National Competency Standards for "Metal Forming & Processing Supervisor"

Level 05

National Vocational and Technical Training Commission (NAVTTC), Government of Pakistan

ACKNOWLEDGEMENTS

National Vocational and Technical Training Commission (NAVTTC) extends its gratitude and appreciation to representatives of business, industry, academia, government agencies, provincial TEVTAs, sector skill councils and trade associations who spared time and extended their expertise for the development of National Vocational Qualification for the trade of **Metal Forming & Processing Level 02 - 05 .**This work would not have been possible without the technical support of all the stakeholders.

NAVTTC initiated development of CBT&A based qualifications for 200 traditional / hi-tech trades under the **Prime Minister's Hunarmand Pakistan Program,** focusing on Development & Standardization of 200 Technical & Vocational Education & Training (TVET) Qualifications. NAVTTC efforts have received full support from the Ministry of Federal Education and Professional Training that highly facilitated the progress under this initiative.

It may not be out of place to mention here that all the experts of Industry, Academia and TVET experts of TEVTAs, BTEs and PVTC work diligently for making this qualification worthy and error free for which all credit goes to them. However, NAVTTC accepts the responsibility of all the errors and omissions still prevailing in the Qualification document.

It is also noteworthy that development of Skill Standards is a dynamic and on-going process and already developed skill standards needs periodic review and updating owing to the constant technological advancements, development in scientific knowledge and growing experience of implementation at the grass-root level as well as the demand of industry. NAVTTC will ensure to keep the qualifications abreast with the changing demands of both national and international job markets.

Engr. Sajid Baloch
Executive Director (NAVTTC)

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1. Introduction

The Metal Forming & Processing industries are an essential part of our society that processes metals in order to manufacture machine components, machinery, instruments and tools needed by industries as well as by other sectors of the economy.

The products and components created by the different metal shaping techniques are used in creating everything from scaffolding and heavy machinery, to designing and creating microprocessors and artificial intelligence.

When it comes to metal forming, there are several processes to choose from, with each offering its own list of benefits and detriments, each suited to certain applications and for different types of metals.

That includes:

- Knowing the principles of common forming processes and their typical applications
- Identifying the key factors in the product to be made which will guide the forming process selection
- Applying basic metallurgy to the situation so as to make an appropriate recommendation.

Keeping in view of the above, the competency based national vocational qualifications have been developed by NAVTTC to train the unskilled human resource on the technical and entrepreneurial skills.

Being conscious of the emerging trends in the market, National Vocational & Technical Training Commission (NAVTTC) has developed competency standards in consultation with the stakeholders including academia, researchers, industry, chambers and TEVTAs for **Metal Forming & Processing Level 02 - 05** under National Vocational Qualifications Framework (NVQF). The competency standards document has been designed in such a way that helps trainees develop professional skills and facilitates them in targeting job market on national and international level especially middle east.

The National Competency Standards could be used as a referral document for the development of curriculum to be used by training institutions.

2. Purpose of the Qualification

The purpose of this qualification is to set the highly professional standards for **Metal Forming & Processing Level 02 - 05** in order to compete local and international job market requirements. The specific objectives of developing these qualifications are as under:

- Empower the youth with locally and globally required employable skills
- Produce competitive **Metal Forming & Processing Skilled Personnel**
- Improve the quality and effectiveness of the training and assessment for **Metal Forming & Processing Industry**

3. Date of Validation

The National Competency Standards **Metal Forming & Processing Level 02 - 05** has been validated by the Qualifications Validation Committee (QVC) members on **01 - 05 November 2021 (5 days)** and will remain valid for **ten years**.

4. Date of Review

The National Competency Standards for **Metal Forming & Processing Level 02 - 05** has been reviewed by the Qualifications Validation Committee (QVC) members **on 01 - 05 November 2021 (5 days)** and will remain valid for **ten years**.

5. Codes of Qualifications

The International Standard Classification of Education (ISCED) is a framework for assembling, compiling and analyzing cross-nationally comparable statistics on education and training. ISCED codes for these qualifications are assigned as follows:

ISCED Classification	
Code	**Description**
0715-MF&P-1	2nd Level National Certificate of level-5, in **Metal Forming & Processing Assistant/Helper**
0715-MF&P-2	3rd Level National Certificate of level-5, in **Metal Forming & Processing Technician**
0715-MF&P-3	4th Level National Certificate of level-5, in

	Metal Forming & Processing Senior Technician
0715-MF&P-4	5th Level National Certificate of level-5, in **Metal Forming & Processing Supervisor**

6. Members of Qualification Development Committee

The following members participated in the qualification development process of the **Metal Forming & Processing Level 02 - 05** at PITAC, Lahore.
Date: 9th - 13th August 2021

S#	Name	Designation	Organization
1.	Engr. Salman Khalid Chaudhary	Assistant Director (Technical) Metallurgy	PITAC, Lahore
2.	Engr. Sohail Naseer	Assistant Professor	GSPCT, Gujrat
3.	Engr. Jamal Akbar	Associate Professor	GCT, Peshawar
4.	Engr. Bismillah Kakar	Deputy Director (Technical)	PITAC, Lahore
5.	Muhammad Ismail	Assistant Foreman	PITAC, Lahore
6.	Engr. Amina Irfan	Lecturer	UOL, Lahore
7.	Engr. Ahsan Shahbaz	Manager	PSS, Lahore
8.	Engr. Rashid Bashir	Senior Instructor	Pak Swiss Training Center, Lahore
9.	Dr. Gull Hamid Awan	Chairman Department of Metallurgy	UET, Lahore
10.	Mr. Javed Afzal	Assistant Manager	SMEDA, Lahore
11.	Engr. Tashiq Semab Amin	Deputy Manager	HIT, Taxila
12.	Engr. Muhammad Umar	Project Engineer	PNAC, Islamabad
13.	Engr. Farooq Iftikhar	Senior Engineer	PCSIR, Lahore

14.	Engr. Fahad Qaiser	Assistant Director (Technical) Mechanical	PITAC, Lahore
15.	Engr. Muhammad Hafeez	Principal (R)	P-TEVTA, Lahore
16.	Engr. Amir Amin	DACUM Facilitator	Malaysian Institute, Lahore
17.	Engr. Muhammad Ishaq	Deputy Director	NAVTTC HQ, Islamabad

7. Qualification Validation Committee

The following members participated in the qualification validation process of **Metal Forming & Processing Level 02 - 05** at PITAC, Lahore.
Date: 01st – 05th November, 2021

S#	Name	Status in Committee	Organization
1.	Engr. Salman Khalid Chaudhary	Assistant Director (Technical) Metallurgy	PITAC, Lahore
2.	Engr. Farooq Iftikhar	Senior Engineer	PCSIR, Lahore
3.	Engr. Umer Farooq	Instructor Mechanical	GSPCT, Gujrat
4.	Engr. Saif Ullah Khan	Assistant Director (Technical) Mechanical	PITAC, Lahore
5.	Engr. Rashid Bashir	Senior Instructor	Pak Swiss Training Center, Lahore
6.	Engr. Tehrim Ijaz	Teaching Assistant	Punjab University, Lahore
7.	Mr. Mushtaq Ahmad	Director M&E Representative of P-TEVTA	P-TEVTA
8.	Engr. Jamal Akbar	Associate Professor Representative of KPK-TEVTA	GCT, Peshawar
9.	Engr. Liaqat Jamro	Director Academics, Representative of S-TEVTA	S-TEVTA

10.	Engr. Muhammad Umar	Project Engineer	PNAC, Islamabad
11.	Ms. Syeda Fatima Iqbal	System Analyst Representative of PBTE	PBTE Lahore
12.	Mr. Shoaib Anwar Sherazi	Principal Representative of B-TEVTA	TTC Quetta
13.	Engr. Abdul Maqsood	DACUM Facilitator	GPI, Mardan
14.	Engr. Muhammad Yasir	Deputy Director, NAVTTC Coordinator	NAVTTC HQ, Islamabad

8. Entry Qualification

The entry for National Competency Standards for **Metal Forming & Processing Level 02 - 05** would be Middle Certificate (8th Class).

