • Show how to remove the forged pieces from the machine after completion of moulding process. • Demonstrate organisational specified procedure of finishing operations such as twisting, straightening etc. get the desired specifications. • Employ appropriate ways of measuring and comparing the final workpiece dimensions with the specified dimensions in the work order and engineering drawing. • Show how to adjust the parameters of the corresponding presses for the finishing operations to get the desired specifications. • Perform steps to run the machine for mass production after first piece meets the specified requirements. • Prepare a sample report about any problems faced during the forging process.
Classroom Aids:	
Whiteboard, marker pen, projector	
Tools, Equipment and Other Requirements	
• PPT's, teaching aids, drawing / blue print, work order • **Raw Materials:** Metal billets • **Machinery:** Furnace, Compressing machine, Forging press, Trim press , Shot blasting machine, destructive and non-destructive tests equipment, eddy current testing and magnetic particle inspection apparatus etc. • **Auxiliaries:** spatulas, chippers etc. • **Measuring Tools:** Steel tape, Steel rule, Vernier calliper, Micrometer, Compass • **Cutting Tools:** Hacksaw frame adjustable, chisel, scissor, Sand paper • **Driving Tools:** Chipping hammer, wooden mallet • **Lifting devices:** Hoists, cranes, bins, part trolleys, pallet trucks • **Safety materials**: Fire extinguisher, portable welding curtains, leather safety gloves, leather aprons, safety glasses, helmet, safety shoe and first-aid kit • **Cleaning material**: Wire brush (M.S.), cleaning agents, cleaning cloth, waste container, dust pan and brush set, liquid soap, hand towel	

Module 6: Perform post-forging operations

Mapped to ASC/N4503, v2.0

Terminal Outcomes:

- Identify requirements for shot blasting and post-forging activities
- Perform steps to carry out shot blasting process.
- Perform steps to carry out post-forging activities.

Duration: *<40:00>*	**Duration**: *<80:00>*
Theory – Key Learning Outcomes	**Practical – Key Learning Outcomes**
• Describe shot blasting process. • Discuss the process of loading/unloading and placing the workpieces from shot blasting machine as per the work instructions. • Discuss post-forging activities like inspection, cleaning, maintenance etc. • Explain methods of inspecting the quality of forged workpieces. • List the commonly occurring defects in the casted workpieces. • Describe various testing methods i.e. destructive and non-destructive, eddy current testing and magnetic particle inspection. • Discuss various eddy current testing parameters such as phase of the current and intensity of magnetic flux generated and their impact on output. • Discuss the importance of magnetizing and de-magnetizing the parts as per the magnetic cycle during magnetic particle inspection process. • Discuss the process of segregating, tagging and storing of damaged and ok workpieces and maintaining records of segregation as per organisational guidelines. • List the steps to be performed for checking the machine operations for any defects in its component and informing the supervisor. • List different methods for disposing off waste material and scrap. • Discuss documents and records needed to prepare and update related to forging work. • List the steps to be performed for sending the workpieces to lab for quality check	• Show how to clean the shot blasting machine by using air pressure. • Apply appropriate ways to check the shot blasting machine and its components for before use. • Perform the steps of lifting and placing the workpieces and shots on shot blasting machine manually or by using lifting tools. • Demonstrate organizational specified procedure of starting the shot blasting machine and performing the shot blasting process. • Apply appropriate ways to check that machine is in the moving position till the cycle time for both sides cycle is achieved. • Perform the steps of lifting the workpieces from shot blasting machine and placing them on trolleys manually or by using lifting tools. • Apply appropriate inspection and testing methods for identifying the defects and checking the quality of forged workpieces as per the control plan. • Demonstrate organisational specified procedure of various testing methods i.e. destructive and non-destructive, eddy current testing and magnetic particle inspection for checking the defects and quality of forged pieces. • Show how to adjust the parameters of the apparatus per the requirement of magnetic particle inspection process to get the desired specifications. • Demonstrate the standard operating procedure to use measurement instruments like rulers, Vernier calipers, micrometer, weighing scale, gauges and other inspection equipment • Employ appropriate ways for comparing

and obtaining batch clearance.	the forged piece texture, color, surface properties, hardness and strength with the specified product specifications. • Apply appropriate inspection methods for identifying the defects, checking the quality of forged workpieces and noting the observations of inspection process as per the control plan. • Show how to remove the minor defects like shape deformation, sharp edges, rough surfaces, extra material from grooves, holes, parting line area etc. from forged pieces. • Show how to segregate, tag, store and record data of damaged and ok workpieces as per organisational guidelines. • Employ appropriate ways for checking the machine operations for any defects in the component. • Show how to clean the tools, forging apparatus and shot blasting machine after completion of work and dispose scrap or waste as per organisational guidelines. • Demonstrate organisational specified procedure of sending first and last work piece from each batch to the lab for quality check and obtaining batch clearance.
Classroom Aids:	
Whiteboard, marker pen, projector	
Tools, Equipment and Other Requirements	
• PPT's, teaching aids, drawing / blue print, work order • **Raw Materials:** Metal billets • **Machinery:** Furnace, Compressing machine, Forging press, Trim press , Shot blasting machine, destructive and non-destructive tests equipment, eddy current testing and magnetic particle inspection apparatus etc. • **Auxiliaries:** spatulas, chippers etc. • **Measuring Tools:** Steel tape, Steel rule, Vernier calliper, Micrometer, Compass • **Cutting Tools:** Hacksaw frame adjustable, chisel, scissor, Sand paper • **Driving Tools:** Chipping hammer, wooden mallet • **Lifting devices:** Hoists, cranes, bins, part trolleys, pallet trucks • **Safety materials**: Fire extinguisher, portable welding curtains, leather safety gloves, leather aprons, safety glasses, helmet, safety shoe and first-aid kit • **Cleaning material**: Wire brush (M.S.), cleaning agents, cleaning cloth, waste container, dust pan and brush set, liquid soap, hand towel	

