



National Competency Standards
“Metal Forming & Processing Senior Technician” Level 04



National Competency Standards for
“Metal Forming & Processing Senior Technician”
Level 04



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



ACKNOWLEDGEMENTS

National Vocational and Technical Training Commission (NAVTTTC) 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.

NAVTTTC 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. NAVTTTC 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, NAVTTTC 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. NAVTTTC will ensure to keep the qualifications abreast with the changing demands of both national and international job markets.

Engr. Sajid Baloch
Executive Director (NAVTTTC)



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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.



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



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	Metal Forming & Processing Senior Technician
0715-MF&P-4	5 th 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



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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



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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.	Soft Skills	CS 32 Manage the meetings	4	Generic	6	12	18	1.8
		CS 33 Manage workforce planning	4	Generic	6	12	18	1.8
		CS 34 Undertake project work	4	Generic	6	12	18	1.8
		CS 35 Identify and communicate trends in career development	4	Generic	3	12	15	1.5
		CS 36 Apply interpersonal skills	4	Generic	3	12	15	1.5
		CS 37 Work safely in an office environment	4	Generic	3	12	15	1.5
		CS 38 Maintain professionalism in	4	Generic	3	12	15	1.5



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		workplace						
2.	Machining Sr. Technician	CS 39 Perform Lathe Machine and Shaper Operations	4	Technical	9	48	57	5.7
		CS 40 Perform Milling and Hobbing Operations	4	Technical	12	51	63	6.3
3.	Welding Sr. Technician	CS 41 Perform Shielded Metal Arc Welding (SMAW)	4	Technical	10	66	76	7.6
		CS 42 Perform Submerged Arc Welding (SAW)	4	Technical	10	48	58	5.8
4.	Metal Casting Sr. Technician	CS 43 Perform Metal Die Casting Operations	4	Technical	6	96	102	10.2
		CS 44 Perform Centrifugal Casting Process	4	Technical	6	45	51	5.1
		CS 45 Perform Shell Mold Casting	4	Technical	6	51	57	5.7
		CS 46 Perform Investment Casting	4	Technical	8	60	68	6.8
5.	Metal Forming Sr. Technician	CS 47 Perform Die Forging Process	4	Technical	6	51	57	5.7
		CS 48 Perform Hydrostatic Extrusion Process	4	Technical	12	96	108	10.8
		CS 49 Perform Wire Drawing Process	4	Technical	12	51	63	6.3
6.	Heat Treatment Technician	CS 50 Perform Heat Treatment of Ferrous Materials	4	Technical	10	48	58	5.8
		CS 51 Perform Heat Treatment of Non-Ferrous Materials	4	Technical	10	36	46	4.6
7.	Destructive Testing Technician	CS 52 Carryout Hardness Testing	4	Technical	10	42	52	5.2
		CS 53 Carryout Impact Testing	4	Technical	10	36	46	4.6
		CS 54 Perform Mechanical Testing on Universal Testing Machine	4	Technical	10	60	70	7
		CS 55 Perform Torsion Test and Fatigue test	4	Technical	9	45	54	5.4



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	Total	186	1014	1200	120
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11. Occupations of Qualification

Level 02	Level 03	Level 04	Level 05
<ul style="list-style-type: none">• Health and Safety Officer• Drawing Assistant• Machining Assistant• Welding Assistant• Metal forming Assistant• Maintenance Assistant	<ul style="list-style-type: none">• Computer Operator• Draughtsman• Machining Technician• Welding Technician• Metal Casting Technician• Metal Forming Technician	<ul style="list-style-type: none">• Soft Skills• Machining Sr. Technician• Welding Sr. Technician• Metal Casting Sr. Technician• Metal Forming Sr. Technician• Heat Treatment Technician• Destructive Testing Technician	<ul style="list-style-type: none">• Machining Supervisor• Welding Supervisor• Metal Processing Supervisor• Metal Forming Supervisor• Quality Testing Inspector• Coating Supervisor• Entrepreneurial skills



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Sr. No	Occupation	Duties/CS
Level-4 Metal Forming & Processing Senior Technician		
1.	Soft Skills	CS 32 Manage the meetings CS 33 Manage workforce planning CS 34 Undertake project work CS 35 Identify and communicate trends in career development CS 36 Apply interpersonal skills CS 37 Work safely in an office environment CS 38 Maintain professionalism in workplace
2.	Machining Sr. Technician	CS 39 Perform Lathe Machine and Shaper Operations CS 40 Perform Milling and Hobbing Operations
3.	Welding Sr. Technician	CS 41 Perform Shielded Metal Arc Welding (SMAW) CS 42 Perform Submerged Arc Welding (SAW)
4.	Metal Casting Sr. Technician	CS 43 Perform Metal Die Casting Operations CS 44 Perform Centrifugal Casting Process CS 45 Perform Shell Mold Casting CS 46 Perform Investment Casting
5.	Metal Forming Sr. Technician	CS 47 Perform Die Forging Process CS 48 Perform Hydrostatic Extrusion Process CS 49 Perform Wire Drawing Process
6.	Heat Treatment Technician	CS 50 Perform Heat Treatment of Ferrous Materials CS 51 Perform Heat Treatment of Non-Ferrous Materials
7.	Destructive Testing Technician	CS 52 Carryout Hardness Testing CS 53 Carryout Impact Testing CS 54 Perform Mechanical Testing on Universal Testing Machine CS 55 Perform Torsion Test and Fatigue test

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
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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 04 - Metal Forming & Processing Senior Technician

1. Soft Skills

0715-MF&P 32. Manage the meetings

Overview: This unit describes the skills and knowledge required to manage a range of meetings including overseeing the meeting preparation processes, chairing meetings, organizing the minutes and reporting meeting outcomes.

Competency Unit	Performance Criteria
CU1. Prepare for meetings	<p>P1. Develop an agenda in line with the stated meeting purpose</p> <p>P2. Ensure the style and structure of the meeting are appropriate to its purpose</p> <p>P3. Identify meeting participants and notify them in accordance with organizational procedures</p> <p>P4. Confirm meeting arrangements in accordance with the requirements of meeting</p> <p>P5. Dispatch meeting working papers to participants within designated timelines</p>
CU2. Conduct meetings	<p>P1. Conduct meetings in accordance with organizational requirements, agreed conventions for type of meeting and legal and ethical requirements</p> <p>P2. Conduct meetings to ensure they are focused, time efficient and achieve the required outcomes</p> <p>P3. Ensure meeting facilitation enables participation, discussion, problem-solving and resolution of issues</p> <p>P4: Record minutes of meeting in accordance with organizational requirements.</p> <p>P4.Brief other minute-taker on method for recording meeting minutes in accordance with organizational requirements and conventions for type of meeting</p>
CU3. Follow up meetings	<p>P1. Check transcribed meeting notes to ensure they reflect a true and accurate record of the meeting and are formatted in accordance with organizational procedures and meeting conventions</p> <p>P2. Distribute and store minutes and other follow-up documentation within designated timelines, and according to organizational requirements</p> <p>P3.Report outcomes of meetings as required, within designated timelines</p>



Knowledge & Understanding

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

- K1.** Outline meeting terminology, structures, arrangements
- K2.** Outline responsibilities of the chairperson and explain group dynamics in relation to managing meetings
- K3.** Describe options for meetings including In-person/physical, teleconferencing, web-conferencing and using webcams
- K4.** Identify the relevant organizational procedures and policies regarding meetings, chairing and minutes including identifying organizational formats for minutes and agendas.