9. Regulation of the qualification and schedule of units

Not Applicable

10. Summary of Competencies

Sr No	Occupation	Competency Standards	NVQF Level	Category	Contact Hours Th	Pr	T	Cr. Hrs.
1.	Machining Supervisor	CS 56 Perform Computerized Numerical Control, CNC Operations	5	Technical	21	81	102	10.2
		CS 57 Perform CNC EDM Wire-Cut Operations	5	Technical	18	66	84	8.4
2.	Welding Supervisor	CS 58 Perform GTAW / TIG Welding	5	Technical	21	48	69	6.9
		CS 59 Perform GMAW (MIG/MAG) and FCAW Welding	5	Technical	18	36	54	5.4
3.	Metal Processing Supervisor	CS 60 Carryout Continuous Casting Machine (CCM)	5	Technical	21	81	102	10.2

		operations						
		CS 61 Carryout Metal processing with Metallic powder	5	Technical	18	60	78	7.8
4.	Metal Forming Supervisor	CS 62 Perform Pre-Rolling Operation	5	Technical	12	24	36	3.6
		CS 63 Perform Hot & Cold Rolling Process	5	Technical	18	81	99	9.9
5.	Quality Testing Inspector	CS 64 Perform Metallography of Metallic Materials	5	Technical	18	48	66	6.6
		CS 65 Perform Handheld XRF Analysis	5	Technical	18	36	54	5.4
		CS 66 Perform optical emission spectroscopic analysis	5	Technical	18	45	63	6.3
		CS 67 Perform Non-Destructive Testing	5	Technical	21	90	111	11.1
6.	Coating Supervisor	CS 68 Perform Galvanizing Coating	5	Technical	21	60	81	8.1
		CS 69 Perform Conversion Coating (Anodizing)	5	Technical	18	51	69	6.9
7.	Entrepreneurial skills	CS 70 Develop Project Proposal	5	Generic	27	9	36	3.6
		CS 71 Develop project management plan	5	Generic	27	6	33	3.3
		CS 72 Develop sales plan	5	Generic	27	6	33	3.3
		CS 73 Conduct research for customer needs and satisfaction	5	Generic	27	9	36	3.6
	Total				**369**	**837**	**1206**	**120.6**

11. Occupations of Qualification

Level 02	Level 03	Level 04	Level 05
• Health and Safety Officer • Drawing Assistant • Machining Assistant • Welding Assistant • Metal forming Assistant • Maintenance Assistant	• Computer Operator • Draughtsman • Machining Technician • Welding Technician • Metal Casting Technician • Metal Forming Technician	• Soft Skills • Machining Sr. Technician • Welding Sr. Technician • Metal Casting Sr. Technician • Metal Forming Sr. Technician • Heat Treatment Technician • Destructive Testing Technician	• Machining Supervisor • Welding Supervisor • Metal Processing Supervisor • Metal Forming Supervisor • Quality Testing Inspector • Coating Supervisor • Entrepreneurial skills

Sr. No	Occupation	Duties/CS
Level-5 Metal Forming & Processing Supervisor		
1.	Machining Supervisor	CS 56 Perform Computerized Numerical Control, CNC Operations
		CS 57 Perform CNC EDM Wire-Cut Operations
2.	Welding Supervisor	CS 58 Perform GTAW / TIG Welding
		CS 59 Perform GMAW (MIG/MAG) and FCAW Welding
3.	Metal Processing Supervisor	CS 60 Carryout Continuous Casting Machine (CCM) operations
		CS 61 Carryout Metal processing with Metallic powder
4.	Metal Forming Supervisor	CS 62 Perform Pre- Rolling Operation
		CS 63 Perform Hot & Cold Rolling Process
5.	Quality Testing Inspector	CS 64 Perform Metallography of Metallic Materials
		CS 65 Perform Handheld XRF Analysis
		CS 66 Perform optical emission spectroscopic analysis
		CS 67 Perform Non-Destructive Testing
6.	Coating Supervisor	CS 68 Perform Galvanizing Coating
		CS 69 Perform Conversion Coating (Anodizing)
7.	Entrepreneurial skills	CS 70 Develop Project Proposal
		CS 71 Develop project management plan
		CS 72 Develop sales plan
		CS 73 Conduct research for customer needs and satisfaction

12. Levelling and Packaging of Qualification

OCCUPATIONS AND LEVELS DESCRIPTOR

Level 2 **Level 3** **Level 4** **Level 5**

Sr. #	Occupations	No of Modules/CS	Level	Occupation Credit Hours	Training Duration

1.	**Metal Forming and Processing Assistant/Helper**	**13**	**02**	**612**	**6 Months**
2.	**Metal Forming and Processing Technician**	**18**	**03**	**600**	**6 Months**
3.	**Metal Forming and Processing Senior Technician**	**24**	**04**	**1200**	**12 Months**
4.	**Metal Forming and Processing Supervisor**	**18**	**05**	**1206**	**12 Months**

13. Generic Modules with respective levels

- Health and Safety — LEVEL 2
- Digital Skills — LEVEL 3
- Soft Skills — LEVEL 4
- Entrepreneurial Skills — LEVEL 5

14. Level 05 - Metal Forming & Processing Supervisor

1. *Machining Supervisor*

0715-MF&P 56. Perform Computerized Numerical Control, CNC Operations

Overview: This competency standard covers the skills and knowledge required to Set-up CNC machine, Run Simulation, Feed the Program, Carry out CNC Lathe/Milling Operations, Perform CNC water jet cutting Operations, Perform CNC laser cutting Operations

Competency Units	Performance Criteria
CU1. Set-up CNC machine	**P1.** Select required work holding device(s) in order to achieve dimensional accuracy **P2.** Mount the work-piece by considering the working capacity of machine as well as job requirement according to the drawing/design. **P3.** Attain proper alignment of tool/cutter and work-piece e.g. concentricity of rotating jobs as per set practice **P4.** Set up and adjust machine according to parameters to achieve work specification. **P5.** Report uncertainties and deviations to person concerned for timely action. **P6.** Maintain safe measures while mounting the work-piece so that unwanted operation by machine may not be initiated as per safety precautions
CU2. Run Simulation	**P1.** Feed the generated part program into required simulation platform and run simulation for checking the tool gouge according to safety measures **P2.** Run simulation and verify movements of tool/cutter to get same results as per defined sequence **P3.** Identify occurrence of errors and modify the program as per defined procedure
CU3. Feed the Program	**P1.** Maintain synchronization between machine control unit and part program file as per standard operating procedure

	P2. Switch machine to receiving mode and feed the desired part program file into machine control unit for further execution as per standard operating procedure **P3.** Select the desired part program file for execution as per standard operating procedure
CU4. Carry out CNC Lathe/Milling Operations	**P1.** Perform dry run-on CNC Lathe/Milling machines to ensure safety measures. **P2.** Control the feeds, speeds and override of machine before operating according to the prescribed procedure **P3.** Switch machine to execution mode (single block or auto) and press cycle start to run the machining sequence as per prescribed method **P4.** Compare the block-wise movements of machining sequence thoroughly during operation of machine according to the part program file **P4.** Complete the job and inspect its accuracy and precision according to the drawing/design
CU5. Perform CNC water jet cutting Operations	**P1.** Perform dry run on CNC water jet cutting machine to ensure safety measures. **P2.** Arrange abrasive material with water jet spray as per requirement **P3.** Adjust the feeds, speeds and pressure by adjusting amperes and current setting before operating according to the prescribed procedure **P4.** Switch machine to execution mode and start to work on defined tool-path as per prescribed method **P5.** Compare the movements of machining sequence thoroughly during operating of machine according to the part program file **P6.** Complete the job and inspect its accuracy and precision according to the drawing/design
CU6. Perform CNC laser cutting Operations	**P1.** Perform dry run-on CNC laser cutting machine to ensure safety measures. **P2.** Connect CO2 gas cylinder and accessories with machine as per requirement **P3.** Adjust the feeds, speeds by adjusting amperes and

	current setting before operating according to the prescribed procedure **P4.** Switch machine to execution mode and start to work on defined tool path as per prescribed method **P5.** Compare the movements of machining sequence thoroughly during operating of machine according to the part program file **P6.** Complete the job and inspect its accuracy and precision according to the drawing/design

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

K1. Basic knowledge of CNC machine.
K2. Machine process standards and functions.
K3. Methods and techniques of adjusting operating parameters of machine.
K4. Interpreting work specifications.
K5. Techniques for checking quality of components produced.
K6. Basic knowledge of G-Code and M-Code.
K7. Basic computer operations.
K8. Procedure for reporting uncertainties and deviations to person concerned for timely action.
K9. Safety precautions and guidelines.
K10. Use of control panel.
K11. Quality check points with standards.
K12. Basic knowledge of machine margins and alignments.
K13. Interpret drawing and work specifications.
K14. Use of coordinate system
K15. Define CNC Milling and its operations
K16. Define CNC Water jet and its working
K17. Define CNC Laser cutting
K18. Functions of CNC Lathe Machine and range of turning operations which include facing, Grooving, tapering, taper turning, step turning, form turning, threading, knurling, drilling, boring, reaming.
K19. Interpreting machine check sheet.
K20. Safety precautions and guidelines

Critical Evidence(s) Required

The candidate must present evidence of practical observations showing their ability to carry out CNC machine operations. The observation measures include.