Annexure

Trainer Requirements

Trainer Prerequisites						
Minimum Educational Qualification	**Specialization**	**Relevant Industry Experience**		**Training Experience**		**Remarks**
		Years	***Specialization***	***Years***	***Specialization***	
ITI	Turner/Fitter/ Electrician	3	Forging	1	Forging	NA
ITI	Turner/Fitter/ Electrician	4	Forging	0	NA	NA
Diploma	Mechanical/Electrical/ Automobile	2	Forging	1	Forging	NA
Diploma	Mechanical/Electrical/ Automobile	3	Forging	0	NA	NA

Trainer Certification	
Domain Certification	**Platform Certification**
"Automotive Forging Technician, ASC/Q4501, version 2.0". Minimum accepted score is 80%.	"Trainer, MEP/Q2601 v1.0" Minimum accepted score is 80%.

Assessor Requirements

Assessor Prerequisites						
Minimum Educational Qualification	**Specialization**	**Relevant Industry Experience**		**Training/Assessment Experience**		**Remarks**
		Years	***Specialization***	***Years***	***Specialization***	
ITI	Turner/ Fitter/Electrician	4	Turner/ Fitter/Electrician	1	Turner/ Fitter/Electrician	NA
ITI	Turner/Fitter/ Electrician	5	Turner/Fitter/ Electrician	0	Turner/Fitter/ Electrician	**NA**
Diploma	Mechanical/Electrical/ Automobile	3	Mechanical/Electrical/ Automobile	1	Mechanical/Electrical/ Automobile	**NA**
Diploma	Mechanical/Electrical/ Automobile	4	Mechanical/Electrical/ Automobile	0	Mechanical/Electrical/ Automobile	**NA**

Assessor Certification	
Domain Certification	**Platform Certification**
"Automotive Forging Technician, ASC/Q4501, version 2.0". Minimum accepted score is 80%.	"Assessor; MEP/Q2701 v1.0" Minimum accepted score is 80%.

Assessment Strategy

1. Assessment System Overview:
    - Batches assigned to the assessment agencies for conducting the assessment on SDMS/SIP or email
    - Assessment agencies send the assessment confirmation to VTP/TC looping SSC
    - Assessment agency deploys the ToA certified Assessor for executing the assessment
    - SSC monitors the assessment process & records

2. Testing Environment:
    - Confirm that the centre is available at the same address as mentioned on SDMS or SIP
    - Check the duration of the training.
    - Check the Assessment Start and End time to be as 10 a.m. and 5 p.m.
    - If the batch size is more than 30, then there should be 2 Assessors.
    - Check that the allotted time to the candidates to complete Theory & Practical Assessment is correct.
    - Check the mode of assessment—Online (TAB/Computer) or Offline (OMR/PP).
    - Confirm the number of TABs on the ground are correct to execute the Assessment smoothly.
    - Check the availability of the Lab Equipment for the particular Job Role.

3. Assessment Quality Assurance levels / Framework:
    - Question papers created by the Subject Matter Experts (SME)
    - Question papers created by the SME verified by the other subject Matter Experts
    - Questions are mapped with NOS and PC
    - Question papers are prepared considering that level 1 to 3 are for the unskilled & semi-skilled individuals, and level 4 and above are for the skilled, supervisor & higher management
    - Assessor must be ToA certified & trainer must be ToT Certified
    - Assessment agency must follow the assessment guidelines to conduct the assessment

4. Types of evidence or evidence-gathering protocol:
    - Time-stamped & geotagged reporting of the assessor from assessment location
    - Centre photographs with signboards and scheme specific branding
    - Biometric or manual attendance sheet (stamped by TP) of the trainees during the training period
    - Time-stamped & geotagged assessment (Theory + Viva + Practical) photographs & videos

5. Method of verification or validation:
    - Surprise visit to the assessment location
    - Random audit of the batch
    - Random audit of any candidate

6. Method for assessment documentation, archiving, and access
    - Hard copies of the documents are stored
    - Soft copies of the documents & photographs of the assessment are uploaded / accessed from Cloud Storage
    - Soft copies of the documents & photographs of the assessment are stored in the Hard Drives

References

Glossary

Term	Description
Declarative Knowledge	Declarative knowledge refers to facts, concepts and principles that need to be known and/or understood in order to accomplish a task or to solve a problem.
Key Learning Outcome	Key learning outcome is the statement of what a learner needs to know, understand and be able to do in order to achieve the terminal outcomes. A set of key learning outcomes will make up the training outcomes. Training outcome is specified in terms of knowledge, understanding (theory) and skills (practical application).
OJT (M)	On-the-job training (Mandatory); trainees are mandated to complete specified hours of training on site
OJT (R)	On-the-job training (Recommended); trainees are recommended the specified hours of training on site
Procedural Knowledge	Procedural knowledge addresses how to do something, or how to perform a task. It is the ability to work, or produce a tangible work output by applying cognitive, affective or psychomotor skills.
Training Outcome	Training outcome is a statement of what a learner will know, understand and be able to do upon the completion of the training.
Terminal Outcome	Terminal outcome is a statement of what a learner will know, understand and be able to do upon the completion of a module. A set of terminal outcomes help to achieve the training outcome.

Acronyms and Abbreviations

NOS	National Occupational Standard(s)
NSQF	National Skills Qualifications Framework
QP	Qualifications Pack
TVET	Technical and Vocational Education and Training
SOP	Standard Operating Procedure
WI	Work Instructions
PPE	Personal Protective equipment