Critical Evidence(s) Required

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

A candidate who demonstrates competency in this unit must be able to provide evidence of the ability to manage meetings. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments. Demonstrated evidence is required of the ability to:

- Apply conventions and procedures for formal and informal meetings including:
- Developing and distributing agendas and working papers
- Identifying and inviting relevant meeting participants
- organizing and confirming meeting arrangements
- running the meeting and following up
 - organize, take part in and chair a meeting
 - record and store meeting documentation
 - Follow organizational policies and procedures



0715-MF&P 33. Manage workforce planning

Overview: This unit describes the skills and knowledge required to manage planning in relation to an organization's workforce including researching requirements, developing objectives and strategies, implementing initiatives and monitoring and evaluating trends.

Competency Unit	Performance Criteria
CU1. Identify workforce	P1. Review current data on staff turnover and demographics P2. Assess factors that may affect workforce supply P3. Develop organization's requirement for skilled workforce
CU2. Develop workforce objectives and strategies	P1. Review organizational strategy and establish aligned objectives for modification P2. Prepare strategies to address unacceptable staff turnover, if required P3. Develop objectives to retain required skilled labor P4. Develop objectives for workforce diversity and cross-cultural management P5. Set targets as per organizational requirement P6. Develop contingency plans to cope with extreme situations
CU3. Implement initiatives to support workforce planning objectives	P1. Implement action to support agreed objectives for recruitment, training, redeployment and redundancy P2. Develop and implement strategies to assist workforce to deal with organizational dynamics P3. Implement succession planning model to ensure desirable workers are developed and retained P4. Implement programs to ensure workplace is an employer of choice
CU4. Monitor and evaluate workforce trends	P1. Evaluate workforce plan against patterns in exiting employee and workforce changes P2. Monitor labor supply trends for areas of high turnover in external environment P3. Monitor effects of labor trends on demand for labor P4. Survey organizational climate to gauge worker satisfaction P5. Refine objectives and strategies in response to national and international changes and make recommendations in response to global trends. P6. Regularly review government policy on labor jobs according to labor rights. P7. Evaluate effectiveness of change processes against



	agreed objectives
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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.** Explain current information about external labor supply relevant to the specific industry or skill requirements of the organization
- K2.** Outline industrial relations relevant to the specific industry
- K3.** Describe labor force analysis and forecasting skills

Critical Evidence(s) Required

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

- Review relevant trends and supply and demand factors that will impact on an organization's workforce
- Develop a workforce plan that includes relevant research and specific strategies to ensure access to a skilled and diverse workforce.



0715-MF&P 34. Undertake project work

Overview: This unit describes the skills and knowledge required to undertake a straightforward project or a section of a larger project. It covers developing a project plan, administering and monitoring the project, finalizing the project and reviewing the project to identify lessons learned for application to future projects. This unit applies to individuals who play a significant role in ensuring a project meets timelines, quality standards, budgetary limits and other requirements set for the project.

Competency Unit	Performance Criteria
CU1. Identify project	P1. Assess project scope and other relevant documentation P2. Identify project stakeholders P3. Seek clarification of discrepancies from delegating authority related to project and project parameters P4. Determine and access available resources to undertake project
CU2. Develop project plan	P1. Develop project feasibility report P2. Develop project plan in line with the project parameters P3. Develop and approve project budget P4. Formulate risk management plan for project, including Workplace Health and Safety (WHS)
CU3. Monitor project	P1. Ensure project team members are clear about their responsibilities and the project requirements P2. Ensure outcomes and documented time lines of the project are met P3. Maintain required recordkeeping systems throughout the project P4. Implement and monitor plans of project finances and resources P5. Prepare project progress reports as required to stakeholders P6. Monitor risk management as required to ensure project outcomes are met
CU4. Finalize the project	P1. Assess project scope and other relevant documentation P2. Identify project stakeholders P3. Seek clarification of discrepancies from delegating authority related to project and project parameters P4. Determine and access available resources to undertake project

Knowledge & Understanding



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

- K1.** Give examples of project management tools and how they contribute to a project
- K2.** Outline types of documents and other sources of information commonly used in defining the parameters of a project
 - a. Explain processes for identifying and managing risk in a project
 - b. Explain the organization's procedures and processes that are relevant to managing a project including:
 - i. lines of authority and approvals
 - ii. quality assurance
 - iii. human resources
 - iv. budgets and finance
 - v. recordkeeping
 - vi. reporting
- K3.** Outline the legislative and regulatory context of the organization in relation to project work, including workplace health and safety (WHS) requirements

Critical Evidence(s) Required

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

Use project management tools to develop and implement a project plan including:

- deliverables
- work breakdown
- budget and allocation of resources
- timelines
- risk management
- recordkeeping and reporting



0715-MF&P 35. Identify and communicate trends in career development

Overview: This unit describes the skills and knowledge required to conduct research to identify and communicate career trends.

Competency Unit	Performance Criteria
CU1. Research and explore career trends	<p>P1. Apply knowledge of changing organizational structures, lifespan of careers and methods of conducting work search, recruitment and selection processes</p> <p>P2. Analyze changing worker and employer issues, rights and responsibilities in context of changing work practices</p> <p>P3. Examine importance of quality careers development services</p> <p>P4. Maintain all research, documentation, sources and references (digital or physical).</p> <p>P5. Analyze implications of relevant policy, legislation, professional codes of practice and national standards relating to worker and employer issues</p> <p>P6. Confirm cluster employability skills and preferences that may open employment options in other career pathways</p>
CU2. Assess and confirm ongoing career development	<p>P1. Assess success of previous career development services</p> <p>P2. Maintain privacy and security of all data, research and personal records according to relevant policy</p> <p>P3. Establish existing work-life balance and friendly environment</p>
CU3. Maintain quality of career development services and professional practice	<p>P1. Analyze and review relevance of career theories, models, frameworks and SOPs</p> <p>P2. Incorporate into career development services and professional practice</p> <p>P3. Comply with all relevant policies</p>

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.** Diversity and its potential effects on career choices
- K2.** Outline human psychological development and needs in relation to career development
- K3.** Outline relevant policy, legislation, codes of practice and standards relevant to career development



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- K4.** Explain recruitment and selection processes in the context of career development services



0715-MF&P 36. Apply interpersonal skills

Overview: This unit describes the skills and knowledge required to use advanced and specialized communication skills in the client-counselor relationship.