- Carry out CNC Lathe/Milling Operations
- Perform CNC water jet cutting Operations
- Perform CNC laser cutting Operations

Tools & Equipment

- CNC Lathe machine and accessories
- CNC milling machine with all accessories
- Cutting Tools
- CNC Laser cutting Machine and accessories
- CNC water jet and accessories
- Zero Setter, Edge Finder and Dial Indicator
- Power Vice
- CNC Programming Manual
- CAM Software with Simulation Module
- Measuring Instruments (Vernier, Inside/Outside Callipers, Micrometre, Steel Rule,
- Tri-Square, Bevel Protractor etc.)
- Work Holding Devices
- Measuring Gauges
- Tooling Catalogue
- Complete Set of Computer System with Multimedia Projector
- CNC Manual
- Hydraulic unit
- Water transmission lines
- On/Off Valve
- Water jet nozzle
- Water jet catchers
- Fluid additives
- Water jet catchers
- Fluid additives

0715-MF&P 57. Perform CNC EDM Wire-Cut Operations

Overview: This competency standard covers the skills and knowledge required to mount the Job on EDM Wire Cut Machine, Generate the Program, Run Simulation, Feed the Program, Perform CNC EDM Wire-cut Operations

Competency Units	Performance Criteria
CU1. Mount the Job on EDM Wire Cut Machine	P1. Mount the work-piece by considering the working capacity of machine as well as job requirement according to the drawing/design P2. Select appropriate work holding device(s) in order to achieve dimensional accuracy and clamp the job firmly as per standard practice P3. Install and adjust proper alignment of installed wire to the vertical direction as per standard practice P4. Keep safe measures while mounting the work-piece and installing the wire so that unwanted operation by machine may not be initiated as per safety precautions
CU2. Generate the Program	P1. Select appropriate CAM software according to the machine control unit and import drawing/sketch into it as per standard procedure P2. Select reference point/start point and apply toolpath by considering the wire compensation according to the prescribed procedure P3. Execute the generated part program file in order to perform wire cutting operation as per prescribed method
CU3. Run Simulation	P1. Refer to the simulation platform and run simulation of wire cutting sequence as per prescribed method P2. Run simulation and verify movements of wire cutting to get same results as per defined sequence P3. Identify occurrence of errors and modify the applied toolpath as per prescribed procedure
CU4. Feed the Program	P1. Ensure proper synchronization between machine control unit and part program file as per standard operating procedure P2. Select and execute the desired part program file as per job

	requirement
CU5. Perform CNC EDM Wire-cut Operations	P1. Ensure to control the safe operation of working on EDM wire-cut machine before execution of part program according to the safety measures P2. Adjust the feeds, speeds by adjusting amperes and current setting before operating according to the prescribed procedure P3. Switch machine to execution mode and start to work on defined toolpath as per prescribed method P4. Compare the movements of machining sequence thoroughly during operating of machine according to the part program file P5. Complete the job and inspect its accuracy and precision according to the drawing/design

Knowledge & Understanding

- **K1.** Work place safety and health considerations
- **K2.** Use of PPE's
- **K3.** Use of CAD/CAM and 3D models
- **K4.** Coolant types along with benefits and uses
- **K5.** Mechanism of working of CNC EDM wire cut machine
- **K6.** Use of control panel and commands
- **K7.** Program debugging techniques
- **K8.** Use of Simulation
- **K9.** Use of portable devices for CNC EDM wire cut
- **K10.** Possible accidents and their counteractions
- **K11.** Methods of calculating Coordinates techniques
- **K12.** G codes and M codes
- **K13.** Use of Clamping devices and their types
- **K14.** Feed and speed concepts

Tools & Equipment

- CNC EDM Wire-cut Machine along with Standard Accessories
- Wire Spool(s) with Wire Dia 0.18mm
- Wire-cut Software (YH, YL or HF)
- Measuring Gauges with Dial Indicator
- Tooling Catalogue

- CNC Manual
- Measuring Instruments (Vernier, inside/ Outside Calipers, Micrometer, Steel Rule, Tri-Square, Bevel Protractor etc.)
- Work Holding Devices
- Personal Protective Equipment (PPEs)
- Complete set of computer system with multimedia projector
- Work Holding Devices

2. *Welding Supervisor*

0715-MF&P 58. Perform GTAW / TIG Welding

Overview: This competency standard covers the skills and knowledge required to Prepare Welding Machine and Accessories for GTAW / TIG, Make Welds on Carbon Steel Plate Flat (1F) and Flat (1G), Make Welds on Carbon Steel Plate Horizontal (2F) and Horizontal (2G), Make Welds on Carbon Steel Plate Vertical (3F) and Vertical (3G), Make Welds on Carbon Steel Plate Overhead (4F) and Overhead (4G), Perform Post Welding Operations

Competency Units	Performance Criteria
CU1. Prepare Welding Machine and Accessories for GTAW / TIG	**P1.** Identify welding requirements from welding procedure specifications/technical drawings **P2.** Prepare welding machine in accordance with welding procedure specifications/ manufacturer instructions. **P3.** Set up welding machine accessories and consumables as per job requirements, welding procedure specifications and/or manufacturer's instructions **P4.** Connect welding machine to an independent power supply **P5.** Set polarity indicated in the welding procedure specifications/ job requirement **P6.** Prepare work piece for welding as per job requirement
CU2. Make Welds on Carbon Steel Plate Flat (1F) and Flat (1G)	**P1.** Adjust welding parameters (current, voltage etc.) as per welding procedure specifications/job requirements to produce acceptable weld **P2.** Maintain standard position of electrode and base metal as per SOPs **P3.** Carry out welding in Flat (1F) and Flat (1G) positions following standard procedures **P4.** Deposit root pass as per welding procedure specifications/job requirements **P5.** Deposit filling passes as per welding procedure specifications/job requirements **P6.** Deposit capping pass as per welding procedure specifications/job requirements **P7.** Check root, filling and capping passes for any visual discontinuities at regular intervals

	P8.	Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
CU3. Make Welds on Carbon Steel Plate Horizontal (2F) and Horizontal (2G)	**P1.**	Adjust welding parameters (current, voltage etc.) as per welding procedure specifications/job requirements to produce acceptable weld
	P2.	Maintain standard position of electrode and base metal as per SOPs
	P3.	Carry out welding in Horizontal (2F) and Horizontal (2G) positions following standard procedures
	P4.	Deposit root pass as per welding procedure specifications/job requirements
	P5.	Deposit filling passes as per welding procedure specifications/job requirements
	P6.	Deposit capping pass as per welding procedure specifications/job requirements
	P7.	Check root, filling and capping passes for any visual discontinuities at regular intervals
	P8.	Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
CU4. Make Welds on Carbon Steel Plate Vertical (3F) and Vertical (3G)	**P1.**	Adjust welding parameters (current, voltage etc.) as per welding procedure specifications/job requirements to produce acceptable weld
	P2.	Maintain standard position of electrode and base metal as per SOPs
	P3.	Carry out welding in Vertical (3F) and Vertical (3G) positions following standard procedures
	P4.	Deposit root pass as per welding procedure specifications/job requirements
	P5.	Deposit filling passes as per welding procedure specifications/job requirements
	P6.	Deposit capping pass as per welding procedure specifications/job requirements
	P7.	Check root, filling and capping passes for any visual discontinuities at regular intervals
	P8.	Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
CU5. Make Welds on Carbon	**P1.**	Adjust welding parameters (current, voltage etc.) as per welding procedure specifications/job requirements to

	Steel Plate Overhead (4F) and Overhead (4G)	produce acceptable weld **P2.** Maintain standard position of electrode and base metal as per SOPs **P3.** Carry out welding in Overhead (4F) and Overhead (4G) positions following standard procedures **P4.** Deposit root pass as per welding procedure specifications/job requirements **P5.** Deposit filling passes as per welding procedure specifications/job requirements **P6.** Deposit capping pass as per welding procedure specifications/job requirements **P7.** Check root, filling and capping passes for any visual discontinuities at regular intervals **P8.** Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
CU6.	Perform Post Welding Operations	**P1.** Carry out finishing work of welds following standard procedures. **P2.** Inspect weld visually and mark any visual defects, as required **P3.** Perform Dye Penetration Test (DPT) **P4.** Carry out repair work in accordance with approved procedures, as required. **P5.** Clean work area in accordance with workplace safety practices. **P6.** Maintain tools/equipment/consumable materials in accordance with organization guidelines **P7.** Store tools/equipment/consumable materials in accordance with organization guidelines .

Knowledge & Understanding

The candidate must be able to demonstrate knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

K1. Explain various types of welding processes

K2. Explain advantages of GTAW

K3. Describe the principle of TIG welding

K4. Explain various welding positions

K5. List Personal Protective Equipment required for TIG welding and state their use

K6. Demonstrate the standard method to wear PPEs

K1. Explain Specifications/ classification of electrode/s required for the job

K2. Explain safe working practices to be followed while carrying out TIG welding

K3. Identify hazards associated with TIG welding and take remedial measures

K1 Define Electrical parameters like (voltage, current etc.) and their effects on weld

K2 Explain Welding techniques as per WPS/instruction sheet

K1. Describe Welding procedure specifications (WPS)

K2. Describe Method of Pre- heating of base metal

K3. Describe Types of Welding Joints

K1. Explain Polarity setting according to standard specifications

K2. Explain the factors to be considered in TIG welding like type and thickness of the base metal, current type and polarity, type of shielding gas to be used

K1. Define Visual welding defects

K2. Describe Welding codes and standards

K3. State the purpose of using shielding gas in TIG welding

K4. Describe various gases/combination of gases for shielding

Tools & Equipments

- TIG welding plant and accessories
- Argon gas cylinders
- Welding Consumables
- PPEs

0715-MF&P 59. Perform GMAW (MIG/MAG) and FCAW Welding

Overview: This Competency Standard is designed to gain basic knowledge and skills required to Prepare Welding Machine for GMAW (MIG/MAG), Make Welds on Carbon Steel Plate with GMAW at Flat (1F) and Flat (1G), Make Welds on Carbon Steel Plate with GMAW at Horizontal (2F) and Horizontal (2G), Prepare Welding Machine for FCAW, Make Welds on Carbon Steel Plate with FCAW at Vertical (3F) and Vertical (3G) and Perform Post Welding Operations.

Competency Units	Performance Criteria
CU1. Prepare Welding Machine for GMAW (MIG/MAG)	**P1.** Identify welding requirements from welding procedure specifications/technical drawings **P2.** Carry out the pre cleaning of base metal as per requirement. **P3.** Prepare welding machine in accordance with welding procedure specifications/ manufacturer instructions **P4.** Install CO2/Argon/Helium gas cylinder to the GMAW/MAG machine as per job requirement **P5.** Install gas heater for CO_2 cylinder as per requirement **P6.** Connect welding machine to an independent power supply **P7.** Install the consumable filler wire spool in wire feeding unit **P8.** Set polarity indicated in the welding procedure specifications **P9.** Carry out pre-heating of the given job.
CU2. Make Welds on Carbon Steel Plate with GMAW Flat (1F) and Flat (1G)	**P1.** Adjust welding parameters (current, voltage etc.) as per welding procedure specifications/job requirements to produce acceptable weld **P2.** Maintain standard position of electrode and base metal as per SOPs **P3.** Carry out welding in Flat (1F) and Flat (1G) positions following standard procedures **P4.** Deposit root pass as per welding procedure specifications/job requirements **P5.** Deposit filling passes as per welding procedure specifications/job requirements **P6.** Deposit capping pass as per welding procedure specifications/job requirements **P7.** Check root, filling and capping passes for any visual discontinuities at regular intervals

	P8. Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
CU3. Make Welds on Carbon Steel Plate with GMAW Horizontal (2F) and Horizontal (2G)	**P1.** Adjust welding parameters (current, voltage etc.) as per welding procedure specifications/job requirements to produce acceptable weld. **P2.** Maintain distance between electrode and base metal as per standard practices. **P3.** Carry out welding in Horizontal (2F) and Horizontal (2G) positions following standard procedures **P4.** Deposit root pass as per welding procedure specifications/job requirements **P5.** Deposit filling passes as per welding procedure specifications/job requirements **P6.** Deposit capping pass as per welding procedure specifications/job requirements **P7.** Carry out the cleaning of passes as per requirement **P8.** Check root, filling and capping passes for any visual discontinuities at regular intervals **P9.** Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
CU4. Prepare Welding Machine for FCAW	**P1.** Identify welding requirements from welding procedure specifications/technical drawings **P2.** Carry out the pre cleaning of base metal as per requirement. **P3.** Prepare welding machine in accordance with welding procedure specifications/ manufacturer instructions **P4.** Connect welding machine to an independent power supply **P5.** Install the flux cored consumable filler wire spool in wire feeding unit **P6.** Install Argon/helium gas cylinder to the FCAW machine for dual shielding if required **P7.** Set polarity indicated in the welding procedure specifications **P8.** Carry out pre-heating of the given job.
CU5. Make Welds on Carbon Steel Plate with FCAW	**P1.** Adjust welding parameters (current, voltage etc.) as per welding procedure specifications/job requirement to produce acceptable weld **P2.** Maintain distance between electrode and base metal as per

	Vertical (3F) and Vertical (3G)	standard practices **P3.** Carry out welding in Vertical (3F) and Vertical (3G) positions following standard procedures **P4.** Deposit root pass as per welding procedure specifications/job requirements **P5.** Deposit filling passes as per welding procedure specifications/job requirements **P6.** Deposit capping pass as per welding procedure specifications/job requirements **P7.** Carry out slag removal process as per requirement **P8.** Check root, filling and capping passes for any visual discontinuities at regular intervals **P9.** Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
CU6.	Perform Post Welding Operations	**P1.** Carry out finishing work of welds following standard procedures **P2.** Inspect weld visually and mark any visual defects, as required **P3.** Perform Dye Penetration Test (DPT) **P4.** Carry out repair work in accordance with approved procedures, as required **P5.** Perform post heat treatment operation as per requirement. **P6.** Clean work area in accordance with workplace safety practices **P7.** Maintain tools/equipment/consumable materials in accordance with organization guidelines **P8.** Store tools/equipment/consumable materials in accordance with organization guidelines

Knowledge & Understanding

The candidate must be able to demonstrate knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

K1. Explain various types of welding processes
K2. Explain advantages of GMAW and FCAW
K3. Describe the principle of MIG welding

K4. Differentiate between MIG and MAG
K5. Explain various welding positions
K6. Enlist the types of metal deposits in MIG/MAG
K7. List Personal Protective Equipment required for MIG welding and state their use
K8. Demonstrate the method to correctly wear PPE
K9. Explain Specifications/ classification of electrode/s required for the job
K10. Explain safe working practices to be followed while carrying out MIG welding
K11. Describe hazards associated with MIG welding and take remedial measures
K12. Define Electrical parameters like (voltage, current etc.) and their effects on weld
K13. Explain Welding techniques as per WPS/instruction sheet
K14. Describe Welding procedure specifications (WPS)
K15. Describe Method of Pre- heating of base metal
K16. Describe Types of welding joints
K17. Explain Polarity setting according to standard specifications
K18. Describe Welding codes and standards
K19. Describe various gases/combination of gases for shielding

Tools & Equipments

- GMAW welding plant with wire feeding unit
- FCAW welding plant with wire feeding unit
- Consumable wire spool
- Welding gun
- CO_2/Helium/Argon gas cylinders
- Welding accessories
- PPEs

3. *Metal Processing Supervisor*

0715-MF&P 60. Carryout Continuous Casting Machine (CCM) operations

Overview: This competency standard covers the skills and knowledge required to Read and Understand Practice safety requirements for CCM, Perform Coordination with attached sections, Carry out pre- casting operations of CCM, Carry out casting process and Conduct cleaning and maintenance of equipment.

Note: The learning units in the module are reccomended to be carried out in a real work envirnoment (relevant industy) under MOU agreed upon between the concerned industry for practical work and training institute for impart of theoratical portion of the module

Competency Units	Performance Criteria
CU1. Practice safety requirements for CCM	**P1.** Use standard PPEs as per job requirement **P2.** Use standard tools and equipment as per job requirement
CU2. Perform Coordination with attached sections	**P1.** Coordinate with melting section to receive molten metal **P2.** Coordinate with the rolling mill section for direct rolling operation **P3.** Inform to the concerned shops in case of any abnormality arises during casting process
CU3. Carry out pre-casting operations of CCM	**P1.** Prepare launder and mold jacket safety cover **P2.** Carry out mold tube cleaning as per standard **P3.** Perform slag box cleaning and changing **P4.** Apply dummy bar packing/ceiling oil as per requirement **P5.** Perform Spray nozzle cleaning as per requirement **P6.** Check primary cooling water pressure inlet and outlet **P7.** Prepare strands for casting as per requirement **P8.** Preheat tundish and tundish nozzles as per requirement **P9.** Prepare strands of casting tundish nozzles **P10.** Carryout centering of tundish trolley as per requirement **P11.** Check the operation of all strands in new tundish as per standard **P12.** Check ladle nozzle opening as per standard **P13.** Fix slide gate plate of ladle as per standard **P14.** Put dummy bar in mold tube by skid bank operator

CU4. Carry out casting process	**P1.** Place Molten metal ladle on CCM platform **P2.** Perform purging as the ladle reaches CCM platform **P3.** Take temperature of metal in ladle **P4.** Open the slide gate ladle if the temperature is as per requirement **P5.** Open tundish nozzles as level reaches 3/4th of tundish **P6.** Remove slag continuously through casting process **P7.** Check level of ladle by using lancing pipe **P8.** Open all tundish nozzles sequentially **P9.** Control casting speed using knob once dummy bar is cut **P10.** Open emergency valve to maintain water pressure **P11.** Report tundish level during casting as per requirement **P12.** Cut head of billet using gas cutter as per standard **P13.** Push billet to cooling bed/rolling mill as per directions
CU5. Conduct cleaning and maintenance of equipment	**P1.** Clean the equipments and process auxiliaries regularly to remove any dust, moisture, waste material **P2.** Open the equipment and clean the internal parts of the equipment **P3.** Clean the working area under the process and create a healthy, clean and safe working environment

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- **K1.** Tundish level Control
- **K2.** Function of tundish nozzels
- **K3.** Mould level Control, by means of strand's speed regulation or nozzle regulation, Mould width adjustment
- **K4.** Strand cooling controls, based on metallurgical recipes
- **K5.** Breakout prediction
- **K6.** Laddle handling and slide gate plate function