Competency Unit	Performance Criteria
CU1. Communicate effectively	P1. Identify communication barriers and use strategies to overcome these barriers in the client-counselor relationship P2. Facilitate the client-counselor relationship through selection and use of micro skills P3. Observe and respond to non-verbal communication cues P4. Integrate case note taking with minimum distraction
CU2. Apply specialized counseling interviewing skills	P1. Select and use communication skills according to the sequence of a counseling interview P2. Identify points at which specialized counseling interviewing skills are appropriate for inclusion P3. Use specialized counseling communication techniques based on their impacts and potential to enhance client development and growth P4. Identify and respond appropriately to strong client emotional reactions
CU3. Evaluate own communication	P1. Reflect on and evaluate own communication with clients P2. Recognize the effect of own values and beliefs on communication with clients P3. Identify and respond to the need for development of own skills and knowledge

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.** Legal and ethical considerations for communication in counseling practice, and how these are applied in individual practice:
- codes of conduct/practice
 - discrimination
 - human rights
 - practitioner/client boundaries
 - privacy, confidentiality and disclosure
 - rights and responsibilities of workers, employers and clients
 - work role boundaries responsibilities and limitations of the counselor role
 - workplace health and safety



K2.Communication techniques and micro-skills including:

- a. attending behaviors active listening, reflection of content feeling, summarizing
- b. questioning skills open, closed, simple and compound questions
- c. client observation skills
- d. providing client feedback

K3.Components of the communication process including:

- a. encoder
- b. decoder

K4.Primary factors that impact on the communication process including:

- a. context
- b. participants
- c. rules
- d. messages
- e. channels
- f. noise
- g. feedback

K5.Communication barriers and resolution strategies, including:

- a. environmental
- b. physical
- c. individual perceptions
- d. cultural issues
- e. language
- f. age issues
- g. disability

K6.Observational techniques including:

- a. facial expressions
- b. non-verbal behavior
- c. posture
- d. silence

K7. Ways including:

- a. visual in which different people absorb information
- b. auditory
- c. kinesthetic

K8. Impacts of trauma and stress on the communication process, including:

- a. concentration and attention
- b. memory
- c. Intelligence
- d. use of verbal and written language
- e. use of body language
- f. challenging within the counseling session

K9.Self-evaluation practices, including:

- a. how to recognize own biases



0715-MF&P 37. Work safely in an office environment

Overview: This unit describes the performance outcomes, skills and knowledge required to participate in workplace occupational health and safety (OHS) processes to protect workers own health and safety, and that of others.

Competency Unit	Performance Criteria
CU1. Ensure safe work environment	P1. Follow established safety procedures when conducting work P2. Carry out pre-start systems and equipment checks in accordance with workplace procedures
CU2. Implement workplace safety requirements	P1. Identify designated persons for reporting queries and concerns about safety in the workplace P2. Identify existing and potential hazards in the workplace, report them to designated persons and record them in accordance with workplace procedures P3. Follow organizational SOP's P4. Report emergency incidents and injuries to designated persons P5. Maintain emergency contact list
CU3. Participate in OHS consultative processes	P1. Contribute to workplace meetings, inspections or other consultative activities P2. Raise OHS issues with designated persons in accordance with organizational procedures P3. Take actions to eliminate workplace hazards or to reduce risks
CU4. Follow safety procedures	P1. Identify and report emergency incidents P2. Follow organizational procedures for responding to emergency incidents P3. Check safety tools

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.** Explain responsibilities of employers and employees under relevant health and safety regulation
- K2.** Describe emergency procedures including procedures for fires, accidents and evacuation
- K3.** Outline commonly used hazard signs and safety symbols.



0715-MF&P 38. Maintain professionalism in workplace

Overview: This unit describes the skills and knowledge required to use advanced and specialized communication skills in the client-counselor relationship.

Competency Unit	Performance Criteria
CU1. Respect work timeframes	P1. Demonstrate punctuality in meeting, set working hours and times. P2. Utilize working hours only for working and follow company regulations. P3. Complete work tasks within deadlines according to order of priority P4. Perform extra ordinary during working hours
CU2. Maintain personal appearance and hygiene	P1. Clean hair, body and nails regularly. P2. Wear suitable cloths for the workplace, and respect local and cultural contexts P3. Meet specific company dress code requirements P4. Keep smiling and have positive body language during working hours
CU3. Maintain adequate distance with colleagues and clients	P1. Respect personal space of colleagues and clients with reference to local customs and cultural contexts. P2. Avoid cross transmission of infections (especially through respiration).
CU4. Work in an ethical manner	P1. Follow company values/ethics codes of ethics and/or conduct, policies and guidelines. P2. Use company resources in accordance with company ethical standards. P4. Undertake work practices in compliance with company ethical standards, organizational policy and guidelines. P5. Instruct co-workers on ethical, lawful and reasonable directives. P6. Share company values/practices with co-workers using appropriate behavior and language. P7. Report work incidents/situations and/or resolved in accordance with company protocol/guidelines.

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.** Application of good manners and right conduct
- K2.** Basic practices for oral and personal hygiene



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- K3.**Common products used for oral and personal hygiene
- K4.**Outline the company code of conduct/values
- K5.**Outline the Company regulations, performance and ethical standards
- K6.**Work responsibilities/job functions
- K7.**Communication skills
- K8.**Workplace hygiene standards



2. **Machining Senior Technician**

0715-MF&P 39. Perform Lathe Machine and Shaper Operations

Overview: This competency standard covers the skills and knowledge required to Perform centering operations, Perform facing Operations, Perform turning Operations, Perform drilling and boring operations, Perform step turning operations, Perform knurling Operations, Perform Internal and External threading Operations and make a Rack Gear on shaper machine

Competency Units	Performance Criteria
CU1. Perform centering operations on lathe machine	P1. Mount and set the required work-holding devices P2. Mount and set the required work piece P3. Mount and set the required cutting tools. P4. Select safe procedures and tools to accomplish the work. P5. Adjust the operating parameters (e.g. speed and feed) of machine tool for centering the job. P6. Follow all safety rules required for the machine.
CU2. Perform facing Operations	P1. Mount and set the required work-holding devices P2. Mount and set the required work piece. P3. Select facing tools according to job requirement. P4. Select safe procedures and tools to accomplish the work. P5. Adjust the operating parameters (e.g. speed and feed) of machine tool to achieve the work specification. P6. Follow all safety rules required for the machine.
CU3. Perform turning Operations	P1. Follow work specifications, drawings or sketches to accomplish the turning operation. P2. Set up and adjust the machine as per work specifications and procedures. P3. Inspect the components produced have the required quality and within the specified dimensional accuracy by turning operation. P4. Shut down the machine and equipment on conclusion of the machining activities.
CU4. Perform drilling and boring operations	P1. Maintain safe working condition at workplace. P2. Follow work specifications, drawings or sketches to accomplish the turning operation. P3. Mount and set the required work-holding devices P4. Mount and set the required work piece