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Prepare strands for casting as per requirement
- Carry out mold tube cleaning as per standard
- Perform slag box cleaning and changing
- Perform Spray nozzle cleaning as per requirement

Tools and Equipment

- CCM and accessories
- Overhead crane
- Mold tube
- Foot ring
- Ladle turret
- Tundish cars
- Oscillating mould
- Withdrawal units
- Straightening machines
- Dummy bar
- Roller tables
- Cooling bed and transfer
- Oxygen lancing accessories

0715-MF&P 61. Carryout Metal processing with Metallic powder

Overview: This competency standard covers the skills and knowledge required to Select particle size and morphology of powder, Calculate the required weight of powder and binder, Prepare metallic powder blend, Operate hydraulic press, Set the parameters of sintering furnace, Perform sintering operation in the furnace, Carry out the inspection of sintered Component

Competency Units	Performance Criteria
CU1. Select particle size and morphology of powder	**P1.** Practice PPEs to control chemical hazards. **P2.** Select the required metallic powder particle size as per job requirement. **P3.** Select the metallic powder morphology from the material supplier catalogue.
CU2. Calculate the required weight of powder and binder	**P1.** Select the density of actual metal **P2.** Select the volume of the required part **P3.** Calculate the required mass of powder **P4.** Calculate the required percentage of binder **P5.** Weight the amount of powder and binder as per requirement
CU3. Prepare metallic powder blend	**P1.** Carry out mixing and blending of powder and binder as per requirement **P2.** Set the time of mixer as per requirement. **P3.** Fill the die with blended powder and close the die.
CU4. Operate hydraulic press	**P1.** Raise the front safety guard of press as per standard **P2.** Place the die filled with powder on the lower pressing die **P3.** Lower the front safety guard as per standard **P4.** Lower the pressing face by turning the screw handle as per SOPs **P5.** Pull and push the pump handle to smoothly build up required pressure and hold the applied tonnage as required. **P6.** Release the pressure load as per standard **P7.** Open the front safety guard and remove die from

	hydraulic press. **P8.** Remove the green compact part from the die. **P9.** Calculate the density of green compact.
CU5. Set the parameters of sintering furnace	**P1.** Adjust the controls of the furnace i.e. water flow, heating chamber, heating coils, thermocouple and exhaust system **P2.** Set the furnace to required temperature **P3.** Set the heating rate of the furnace **P4.** Set the holding time of the furnace **P5.** Select the required inert gas for environmental conditions **P6.** Connect the gas cylinder with furnace **P7.** Set the required pressure of gas **P8.** Connect the vacuum pump to the furnace heating chamber, if vacuum is required
CU6. Perform sintering operation in the furnace	**P1.** Place the green compact in the heating chamber of furnace **P2.** Close the door of heating chamber **P3.** Set ON the furnace power supply. **P4.** Carryout sintering cycle as per set parameters **P5.** Take out the sintered part from the furnace after process completion.
CU7. Carry out the inspection of sintered Component	**P1.** Inspect the component visually for any defects **P2.** Inspect the dimensions of the component by using measuring scale or devices **P3.** Separate the defected and non-defected components. **P4.** Make use of grinder to refine tolerance **P5.** Make use of buffing operation to improve surface finish

Knowledge & Understanding

The candidate must be able to demonstrate knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

- **K1.** Define powder metallurgy.
- **K2.** Describe different shapes and size of powder particles.
- **K3.** Define density.

K4. Describe the difference between bulk density and apparent density.
K5. Describe packing of particle in pressed form
K6. Explain the effect of particles size distribution in pressing
K7. Describe the effect of binder amount
K8. Explain the operating principle of hydraulic press
K9. Explain the relative density
K10. Define Sintering.
K11. Describe the purpose of sintering.
K12. Describe sintering temperature for common metals.
K13. Define inert gas.
K14. Describe the names of common inert gases.

Critical Evidence(s) Required

The candidate must present evidence of practical observations showing their ability to maintain safety at site. The observation measures include.

- Calculate the required weight of powder and binder
- Perform sintering operation in the furnace
- Carry out the inspection of sintered Component and report

Tools and Equipment

- Layout tools
- Metallic powders
- Binders
- Mixer Machine
- Hydraulic Press & Accessories
- Gas cylinders
- Vacuum pump
- Sintering furnace & Accessories

4. *Metal Forming Supervisor*

0715-MF&P 62. Perform Pre-Rolling Operation

Overview: This competency standard covers the skills and knowledge required to select the suitable types of rollers, adjust the Sequence of rolling stages to obtain the desired shape

Competency Units	Performance Criteria
CU1. Select the suitable types of rollers	**P1.** Check the property of rolling Materials as per requirement **P2.** Arrange the required Materials for rolling **P3.** Measure the work piece dimensions as per standard **P4.** Select the types of roller as per the shape, size and gap between the rollers and their contour **P5.** Set parameters (Pressure, Current, Speed, Time Temperature cycle, concentration, Tension) according to work piece specifications **P6.** Set the rollers according to required rolling process **P7.** Set the number of passes through the rollers required to get the finished product
CU2. Adjust the Sequence of rolling stages to obtain the desired shape	**P1.** Check points in different mills during roller assembly. **P2.** Check the functions of guide and stripper guards **P3.** Perform the Cleaning / Lubrication of different parts of rolling mill. **P4.** Maintain the specified tolerance for straightness **P5.** Align the Rollers after changing the section **P6.** Adjust straightening rollers as per job requirement **P7.** Use hammer for tightening / opening lock nut and Ring nut. **P8.** Use Sample piece for fixing liners in between Roll pairs for Out of Square adjustment.

Knowledge & Understanding

The candidate must be able to demonstrate knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

K1. Define metal forming process
K2. Describe types of rolling product.
K3. Explain types of rolling process (Hot & Cold)
K4. Explain importance of material behavior in metal forming processes
K5. Explain rolling temperature for different materials.
K6. Explain strain rate sensitivity.
K7. Explain friction and lubrication in metal forming
K8. Describe basic OSH practices regarding rolling process
K9. Types of Heating Furnaces
K10. Types of Lubricants
K11. Types of forces responsible for rolling.
K12. Condition of rolling process.
K13. Explain types of rolling defects
K14. Two-High Rolling Mills
K15. Three-High Rolling Mills
K16. Four High Rolling Mills
K17. Tandem Rolling Mills
K18. Cluster Rolling Mills
K19. Ring Rolling Process
K20. Thread Rolling Process
K21. Skew Rolling Process
K22. Tube Rolling Process

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Select the rollers as per given requirement
- Adjust the sequence of rolling stages to obtain the desired shape

Tools & Equipment

- Measuring Tools
- Hand Tools

- Inspection tools
- Rolling Mills and accessories
- Heating Furnaces
- Twist Pipe
- Brush Rolls
- Billet Pusher
- Rolling Mill Un Coiler Machine
- Steel Rolling Mill Parts
- Fly Wheel
- Different types of Rollers

0715-MF&P 63. Perform Hot & Cold Rolling Process

Overview: This competency standard covers the skills and knowledge required to Perform Two, Three & Four high rolling mill process (Hot rolling), Perform Tandem rolling mill process (Cold rolling) and Carryout inspection of finished product.

Competency Units	Performance Criteria
CU1. Perform Two, Three & Four high rolling mill process (Hot rolling)	**P1.** Ensure health safety and environment standards as per requirement **P2.** Set the temperature of the Re-heating furnace for heating the job to be rolled as per standard operating procedures. **P3.** Adjust the rollers in Rolling Mill according to job requirements (shape and size) **P4.** Set the rollers gap according to the job dimensions as per drawing **P5.** Use lubrication in rolling process to reduce the friction between rolls and metal **P6.** Pass the job in different high rolling mills gradually to get the final product as per given requirement **P7.** Use standard hand tools used in rolling process as per requirement
CU2. Perform Tandem rolling mill process (Cold rolling)	**P1.** Ensure health safety and environment standards as per requirement **P2.** Adjust the rollers in Rolling Mill according to job requirement **P3.** Set the rollers gap according to the job dimensions as per drawing **P4.** Use lubrication in rolling process to reduce the friction between rolls and metal **P5.** Pass the job in tandem rolling mills to get the final product as per given requirement **P6.** Use standard hand tools used in rolling process as per requirement

CU3. Carryout inspection of finished product	**P1.** Inspect rolling defects as per standard operating procedure **P2.** Use standard tools to rectify the defects in the given product. **P3.** Check the dimension of the product by using calibrated tools **P4.** Verify the final product dimensions **P5.** Generate report as per requirement

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

K1. Describe types of metal forming processes (bulk deformation and sheet metalworking)
K2. Explain types of rolling process (Hot & Cold)
K3. Describe material behavior in metal rolling processes
K4. Explain temperature in metal rolling
K5. Explain strain rate sensitivity
K6. Explain friction and lubrication in metal forming
K7. Describe Basic safety practices regarding rolling process
K8. Types of heating furnaces
K9. Types of lubricants
K10. Explain engineering materials ferrous and non-ferrous
K11. Types of forces during rolling
K12. Explain types of rolling defects
K13. Rolling Mill Un-Coiler Machine
K14. Two-High Rolling Mills
K15. Three-High Rolling Mill
K16. Four high rolling mills
K17. Tandem rolling mills
K18. Cluster rolling mills