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	<p>P5. Adjust the drill bit in the tail stock.</p> <p>P6. Adjust the RPM of machine according to the cutting speed.</p> <p>P7. Make the hole according to given drawing.</p> <p>P8. Perform the boring operation according to the drawing.</p> <p>P9. Check quality of the component produced at different intervals.</p>
CU5. Perform step turning operations	<p>P1. Follow work specifications, drawings or sketches to accomplish the turning operation.</p> <p>P2. Set up and adjust the machine as per work specifications and procedures.</p> <p>P3. Inspect the components produced have the required quality and within the specified dimensional accuracy by turning operation</p> <p>P4. Check quality of the component produced at different intervals.</p> <p>P5. Follow safety precautions to ensure safe work and to avoid any injury.</p>
CU6. Perform knurling Operations	<p>P1. Maintain safe working condition at workplace.</p> <p>P2. Select the knurling tool according to requirement.</p> <p>P3. Set the tool and work piece in the machine according to procedure.</p> <p>P4. Use right methods and techniques to produce proper knurling on work piece.</p> <p>P5. Select and adjust appropriate speeds and feeds of lathe machine.</p> <p>P6. Use coolants during knurling to achieve smooth impression on work piece.</p>
CU7. Perform Internal and External threading Operations	<p>P1. Mount and set the required work-holding devices</p> <p>P2. Mount and set the required work piece</p> <p>P3. Use Proper cutting tool to cut the threads with required dimensions.</p> <p>P4. Select and adjust appropriate speeds and feeds of turning machine.</p> <p>P5. Produce a component which matches the work specifications using appropriate methods and techniques.</p> <p>P6. Check quality of the component produced at different intervals.</p> <p>P7. Follow safety precautions to ensure safe work and to avoid any injury</p>



CU8. Perform Squaring of workpiece on shaper machine.	<p>P1. Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident.</p> <p>P2. Interpret the drawings as per job requirement</p> <p>P3. Install the machine vice according to job requirement.</p> <p>P4. Set cutting tool and set machine as per requirements.(feed, speed, depth of cut and length of stroke)</p> <p>P5. Mount cutting tool and work piece in the machine.</p> <p>P6. Perform Squaring operation</p> <p>P7. Check quality of the component at suitable intervals.</p> <p>P8. Shut down the machine at safe position after finishing the work.</p>
CU9. Perform Slotting on Shaper machine	<p>P1. Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident.</p> <p>P2. Interpret the drawings as per job requirement</p> <p>P3. Install the machine vice according to job requirement.</p> <p>P4. Set cutting tool and set machine as per requirements.(feed, speed, depth of cut and length of stroke)</p> <p>P5. Mount cutting tool and work piece on the machine.</p> <p>P6. Cut a slot on the work piece as per given drawing.</p> <p>P7. Check quality of the component at suitable intervals.</p> <p>P8. Shut down the machine at safe position after finishing the work.</p>

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.** Calculation of speed and feed.
- K2.** Safety precautions involved in work.
- K3.** Methods and techniques of mounting and setting of workpieces.
- K4.** Methods and techniques of adjusting operating parameters of machine tool.
- K5.** Procedure of adjusting speed and feed.
- K6.** Calculation of speed and feed.
- K7.** Use of cutting tool



- K8. Reading and interpreting work specifications, drawings and sketches.
- K9. Method and technique of setting up and adjusting the machine.
- K10. Techniques to check quality of component produced.
- K11. Procedure of shutting down of machine and equipment after closure of activities.
- K12. Safety precautions and procedures need to be observed during work.
- K13. Types of drilling or boring tools and their function.
- K14. Procedure of mounting and setting up of work-holding devices, work pieces and cutting tools.
- K15. Method and technique of adjusting RPM of lathe machine.
- K16. Safe boring procedures.
- K17. Calculation of RPM.
- K18. Types of knurling tools and Methods of knurling.
- K19. Knowledge of lathe operations
- K20. Use of dial indicator
- K21. Types of threading tool.
- K22. Types and methods of threading.
- K23. Procedure of setting tools and work piece in the machine.
- K24. Procedure of adjusting speeds and feeds of lathe machine.
- K25. Importance of using coolants during knurling.
- K26. Method of mounting of cutting tool
- K27. Checking of right angle with the tri square.
- K28. Explain square facing procedure.
- K29. Safety guidelines and procedures.
- K30. Safety checks for operating shaper machine.
- K31. Difference between shaper, planner and slotter
- K32. Types of shaper machines
- K33. Calculate Feed and speed of shaper machine
- K34. Use of Dial indicator
- K35. Rack and Pinion gears

Critical Evidence(s) Required

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

- Perform step turning operation on lathe machine.
- Perform drilling operation on lathe machine.
- Perform knurling operation on lathe machine.
- Cut internal and external threads on lathe machine.
- Carry out external keyways with shaper machine
- Carry out machining of irregular surfaces with shaper machine



Tools & Equipments

- Measuring Tools
- Cutting Tool
- Vernier Caliper
- Checking gauges
- Drill bits.
- Knurling Tool
- Lathe Machine and accessories
- Threading Tools
- Personal Protective Equipment
- Files
- Shaper/Planar/Slotter
- Machine Vice
- Tri square
- Vernier Calliper
- Dial indicator with magnet stand



0715-MF&P 40. Perform Milling and Hobbing Operations

Overview: This competency standard covers the skills and knowledge required to arrange Tools, Equipment and material for milling operation, prepare work piece for milling operation, perform setting of milling machine, carryout milling operations, arrange tools, equipment and material for hobbing to make the gear, set hobbing Machine for operations, and carry out hobbing operations to make gear.

Competency Units	Performance Criteria
CU1. Arrange Tools, Equipment and material for Milling Operation	P1. Identify tools, equipment and material for milling operation P2. Select the tool, equipment, material (type, shape and size of cutter) according to the job requirements P3. Arrange the measuring instruments and holding devices
CU2. Prepare work piece for milling operation	P1. Interpret drawing as per job requirement P2. Prepare the work-piece by required machining (sawing and filing etc.) P3. Check and verify the dimensions of blank for making gear as per drawing
CU3. Perform setting of milling machine	P1. Clamp the blank work-piece and tool into its holding devices as per SOPs P2. Maintain the safe distance between work-piece and cutter as per prescribed method P3. Adjust the revolution per minute(rpm) of spindle according to the specifications of work piece P4. Adjust parameters of speed and feed from control unit as per prescribed methods
CU4. Carryout Milling operations.	P1. Check the alignment of work piece P2. Locate the cutter at work piece as per standard practice P3. Start the milling operation as per drawing and job specifications P4. Verify the dimensions of work piece as per drawing
CU5. Arrange Tools, Equipment and material for hobbing to make the gear	P1. Identify tools, equipment and material for hobbing operation P2. Select the tool, equipment, material (type, shape and size of cutter) according to the job requirements P3. Arrange the measuring instruments and holding devices



CU6. Set Hobbing Machine for operations	<p>P1. Clamp the gear blank in their holding devices as per the standard practice</p> <p>P2. Attach the Hob cutter as per the standard practice</p> <p>P3. Maintain safe distance between gear blank and hob cutter as per prescribed method</p> <p>P4. Adjust the Revolution Per Minute (RPM) of hob cutter</p> <p>P5. Adjust feed from control unit as per prescribed method</p> <p>P6. Adjust the table according to the specifications of work piece</p>
CU7. Carry out Hobbing operations to make gear	<p>P1. Produce simple/angled/differential indexing and divide the gear into required number of divisions</p> <p>P2. Check the position of hob cutter and the gear blank and adjust them, if required</p> <p>P3. Operate Hobbing machine according to given specifications</p> <p>P4. Ensure the parameters of the gear as per requirement</p> <p>P5. Check and confirm the measurements with given specifications and finalize the gear</p>

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 Milling operation
- K2.** Conventional and climb milling
- K3.** Milling machine and its accessories
- K4.** Hobbing machine and its accessories
- K5.** Cutter holding devices
- K6.** Procedure of safe clamping the work-piece
- K7.** Importance and usage of coolant
- K8.** Use of measuring and marking tools
- K9.** Measurement systems
- K10.** Proper clamping and tool alignment
- K11.** Calculation and setting of feed, speed according to the work-piece and tool material
- K12.** Structure and functions of Hobbing Machine
- K13.** Accessories of Hobbing Machine and types of different tooling
- K14.** Use of gear cutters, marking tools, measuring instruments and gauges types of gears



- K15.** Types of materials used for making the gears
- K16.** Types of indexing such as single, angled and differential and techniques of producing indexing
- K17.** Interpreting drawings and specifications used for gear cutting
- K18.** Method of calculating machine speed, feed etc.
- K19.** Measurement techniques, mathematical calculations, indexing measurements etc.
- K20.** Use of various devices and attachments for holding the work-piece
- K21.** Method of setting the Hobbing Machine for gear making operations
- K22.** Method of positioning hob cutter and work-piece in the Hobbing Machine

Critical Evidence(s) Required

The candidate must present evidence of practical observations showing their ability to perform milling operations. The observation measures include.

- Perform setting of milling machine for making gear
- Perform setting of hobbing machine for making gear
- Operate milling machine to make gear
- Operate hobbing machine to make gear
- Perform sawing and filing operations

Tools & Equipment

- Hobbing machine and its accessories
- Universal milling machine with standard accessories
- Power hacksaw machine with blade
- Work bench and stools
- Machine vices, swivel vices
- Measuring and marking tools (assorted range)
- Hob cutter sets
- Lathe machine along with standard accessories
- Tooth vernier calliper
- Work holding devices
- Pedestal grinder with tools cutting angle support
- Files
- Coolants and lubrications oils
- Personal protective equipment
- First aid box
- Maintenance tool kit, general repairing tool kit and hands tool kit



3. **Welding Senior Technician**

0715-MF&P 41. Perform Shielded Metal Arc Welding (SMAW)

Overview: This Competency Standard is designed to Prepare Welding Machine and Accessories for SMAW, 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)], and perform Post Welding Operations.

Competency Units	Performance Criteria
CU1. Prepare Welding Machine and Accessories for SMAW	<p>P1. Identify welding requirements of the job, Welding Procedure Specifications (WPS) and/or technical drawings</p> <p>P2. Carry out the pre-cleaning of base metal as per requirement.</p> <p>P3. Prepare SMAW welding machine in accordance with WPS/ manufacturer instructions</p> <p>P4. Set-up welding machine accessories and consumables as per job requirements, WPS and/or manufacturer's instructions</p> <p>P5. Connect welding machine to an independent power supply</p> <p>P6. Perform baking of electrode in an Oven as per standard.</p> <p>P7. Set polarity indicated in the WPS</p>
CU2. Make Welds on Carbon Steel Plate Flat (1F) and Flat (1G)	<p>P1. Adjust welding parameters (current, voltage etc.) as per WPS/job requirements to produce acceptable weld by maintaining gap between electrode and base metal as per standard practices</p> <p>P2. Carry out pre-heating of the given job, if needed.</p> <p>P3. Carry out welding in Flat (1F) and Flat (1G) positions following standard procedures.</p> <p>P4. Carry out the cleaning of root pass as per requirement</p> <p>P5. Maintain distance between electrode and base metal as per standard practices.</p> <p>P6. Deposit root pass as per WPS/job requirements</p> <p>P7. Deposit filling passes as per WPS/job requirements</p> <p>P8. Deposit capping pass as per WPS/job requirements</p> <p>P9. Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects</p>
CU3. Make Welds on Carbon Steel Plate	<p>P1. Adjust welding parameters (current, voltage etc.) as per welding procedure specifications/job requirements to produce acceptable weld.</p> <p>P2. Carry out pre-heating of the given job, if needed.</p>



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Horizontal (2F) and Horizontal (2G)	<p>P3. Maintain distance between electrode and base metal as per standard practices.</p> <p>P4. Carry out welding in Horizontal (2F) and Horizontal (2G) positions following standard procedures</p> <p>P5. Deposit root pass as per welding procedure specifications/job requirements</p> <p>P6. Deposit filling passes as per welding procedure specifications/job requirements</p> <p>P7. Deposit capping pass as per welding procedure specifications/job requirements</p> <p>P8. Carry out the cleaning of passes as per requirement</p> <p>P9. Check root, filling and capping passes for any visual discontinuities as per acceptance standards</p> <p>P10. Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects</p>
<p>CU4. Make Welds on Carbon Steel Plate</p> <p>Vertical (3F) and Vertical (3G)</p>	<p>P1. Adjust welding parameters (current, voltage etc.) as per welding procedure specifications/job requirement to produce acceptable weld</p> <p>P2. Carry out pre-heating of the given job, if needed.</p> <p>P3. Maintain distance between electrode and base metal as per standard practices</p> <p>P4. Carry out welding in Vertical (3F) and Vertical (3G) positions following standard procedures</p> <p>P5. Deposit root pass as per welding procedure specifications/job requirements</p> <p>P6. Deposit filling passes as per welding procedure specifications/job requirements</p> <p>P7. Deposit capping pass as per welding procedure specifications/job requirements</p> <p>P8. Carry out the cleaning of passes as per requirement</p> <p>P9. Check root, filling and capping passes for any visual discontinuities as per acceptance standards</p> <p>P10. Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects</p>
<p>CU5. Make Welds on Carbon Steel Plate</p> <p>Overhead (4F) and Overhead (4G)</p>	<p>P1. Adjust welding parameters (current, voltage etc.) as per WPS/job requirements to produce acceptable weld</p> <p>P2. Carry out pre-heating of the given job, if needed.</p> <p>P3. Maintain distance between electrode and base metal as per standard practices</p> <p>P4. Carry out welding in Overhead (4F) and Overhead (4G) positions following standard procedures</p> <p>P5. Deposit root pass as per WPS/job requirements</p>



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	<p>P6. Deposit filling passes as per WPS/job requirements</p> <p>P7. Deposit capping pass as per WPS/job requirements</p> <p>P8. Carry out the cleaning of passes as per requirement</p> <p>P9. Check root, filling and capping passes for any visual discontinuities as per acceptance standards</p> <p>P10. Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects</p>
CU6. Perform Post Welding Operations	<p>P1. Carry out finishing work of welds following standard procedures</p> <p>P2. Inspect weld visually and mark any defects, if any</p> <p>P3. Carry out repair work in accordance with approved procedures, if required</p> <p>P4. Perform post weld heat treatment operation as per requirement.</p> <p>P5. Clean work area in accordance with workplace safety practices</p> <p>P6. Maintain tools/equipment/consumable materials in accordance with organization guidelines</p> <p>P7. Store tools/equipment/consumable materials in accordance with organization guidelines</p>