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Select engineering materials according to required standards.
- Perform Three high hot rolling mill process
- Perform Tandem cold rolling mill process
- Inspect Rolling defects as per SOPs

Tools & Equipments

- Measuring Tools
- Mechanical Hand Tools kit
- Inspection tools
- Two-High Rolling Mills
- Three-High Rolling Mills
- Four high rolling mills
- Tandem rolling mills
- Reheating Furnaces
- Pre Stressed Mill Stands
- Twist Pipe
- Brush Rolls
- Billet Pusher
- Rolling Mill Un-Coiler Machine
- Steel Rolling Mill Parts
- Fly Wheel
- Rolling Mill Plant Spare Parts
- Ejector Machines
- Metal Straightening Machine
- Roller Guide Box
- Rolling Mill Coilers

5. *Quality Testing Inspector*

0715-MF&P 64. Perform Metallography of Metallic Materials

Overview: This competency standard covers the skills and knowledge required to Prepare specimen for metallography, Demonstrate the working of metallurgical microscope

Competency Units	Performance Criteria
CU1. Prepare specimen for metallography	P-1. Select the material to perform metallography P-2. Cut the specimen according to specifications P-3. Mount the specimen by ensuring flat level P-4. Perform Rough polishing of the specimen with round grinder P-5. Perform fine polishing of the specimen using emery paper from low mesh number to high mesh number P-6. use polishing cloth as final polishing step P-7. Etch the polished specimen using advised etchant P-8. Observe the work piece under metallurgical microscope
CU2. Demonstrate the working of metallurgical microscope	P-1. Prepare metallic specimen according to metallographic procedures P-2. Put the specimen on the mechanical stage of microscope P-3. Use plasticine to level its surface P-4. use various magnifications to observe microstructure of specimen P-5. throw light on the surface of metallic specimen to see its microstructures P-6. observe the light throwing procedure in the microscope P-7. inspect a bright refection of the work piece through eye piece P-8. inspect the microstructure through eye piece P-9. record the results

Knowledge & Understanding

- **K1.** Explain the metallography Process
- **K2.** enlist various emery paper mesh sizes
- **K3.** Explain various etchants and their respective applications
- **K4.** enlist various parts of Metallurgical Microscope
- **K5.** Explain function of each part
- **K6.** Explain the importance of throwing light on the metallic work piece before seeing the microstructure
- **K7.** handling procedure of Metallurgical microscope

Critical Evidence(s) Required

The candidate must present evidence of practical observations showing their ability to maintain safety at site. The observation measures include.

- Prepare specimen for metallography
- Demonstrate the working of metallurgical microscope

Tools & Equipment

- Specimen Cut off Machine & Accessories
- Specimen Mounting Press & Accessories
- Belt Grinder,
- Polishing Stand,
- Disc Polishing Machine,
- Drier,
- Emery Papers (120, 220, 400, 600, 800 Grit)
- Polishing Cloth
- Etchant (2% Nital).
- Safety Equipment
- Metallurgical Microscope & Accessories
- Metallic Specimen
- Tissue for cleansing

0715-MF&P 65. Perform Handheld XRF Analysis

Overview: This competency standard covers the skills and knowledge required to Prepare the Sample, Perform Calibration and standardization and Perform the Test

Competency Units	Performance Criteria
CU1. Prepare the Sample	**P1.** Clean the surface of sample with emery paper to remove rust **P2.** Make the surface of sample smooth and flat **P3.** Resin the sample with water **P4.** Clean with alcohol
CU2. Perform Calibration and standardization	**P1.** Charge the external battery **P2.** Energize the XRF gun **P3.** Open the analytical software of the XRF gun **P4.** Clean calibration block with alcohol **P5.** Apply the lubricant on the calibration block **P6.** Place XRF gun on calibration block **P7.** Press the XRF gun trigger to start calibration **P8.** Record and compare the results with calibration certificate
CU3. Perform the Test on XRF machine	**P1.** Charge the extra batteries of gun **P2.** Energized the XRF gun **P3.** Open the analytical software of the XRF gun **P4.** Apply the lubricant on the sample surface **P5.** Place the XRF gun on the sample surface **P6.** Press the XRF gun trigger to start analysis **P7.** Evaluate and Record the results **P8.** Print the results **P9.** Shut down the software **P10.** Store the XRF gun at designated station after the test

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

K1. Define spectrum.
K2. Describe the different parts of electromagnetic radiation spectrum.
K3. Describe principle of X rays production.
K4. Describe the properties of X rays.
K5. Describe Calibration.
K6. Describe Importance of calibration.
K7. Describe different standards of steel grades

K8. Describe the principle of XRF analysis.
K9. Describe different parts of XRF gun.

Critical Evidence(s) Required

The candidate must present evidence of practical observations showing their ability to maintain safety at site. The observation measures include.

- Prepare the Sample for XRF
- Perform Calibration and standardization for XRF
- Perform the XRF Test

Tool and Equipment

- Emery paper
- Distilled water
- Alcohol
- XRF Gun software
- XRF Gun and accessories
- Lubricants
- PPEs

0715-MF&P 66. Perform optical emission spectroscopic analysis

Overview: This competency standard covers the skills and knowledge required to prepare the sample, Perform calibration and standardization and to Perform Optical Emission test.

Competency Units	Performance Criteria

CU1. Prepare the Sample of emission spectroscopy	**P1.** Cut the sample as per standard **P2.** Clean the surface of sample with emery paper to remove rust **P3.** Make the surface of sample smooth and flat **P4.** Resin the sample with water **P5.** Clean with alcohol and dry.
CU2. Perform Calibration and standardization	**P1.** Energize the Optical Emission Spectrometer as per standard **P2.** Set the pressure of inert gas (Argon) **P3.** Switch ON the filter machine **P4.** Power ON the computer and open analytical software **P5.** Clean the electrode chamber with metal wire brush **P6.** Place the calibration block in electrode chamber **P7.** Clamp the calibration block **P8.** Start the spark for specific time **P9.** Record and compare the results with calibration certificate **P10.** Remove the calibration block and place at designated place
CU3. Perform the Test	**P1.** Ensure the pressure of gas (Argon) **P2.** Ensure the working of filter machine **P3.** Open the analytical software **P4.** Clean the electrode chamber with metal wire brush **P5.** Place the sample in electrode chamber **P6.** Clamp the sample as per SOPs **P7.** Ignite the spark for specific time **P8.** Record and evaluate the results **P9.** Perform printout of the results **P10.** Shut down the software **P11.** Switch off the filter machine **P12.** Remove the sample and store as per requirements

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

K1. Define spark.
K2. Define ionization.
K3. Describe ionization of gases.
K4. Describe the properties of inert gases.
K5. Describe purpose of optical spectrometry.
K6. Describe different parts of optical emission spectrometer.
K7. Describe the working principle of optical emission spectrometer.

Critical Evidence(s) Required

The candidate must present evidence of practical observations showing their ability to maintain safety at site. The observation measures include.

- Prepare the Sample for optical emission spectroscopic
- Perform Calibration and standardization for optical emission spectroscopic
- Perform the optical emission spectroscopic Test

Tools and Equipment

- Cutting machine
- Emery paper
- Distilled water
- Alcohol
- Optical Emission Spectrometer software
- Optical Emission Spectrometer and accessories
- Argon Gas cylinders
- Lubricants
- PPEs

0715-MF&P 67. Perform Non-Destructive Testing

Overview: This competency standard covers the skills and knowledge required to Determine the surface defects of specimen using dye penetrant technique, Determine the defects of given specimen using magnetic particle testing technique, Determine the defects of metallic specimen using eddy current testing technique, Determine the

defects of specimen using ultrasonic technique and Determine the defects of given specimen by using radiographic testing technique

Competency Units	Performance Criteria
CU1. Determine the surface defects of specimen using dye penetrant technique	**P1.** Perform pre-cleaning of samples **P2.** Apply dye penetrant on the specimen **P3.** Remove the excess dye penetrant **P4.** Apply the developer on the specimen **P5.** Inspect the specimen for defects **P6.** Interpret the results **P7.** Record the results
CU2. Determine the defects of given specimen using magnetic particle testing technique	**P1.** Perform pre-cleaning of given ferromagnetic samples. **P2.** Select the working mode of the equipment **P3.** Apply magnetic field to the specimen **P4.** Apply ferromagnetic medium with respect to type of test (Dry or Wet) **P5.** Remove the excess ferromagnetic medium. **P6.** Interpret the indications. **P7.** Evaluate the results.
CU3. Determine the defects of metallic specimen using eddy current testing technique	**P1.** Perform pre-cleaning of given metallic samples. **P2.** Select the working mode of the equipment **P3.** Place the specimen on insulator table **P4.** Test the specimen as per SOPs **P5.** Note the values of resultant current of the coil **P6.** Interpret and record the results
CU4. Determine the defects of specimen using ultrasonic technique	**P1.** Perform pre-cleaning of given samples. **P2.** Select the working mode of the equipment **P3.** Switch ON the ultrasonic testing equipment **P4.** Calibrate the ultrasonic equipment with respect to calibration block **P5.** Select the probe according to the specimen **P6.** Apply couplant gel on the given specimen **P7.** Test the given specimen as per SOPs **P8.** Record the graph peaks on the display **P9.** Interpret the graph peaks

	P10.	Record the results
CU5. Determine the defects of given specimen by using radiographic testing technique	**P1.**	Perform pre-cleaning of given metallic samples.
	P2.	Select the working mode of the radiographic equipment
	P3.	Inspect all safety facilities as per standard
	P4.	Set the position of photographic film
	P5.	Place the specimen at specific position in front of photographic film
	P6.	Pass the rays through the specimen
	P7.	Develop the photographic film
	P8.	Inspect the image of specimen
	P9.	Record the results

Knowledge & Understanding

K1. Define Non-destructive test.
K2. Describe different types of defects of engineering materials.
K3. Describe procedure of dye penetrant technique.
K4. Describe limitations of dye penetrant test.
K5. Enlist applications of dye penetrant test.
K6. Describe the test procedure of ultrasonic testing.
K7. Enlist applications of ultrasonic testing.
K8. Describe test procedure of magnetic particle test.
K9. Enlist applications of magnetic particle test.
K10. Enlist limitations of magnetic particle test.
K11. Describe test procedure of eddy current inspection.
K12. Describe applications of eddy current inspection.
K13. Describe test procedure of radiography.
K14. Describe applications of radiography.

Critical Evidence(s) Required

The candidate must present evidence of practical observations showing their ability to maintain safety at site. The observation measures include.

- Determine the surface defects of specimen using dye penetrant technique
- Determine the defects of given specimen using magnetic particle testing technique
- Determine the defects of metallic specimen using eddy current testing technique
- Determine the defects of specimen using ultrasonic technique

- Determine the defects of given specimen by using radiographic testing technique

Tool and Equipment

- dye penetrant & Accessories
- eddy current & Accessories
- magnetic particle& Accessories
- ultrasonic& Accessories
- radiographic & Accessories
- Relevant Testing Apparatus
- Relevant PPEs
- Relevant instruments

6. *Coating Supervisor*

0715-MF&P 68. Perform Galvanizing Coating

Overview: This competency standard covers the skills and knowledge required to Perform cataloging, Perform Cleaning Operation, Perform Drying Operation, Perform Galvanize coating Operation and Perform quenching Operation.

Competency Units	Performance Criteria
CU1. Perform cataloging	**P1.** Perform documentation of the initial conditions of Specimen and recognize its identity. **P2.** Adopt standard safety practice and procedure for handling. **P3.** Prepare job layout according to process requirements
CU2. Perform Cleaning Operation	**P1.** Carry out cleaning process as per standard requirement. **P2.** Perform standard safety practice and procedure for chemical handling. **P3.** Select the specimen side/face for coating **P4.** Prepare caustic cleaning solution for treatment with a hot alkali solution to remove dirt and oil. **P5.** Place specimen in the solution for standard time then remove and rinsing with water. **P6.** Prepare pickling cleaning solution where the surface rust and scales are removed by using a hydrochloric acid solution. **P7.** Place specimen in the solution for specific time then remove and rinsing with water. **P8.** Prepare flux solution where the surface oxides are removed and protected from further oxidation risks. **P9.** Place specimen in the solution for specific time. **P10.** Remove the specimen from bath and ready for next step.
CU3. Perform Drying Operation	**P1.** Place the specimen on the drying holders or fixtures. **P2.** Arrange specimen in sequence with all safety factors **P3.** Use hot air blower for drying the specimen.
CU4. Perform Galvanize coating	**P1.** Identify galvanizing material specifications (Zn or Al %) according to standard and type of galvanizing coating on specimen.

Operation	**P2.** Follow standard safety practice and procedure for handling process. **P3.** Prepare molten metal bath to react specimen surface with molten material. **P4.** Place specimen in the bath for given time **P5.** Remove specimen from bath and detract the excess coating material through pressurized air
CU5. Perform quenching Operation	**P1.** Identify quenching material specifications according to standard and type of galvanizing coating on specimen. **P2.** Follow standard safety practice and procedure for handling process. **P3.** Prepare mild sodium dichromate solution in the bath to prevent the onset of wet storage staining during the early life of galvanizing. **P4.** Place specimen in the bath for given time then remove.

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

K1. Define purpose of galvanizing.
K2. Describe safety symbols for acid chemical.
K3. Explain drying and quenching techniques
K4. Define General coating thickness ranges
K5. Define cleaning types.
K6. Define galvanizing materials.
K7. Explain galvanizing time and temperatures.
K8. Define galvanizing of metals specimen.
K9. Explain cleaning steps.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Perform cataloging
- Perform Cleaning Operation
- Perform Drying Operation

- Perform Galvanize Coating Operation
- Perform quenching Operation

Tools and Equipment

- Drying tools & equipment
- Galvanizing tools & equipment
- Cleaning tools & equipment
- Baths & equipment
- Measuring devices
- Hand held calculator
- Chemical & Glass wares

0715-MF&P 69. Perform Conversion Coating (Anodizing)

Overview: This competency standard covers the skills and knowledge required to Perform cataloging, Perform Cleaning Operation, Perform Solution Preparation, Set up Coating bath, Perform Coating Operation and Perform Drying Operation

Competency Units	Performance Criteria
CU1. Perform cataloging	**P1.** Perform documentation of the initial conditions of Specimen and recognize its identity. **P2.** Follow standard safety practice and procedure for handling. **P3.** Prepare job layout according to process requirements
CU2. Perform Cleaning Operation	**P1.** Identify the cleaning process as per requirement of standards. **P2.** Follow standard safety practice and procedure for chemical handling. **P3.** Select the specimen side or face, which will be coating. **P4.** Prepare degreasing cleaning solution where steel is treated with spirit solution which removes common dirt and oils. **P5.** Place specimen in the solution for specific time then remove and rinsing with water. **P6.** Prepare chemical cleaning solution where the surface rust and scales are removed by using alkaline solution. **P7.** Place specimen in the solution for specific time then remove and rinsing with water. **P8.** Prepare nitric acid solution where the surface oxides are removed. **P9.** Place specimen in the solution for specific time. **P10.** Remove the specimen from bath and ready for next step.
CU3. Perform Solution Preparation	**P1.** Take glass beaker or polythene tank. **P2.** Follow standard safety practice and procedure for handling chemical process. **P3.** Filled half with distil or deionized water. **P4.** Add acid solution slowly and stir it.
CU4. Set up Coating bath	**P1.** Add prepared solution in the bath. **P2.** Follow standard safety practice and procedure for handling process.

	P3. Place the lead sheets or plates on the opposite sides of bath. (Act as cathodes) **P4.** Connect the both lead plates to electric supply. **P5.** Place Ti rod or wood coiled with Al wire in the middle of bath. (Act as Anode) **P6.** Connect the bar to electric supply. **P7.** Arrange them in sequence and order that they don't touch each other. **P8.** Hang the specimen with wire to anode.
CU5. Perform Coating Operation	**P1.** Identify anodizing specifications. **P2.** Follow standard safety practice and procedure for handling process. **P3.** Switch on rectifier and adjust required current density. **P4.** Allow coating deposition for specific time. **P5.** Agitate the bath with air bubbles system. **P6.** Bath temperature should be maintained at standard temperature **P7.** Switch off rectifier and remove specimen.
CU6. Perform Drying Operation	**P1.** Place specimen in the drying oven. **P2.** Set temperature the switch on oven. **P3.** Remove specimen after specific time for drying.

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes the knowledge of:

K1. Define purpose of anodizing.
K2. Describe safety symbols for acid chemical.
K3. Explain drying techniques
K4. Define General coating thickness ranges
K5. Define cleaning types.
K6. Define anodizing materials.
K7. Explain anodizing time and temperatures.
K8. Explain cleaning steps.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in this competency standard:

- Perform cataloging
- Perform Cleaning Operation
- Perform Solution Preparation
- Set up Coating bath
- Perform Anodizing Coating Operation
- Perform Drying Operation

Tools and Equipment

- Drying tools & equipment
- Anodizing tools & equipment
- Cleaning tools & equipment
- Baths & equipment
- Measuring devices
- Hand held calculator
- Chemical & Glass wares

7. *Entrepreneurial Skills*

0715-MF&P 70. Develop Project Proposal

Overview: This Competency Standard identifies the competencies required to develop entrepreneurial skills by Hotel manager, in accordance with the organization's approved guidelines and procedures. You will be expected to develop a business plan, collect information regarding revenue generation, develop a marketing plan and develop basic business communication skills. Your underpinning knowledge regarding entrepreneurial skills will be sufficient to provide you the basis for your work.