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.** Understanding of technical drawings
- K2.** Electrical supply AC and DC
- K3.** Specifications/ classification of electrode(s) required for the job
- K4.** Electrical parameters like (voltage, current, polarity etc.) and their effects on weld deposits
- K5.** Welding techniques as per WPS/instruction sheet
- K6.** Welding position types
- K7.** Welding Procedure Specifications (WPS)
- K8.** Method of Pre-Heating of base metal
- K9.** Polarity setting according to standard specifications
- K10.** Visual welding defects
- K11.** Welding codes and standards

Critical Evidence(s) Required

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



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- Use of PPEs according to hazard/job.
- Setting up the welding machine
- Prepare Welds on Carbon Steel Plate, Flat (1F) and Flat (1G)
- Prepare Welds on Carbon Steel Plate, Horizontal (2F) and Horizontal (2G)
- Prepare Welds on Carbon Steel Plate, Vertical (3F) and Vertical (3G)
- Prepare Welds on Carbon Steel Plate, overhead (4F) and Overhead (4G)

Tools and Equipment

- Shielded Metal Arc Welding plant
- Welding plant accessories
- PPEs
- Welding Electrodes
- Electrode baking Oven



0715-MF&P 42. Perform Submerged Arc Welding (SAW)

Overview: This competency standard covers the skills and knowledge required to Prepare Welding Machine and Accessories for SAW, Make Fillet Weld on Carbon Steel Plate, Make Groove Weld on Carbon Steel Plate and Perform Post Welding Operations.

Competency Units	Performance Criteria
CU1. Prepare Welding Machine and Accessories for SAW	<p>P1. Identify welding requirements from the job, Welding Procedure Specifications (WPS) and/or technical drawings</p> <p>P2. Prepare Submerged Arc Welding (SAW) power supply unit in accordance with WPS/manufacturer instructions</p> <p>P3. Set up welding machine accessories as per job requirements, WPS and/or manufacturer instructions</p> <p>P4. Set up welding machine's wire feeding unit as per WPS</p> <p>P5. Set Granular flux hopper as per requirement</p> <p>P6. Connect welding machine to an independent power supply</p> <p>P7. Set polarity indicated in the WPS</p>
CU2. Make Fillet Weld on Carbon Steel Plate	<p>P1. Adjust welding parameters (current, voltage, wire feed speed, welding speed etc.) as per welding procedure specifications/job requirements to produce acceptable weld</p> <p>P2. Maintain gap between electrode and base metal as per standard practices</p> <p>P3. Carry out pre-heating of the given job, if needed.</p> <p>P4. Carry out welding in 1F, 2F, 3F positions following standard procedures</p> <p>P5. Carry out the cleaning of root pass as per requirement</p> <p>P6. Carryout the re-usage of granular flux during welding</p> <p>P7. Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects</p>
CU3. Make Groove Weld on Carbon Steel Plate	<p>P1. Adjust welding parameters (current, voltage, wire feed speed, welding speed etc.) as per welding procedure specifications/job requirements to produce acceptable weld</p> <p>P2. Maintain gap between electrode and base metal as per standard practices</p> <p>P3. Carry out pre-heating of the given job, if needed.</p> <p>P4. Carry out welding in 1G position following standard procedures</p> <p>P5. Deposit root pass as per WPS/job requirements</p> <p>P6. Deposit filling passes as per welding procedure specifications/job requirements</p>



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	<p>P7. Deposit capping pass as per welding procedure specifications/job requirements</p> <p>P8. Carry out the cleaning of passes as per requirement</p> <p>P9. Check root, filling and capping passes for any visual discontinuities as per acceptance standards</p> <p>P10. Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects</p>
CU4. Perform Post Welding Operations	<p>P1. Carry out finishing work of welds following standard procedures</p> <p>P2. Inspect weld visually and mark any visual defects, as required</p> <p>P3. Perform Post Weld Heat Treatment of weld as per requirement</p> <p>P4. Carry out repair work in accordance with approved procedures, as required</p> <p>P5. Clean work area in accordance with workplace safety practices</p> <p>P6. Maintain tools/equipment/consumable materials in accordance with organization guidelines</p> <p>P7. Store tools/equipment/consumable materials in accordance with organization guidelines</p>

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 characteristics of Ferrous material – Carbon Steel, Stainless steel
- K2. Explain basic principle of a mechanized and automated welding equipment
- K3. Explain key components and features of the SAW equipment
 - Define Power source
 - Define Parameter setting
 - Define Wire feed mechanism
 - Define Flux dispensing unit
- K4. Explain characteristics of an electric arc used for welding purposes
 - Voltage distribution across the arc
 - Alternating current (AC)
 - Direct Current (DC)
 - Effects and influence of magnetic fields
- K5. Describe various weld features and related terminology
 - Face
 - Root
 - Filling
 - Capping



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- Heat affected zone
- Convex fillet profile
- Concave fillet profile
- Mitered fillet profile
- Root face
- Root gap
- Bevel angle

Tools and Equipment

- SAW Welding plant
- Welding plant accessories
- Granular flux
- PPEs



4. **Metal Casting Senior Technician**

0715-MF&P 43. Perform Metal Die Casting Operations

Overview: This competency standard covers the specific skills and knowledge related to arrange material for die casting, conduct pre-operational checks on machine, prepare the casting molds, operate die casting machine, inspect final product and perform workplace cleaning.

Competency Unit	Performance Criteria
CU1. Arrange material for die (Cold Chambered High pressure) casting	<p>P1. Interpret the drawing/process sheet for material requirement</p> <p>P2. Select tools and equipment.</p> <p>P3. Prepare the melting furnace as per SOPs (Crucible).</p> <p>P4. Prepare holding furnace as per SOPs (Crucible)</p> <p>P5. Set die casting machine parameters as per job specification.</p>
CU2. Conduct pre-operational checks on machine	<p>P1. Inspect all electrical connections.</p> <p>P2. Check all mechanical fittings of mould (Bush water leakage nozzles etc.) coolants, lubricants, pastes, gate breaking fixture etc.</p> <p>P3. Check operation of emergency switches.</p> <p>P4. Check plunger rod tip moment, cooling system</p> <p>P5. Check cleaning, de-scaling of cooling lines of mould</p> <p>P6. Check and maintain proper lubrication of plunger rod, sleeve, mould</p> <p>P7. Check air pressure of safety door, spray head</p> <p>P8. Check all water connection.</p>
CU3. Prepare the high pressure die casting molds	<p>P1. Lift mould with standard lifting equipment.</p> <p>P2. Place the mould between both sides (fixed and movables) of mould pattern</p> <p>P3. Align mould in the center of platen.</p> <p>P4. Connect hydraulic and water connections.</p> <p>P5. Clamp mould with bolts/ hydraulic couplings</p> <p>P6. Check spray head nozzles position as per mould, core requirements</p>



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	<p>P7. Apply die releasing agent/paste spray/beads.</p> <p>P8. Make a three to shots on intensification on off position for preheating of mould</p>
CU4. Operate die casting machine (Cold chambered high pressure)	<p>P1. Set all operating parameters of machine as per SOP</p> <p>P2. Adjust quantity of molten metal from holding furnace in machine ladle as per mould size for auto liddle</p> <p>P3. Check all lubrication of mould, tip, tie bars on auto</p> <p>P4. Pour the casting material in the sleeve of plunger rod</p> <p>P5. Preheat mould with burner</p> <p>P6. Make dehydration of molten material in holding furnace</p> <p>P7. Preheat mould sleeve by pouring molten metal in sleeve</p> <p>P8. Proceed with die casting operation on auto run</p> <p>P9. Break risers, air vents, flashes, gate of mould breaking fixture of mould</p> <p>P10. Make air blow on mould face, spray die release agent in mould with spray head/manual spray gun and dry with air as per mould requirement</p> <p>P11. Monitor operations to ensure compliance with job requirements.</p>
CU5. Inspect final product	<p>P1. Perform visual inspection for defects, if any.</p> <p>P2. Check dimensions of the product as per drawing for first production only</p> <p>P3. Check part on checking fixture if any</p> <p>P4. Complete inspection report.</p>
CU6. Perform workplace cleaning	<p>P1. Maintain all check sheets and work instructions.</p> <p>P2. Perform cleaning and de-scaling of mould cooling lines, machine and floor after job completion.</p> <p>P3. Perform Lubrication on slides, tie bar and mould.</p> <p>P4. Apply anti-rust spray/cleaning agent.</p> <p>P5. Store the tools and equipment.</p> <p>P6. Return excess material to store.</p> <p>P7. Transfer waste material into designated area.</p>



Knowledge and understanding

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

- K1.** Describe Die casting applications.
- K2.** Define Die casting process.
- K3.** Types of casting (cold chambered, hot chambered, gravity die casting)
- K4.** Describe types of materials used for Die casting materials.
- K5.** Describe Die casting mould.
- K6.** Define melting point of die casting material
- K7.** Advantages of die casting.
- K8.** Types of Hydraulics pumps used in High pressure Die Casting machines.
- K9.** Difference between hydraulic, gear oil and lubricating oil
- K10.** Describe use of water chiller in return line of hydraulic oil.
- K11.** Common faults in HP die casting machine
- K12.** State reasons of hot-spots, cold-shut misrun, honeycombing/pinholes, blowhole's fault in die casted parts
- K13.** State reasons of sticking of casting in die casting moulds
- K14.** Explain water softening process for water used in die casting cooling lines.
- K15.** Explain use cooling tower in return water and storage tank from mould cooling line.
- K16.** Explain Die casting defects and their remedy.
- K17.** Use of measuring instruments.
- K18.** Explain Fit & limit system

Critical Evidence(s)

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

- Demonstrate the mould clamping.
- Perform die casting machine parameters setting.
- Operate die casting machine
- Identify defects in final casted product.



Tools and Equipment

The tools and equipment required for this competency standard are given below:

- Cold Chamber Die Casting Machine
- Die Casting Mould
- Holding furnace
- Melting furnace
- Degasser, grain refiner, touch up paste, die release agent, water softening resins, epoxy etc. chemicals
- Lubricating oil
- Melting furnace (Crucible)
- Eye bolts
- Lifting chains
- Shackles
- Fork lifter
- Lifting Hoist
- Different sizes of plunger
- Wrenches
- Combination Spanner Set
- Allen-Key Set
- Socket Set with Handle
- Pliers Set
- Screw Driver Set
- Brass Hammer
- Micrometer
- Go & No-Go Gauges
- Checking Fixture
- Vernier Caliper
- Pyrometer
- First aid box
- PPEs



0715-MF&P 44. Perform Centrifugal Casting Process

Overview: This competency standard covers the skills and knowledge required to prepare mold for casting, cast the molten metal, remove the Casting from molds and perform post casting operations.

Competency Units	Performance Criteria
CU1. Prepare mold for casting	P1. Arrange material for centrifugal casting process P2. Apply refractory ceramic coating to cylindrical mold walls P3. Perform rotation of mold to spread coating properly P4. Perform drying of ceramic coat as per standard operating procedures P5. Rotate mold about its axis at required speeds
CU2. Cast the molten metal	P1. Pour molten metal directly into the rotating mold without the use of runners or a gating system. P2. Pour the molten metal into the mold P3. Carryout pouring of molten metal as per standard P4. Follow safe handling practice during pouring of molten metal P5. Perform solidification of molten metal at room temperature P6. Trim the casting to the desired shape
CU3. Remove the Casting from molds	P1. Take the metal out of the mold as per standard practice P2. Remove the solidified casting from mold P3. Inspect the molted part for defects, if any P4. Prepare the inspection report as per SOPs
CU4. Perform post casting operations	P1. Clean less dense impurities or bubbles at the inner surface of the casting. P2. Perform shot blast to smooth the inner diameter of the part. P3. Execute proper shut down of the machine P4. Perform regular cleaning process as prescribed by manufacturer

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.** Understand centrifugal casting process
- K2.** types of centrifugal casting process
- K3.** Explain preparation of mold for casting process
- K4.** Explain semi centrifugal casting



Critical Evidence(s) Required

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

- Prepare mold for centrifugal casting process
- Cast the molten metal
- Perform post casting inspection of the casted job

Tools and Equipment

- Centrifugal Casting Machine & accessories
- Centrifugal Casting Mold
- Melting furnace (Crucible)
- Plungers
- Pot
- Goose neck
- Ladle
- Moving and fixed platen
- Lifting chains
- Shackles
- Hoist
- Different size of plunger
- Wrenches
- Combination Spanner Set
- Allen-Key Set
- Socket Set with Handle
- Pliers Set
- Screw Driver Set
- Brass Hammer
- Micrometer
- Go & NoGo Gauges
- Checking Fixture
- Vernier Caliper
- First aid box
- PPEs



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0715-MF&P 45. Perform Shell Mold Casting

Overview: This competency standard covers the skills and knowledge required to arrange pattern for casting, prepare the mold for casting, assemble mold for casting, cast molten metal in mold and remove the casting from mold.