Competency Unit	Performance Criteria
CU1. Develop a business plan	P1. Conduct a market survey to collect following information • Business Model • Financials • Equipment Estimation • Revenue Generation Sources • Marketing strategy • Market Trends • Overall Expenses P2. Select the best option in terms of cost, service, quality, sales, operational expenses P3. Compile the information collected through the market survey, in the business plan format
CU2. Develop a marketing plan	P1. Make a marketing plan for the service products, price, placement, promotion, people, packaging and positioning P2. Incorporate the information of marketing plan in the business plan
CU3. Develop basic business communication skills	P1. Communicate with guests using effective communication skills P2. Use different modes of communication to communicate effectively e.g.: presentation, speaking, writing, listening, visual representation, reading etc. P3. Use specific business terms used in the market

Knowledge & Understanding

K1. The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes:
K2. 7Ps of marketing including product, price, placement, promotion, people, packaging and positioning
K3. 7Cs of business communication
K4. Different modes of communication and their application in the industry
K5. Specific business terms used in the industry
K6. Available funding sources
K7. Low interest loans to start a new business
K8. Market survey and its tools e.g. : questionnaire, interview, observation etc,.
K9. Market trends for specific product offering
K10. State the main elements of business plan
K11. Business plan format

Critical Evidence(s) Required

The candidate needs to produce following Critical Evidence(s) in order to be competent in this competency standard:

- List 7Ps of marketing
- List 7Cs of business communication

0715-MF&P 71. Develop project management plan

Overview: This unit describes the skills and knowledge to develop a plan for a hotel management plan, including assessing project requirements and planning for all stages to completion and final documentation.

Competency Unit		Performance Criteria
CU1.	Prepare project management plan	P1. Evaluate and assess project brief and related documents P2. Produce document on project tasks and associated timelines, including installation processes and test requirements P3. Assess and produce document on resource requirements to assist allocation of appropriate resources P4. Produce training plan assessing training needs and associated timelines for efficient project implementation P5. Determine and document budgetary requirements P6. Discuss roles of all stake holders associated with project to ensure their involvement P7. Prepare project verification document, including monitoring and control processes, and review processes such as quality audits P8. Consult with all stake holders prior to finalizing draft plan and make changes as appropriate
CU2.	Develop monitoring and evaluation plan	P1. Produce preliminary plan for consultation, including identified factors that may impact on realization of project and observance of relevant legislation, codes, regulation and standards P2. Consult with client and clarify any amendments P3. Develop final plan with recommendations
CU3.	Communicate project plan	P1. Produce and document final plan to include implementation details and training needs P2. Present plan to client and obtain sign off
CU4.	Contribute to assessing effectiveness of communication	P1. Assist in ongoing review of project outcomes to determine effectiveness of communications-management activities P2. Report communications-management issues and responses to higher project authorities for application of lessons learned to future projects

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes:

- **K1.** Understanding of project plan
- **K2.** Know about the project tasks to be covered, along with the allocated time line
- **K3.** Assessment techniques of resources for their appropriate allocation to the project
- **K4.** Understanding of Training needs assessment(TNA) procedure for conduct of training
- **K5.** Understanding of Training plan development
- **K6.** Knowledge of all the stakeholders related to the project
- **K7.** Monitoring, control and review skills required to produce project verification document
- **K8.** Project Presentation skills to get input from all the parties prior to finalizing the draft plan of the project document
- **K9.** Understanding of client satisfaction techniques
- **K10.** Understanding of project outcomes
- **K11.** Evaluation techniques of project outcomes to determine effectiveness of communications-management activities
- **K12.** Report writing techniques to pin point the issues and responses to higher project authorities for application of lessons learned to future project

Critical Evidence(s) Required

The candidate needs to produce following Critical Evidence(s) in order to be competent in this competency standard:

- Produce training plan assessing training needs and associated timelines for efficient project implementation
- Determine and document budgetary requirements
- Produce project verification document, including monitoring and control processes, and review processes such as quality audits
- Produce and document final plan to include implementation details and training needs

0715-MF&P 72. Develop sales plan

Overview: This unit describes the skills and knowledge required to develop a sales plan for a product or service for a team covering a specified sales territory based on strategic objectives and in accordance with established performance targets. It applies to individuals working in a supervisory or managerial sales role who develop a sales plan for a product or service.

Competency Unit	Performance Criteria
CU1. Identify organizational strategic direction	P1. Obtain and analyze assessment of market needs and strategic planning documents P2. Review previous sales performance and successful approaches to identify factors affecting performance P3. Analyze information on market needs, new opportunities, customer profiles and requirements as a basis for decision making P4. Carry out competitor analysis for rate structure
CU2. Establish performance targets	P1. Determine practical and achievable sales targets P2. Establish realistic timelines for achieving targets P3. Determine measures to allow for monitoring of performance P4 .Ensure objectives of the sales plan and style of the campaign are consistent with organizational strategic objectives and corporate image
CU3. Develop a sales plan for a product	P1. Determine approaches to be used to meet sales objectives P2. Identify additional expertise requirements and allocate budgetary resources accordingly P3. Identify risks and develop risk controls P4. Develop advertising and promotional strategy for product P5. Identify appropriate distribution channels for product P6. Prepare a budget for the sales plan P7. Present documented sales plan to appropriate personnel for approval
CU4. Identify support requirements	P1. Identify and acquire staff resources to implement sales plan P2. Develop an appropriate selling approach P3. Train staff in the selling approach selected P4. Develop and assess staff knowledge of product to be

	sold
CU5. Monitor and review sales plan	P1. Monitor implementation of the sales plan P2. Record data measuring performance versus sales targets P3. Make adjustments to sales plan as required to ensure required results are obtained

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes:

- **K1.** Outline principles and techniques for selling
- **K2.** Outline methods for monitoring sales outcomes
- **K3.** Statistical techniques for analyzing sales and market trends
- **K4.** Internal and external sources of information that are relevant to identifying organizational strategic direction and developing a product sales plan.
- **K5.** Competitors intelligence

Critical Evidence(s) Required

The candidate needs to produce following Critical Evidence(s) in order to be competent in this competency standard:

- Identify the risks of the product i.e., sale/deployments
- Produce a sales plan for the product
- Demonstrate marketing and selling approach
- Demonstrate advertising and promotional strategy for product

0715-MF&P 73. Conduct research for customer needs and satisfaction

Overview: This unit describes the skills and knowledge required to manage an ongoing relationship with a customer over a period of time. This includes helping customers articulate their needs and managing networks to ensure customer needs are addressed. It applies to individuals who are expected to have detailed product knowledge in order to recommend customized solutions. In this role, individuals would be expected to apply organizational procedures and be aware of, and apply as appropriate, broader factors involving ethics, industry practice and relevant government policies and regulations.

Competency Unit	Performance Criteria
CU1. Assist customer to articulate needs	P1. Ensure customer needs are fully explored, understood and agreed P2. Explain and match available services and products to customer needs P3. Identify and communicate rights and responsibilities of customers to the customer as appropriate
CU2. Satisfy complex customer needs	P1. Explain possibilities for meeting customer needs P2. Assist customers to evaluate service and/or product options to satisfy their needs P3. Determine and prioritize preferred actions P4. Identify potential areas of difficulty in customer service delivery and take appropriate actions in a positive manner
CU3. Manage networks to ensure customer needs are addressed	P1. Establish effective regular communication with customers P2. Establish, maintain and expand relevant networks to ensure appropriate referral of customers to products and services from within and outside the organization P3. Ensure procedures are in place to ensure that decisions about targeting of customer services are based on up-to-date information about the customer and the products and services available P4. Ensure procedures are put in place to ensure that referrals are based on the matching of the assessment of customer needs and availability of products and services P5.Maintain records of customer interaction in accordance with organizational procedures

CU4. Convert customer enquiries into sales	P1. Use information provided by customers or accessed from the customer relationship management (CRM) system to identify any needs P2. Identify suitable products/services to meet needs P3. Make convincing sales pitches to customers following standard scripts P4. Handle customer queries, objections and rebuttals following standard scripts P5. Adapt your approach and style to customer preferences, within the limits of your competence and authority P6. Refer issues outside your area of competence and authority to appropriate people, following your organization's procedures P7. Identify and act on opportunities to up-sell or cross-sell other products/services to customers P8. Confirm customer wishes and needs in order to close sales P9. Obtain required financial information from customers, following your organization's procedures P10.Complete your organization's post-sales procedures in order to complete/ fulfill sales P11. Comply with relevant standards, policies, procedures and guidelines when converting customer enquiries into sales

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes:

- **K1.** Organizational procedures and standards for establishing and maintaining customer service relationships
- **K2.** Consumer rights and responsibilities
- **K3.** Ways to establish effective regular communication with customers
- **K4.** Outline details of products or services including with reference to:
- **K5.** possible alternative products and services
- **K6.** Variations within a limited product and service range

Critical Evidence(s) Required

The candidate needs to produce following Critical Evidence(s) in order to be competent in this competency standard:

- Gather customer needs and requirements
- Analyse customer needs and requirements
- Enlist communication rights and responsibilities of customers
- Handle customer relationship management (CRM) model to identify suitable products/services to meet customer needs.