Competency Units	Performance Criteria
CU1. Arrange pattern for casting	P1. Handle two-piece metal pattern as per job requirement P2. Use Aluminum pattern for mass production of patterns P3. Use Graphite pattern for casting of reactive materials.
CU2. Prepare the mold for casting	P1. Heat up the pattern as per job requirements P2. Coat the pattern with a lubricant to facilitate removal. P3. Clamp the heated pattern to a dump box (containing a mixture of molding material). P4. Invert the dump box allowing molding material (Sand-resin mixture) to coat the pattern. P5. Make a shell around the heated pattern P6. Eject the shell from the pattern.
CU3. Assemble mold for casting	P1. Join the two shell together as per job requirement P2. Insert core in the mold, if required. P3. Clamp mold parts to form the complete shell mold. P4. Place the shell mold into a flask supported by a backing material.
CU4. Cast molten metal in mold	P1. Pour molten metal from ladle through gating system P2. Fill the mold cavity completely with the molten metal P3. Perform cooling of molten metal as per SOPs P4. Carryout solidification of molten metal into final casting
CU5. Remove the casting from mold	P1. Break the mold after the metal is cool down P2. Trim excess metal from the feed system, if any P3. Remove any sand from the mold, if any P4. Perform post casting inspection for any defect, if any P5. Prepare the inspection report as per SOPs

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:



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- K1.** Understand shell mold casting process
- K2.** Demonstrate shell mold casting
- K3.** Mold creation techniques
- K4.** Assembly of molding
- K5.** Gating system
- K6.** Knowledge of pouring techniques

Critical Evidence(s) Required

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

- Prepare mold for shell casting
- Pour molten metal into the mold
- Remove casted metal from the mold

Tools and Equipment

- Melting Furnace and accessories
- Dump box
- Shell Mold
- Transfer Ladles
- Tongs
- Crucible
- Dies
- Die coats
- Metal holding pot
- Clamping device
- Transfer ladles
- PPEs



0715-MF&P 46. Perform Investment Casting

Overview: This competency standard covers the skills and knowledge required to arrange pattern for Casting, prepare mold for casting, perform casting and perform post-casting operations.

Competency Units	Performance Criteria
CU1. Arrange pattern for Casting	P1. Arrange wax patterns as per requirement P2. Use cores to form internal features within the pattern, if required P3. Attach patterns to a central wax gating system (sprue, runners, and risers) to form a tree-like assembly
CU2. Prepare mold for casting	P1. Place wax tree-like assembly into mold flask P2. Prepare slurry by mixing ceramic powder with water and stir it homogenously P3. Perform degassing of slurry in vacuum chamber P4. Pour slurry into the flask to coat the wax pattern tree P5. Bake the shell as per standard to form a ceramic shell around the patterns and gating system P6. Remove the wax leaving a hollow ceramic shell that acts as a one-piece mold P7. Apply protective coating to mold as per standard
CU3. Perform casting	P1. Pre-heat mold in a furnace as per SOP P2. Pour molten metal from a ladle into the gating system of the mold P3. Carry out complete filling of the mold cavity with liquid melt as per standard operating procedure
CU4. Perform post-casting operations	P1. Perform cooling of molten metal as per SOPs P2. Carryout solidification of molten metal into final casting P3. Remove casting flask as per standard procedure P4. Separate the casted parts from gating system either by sawing or cold breaking (using liquid nitrogen) P5. Perform post casting inspection for any defect, if any P6. Prepare the inspection report as per SOPs P7. Clean up work area and equipment P8. Dispose off waste at designated place

Knowledge & Understanding



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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.** Enlist Investment casting steps
- K2.** Advantages of investment casting
- K3.** Limitation of investment casting process
- K4.** Importance of identification of precious metals and alloys
- K5.** Describe charge calculations of alloys
- K6.** Importance of melting points of various metals/alloys
- K7.** Safe work practices and procedures
- K8.** Applying safe casting procedures

Critical Evidence(s) Required

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

- Prepare pattern for investment Casting
- Prepare mold for investment casting
- Perform investment casting
- Perform post- investment casting operations

Tools and Equipment

- Melting Furnace and Accessories
- Wax Injector
- Flask
- Ladle
- Wax patterns
- Shell Coater
- Slurry Tanks
- Shell Handlers
- Casting Handlers
- Barrel Sanders
- Grinders
- Casting Positioner



5. **Metal Forming Senior Technician**

0715-MF&P 47. Perform Die Forging Process

Overview: This competency standard covers the skills and knowledge required to perform Open Die Forging (Cold, Hot), perform Closed/Impression Die Forging (Cold, Hot), perform precision/flash less forging operation, and Perform forging machine maintenance.

Competency Units	Performance Criteria
CU1. Perform Open Die Forging (Cold/Hot)	<p>P1. Identify the tools and equipment required for the task.</p> <p>P2. Calculate the material volume based on task requirements.</p> <p>P3. Select open die as per requirement of forging</p> <p>P4. Setup the Forging machine in accordance with the Standard Operating Procedure and specifications.</p> <p>P5. Heat up the charge / billet to the specified temperature in case of hot die forging</p> <p>P6. Carryout pre-forming / Edging operation</p> <p>P7. Carryout forging operation as per requirement</p> <p>P8. Perform trimming operation as per requirement</p> <p>P9. Carryout inspection of the finish product.</p>
CU2. Perform Impression Die Forging (Cold/Hot)	<p>P1. Identify the tools and equipment required for the task.</p> <p>P2. Calculate the material volume based on task requirements.</p> <p>P3. Select close/impression die as per the requirement of forging</p> <p>P4. Setup the Forging machine in accordance with the Standard Operating Procedure and specifications.</p> <p>P5. Heat up the charge / billet to the specified temperature in case of hot die forging</p> <p>P6. Carryout pre-forming / Edging operation</p> <p>P7. Carryout forging operation as per requirement</p> <p>P8. Perform trimming operation as per requirement</p> <p>P9. Carryout inspection of the finish product.</p>



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CU3. Perform precision / flash less forging operation	P1. Select the tools and Equipment required for the given task. P2. Calculate the material volume based on task requirements. P3. Use tools and formers according to the standard operating procedure. P4. Setup the forging machine in accordance with the Standard Operating Procedure and specifications. P5. Operate the forging machine in accordance with the Standard Operating Procedure P6. Carryout inspection of the finish produce.
CU4. Perform forging machine maintenance	P1. Carryout Preventive maintenance of the machine. P2. Check the moving parts of the machine for excessive play. P3. Calibrate forging load of the machine as per SOPs P4. Clean, align and lubricate die load of the machine P5. Use required PPEs during maintenance of machine

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.** State different types of forging dies and their uses.
- K2.** Enlist different types of forging machines.
- K3.** Explain open die forging and close die forging.
- K4.** Describe uses of precision die forging.
- K5.** Describe Pre-heating operation of charge for forging
- K6.** State the importance of post-Forging heating operations.
- K7.** Explain heating equipment and their applications
- K8.** Explain forging temperatures and heat specifications for multiple jobs.
- K9.** Explain the importance of effects of material shrinkage and oxidization on the dimensions of the forged article
- K10.** Explain safety practices and PPEs used during forging process.

Critical Evidence(s) Required

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

- Perform Open Die Forging (Cold/Hot)



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- Perform Close / Impression Die Forging (Cold/Hot)
- Perform precision / flash less forging operation
- Carryout inspection of finished product
- Perform forging machine maintenance

Tools & Equipment

- Forging machine and accessories
- Forging hammer
- Forging dies
- Anvil
- Heating furnaces
- PPEs
- Clamping devices
- Tongs
- Punch
- Fuller
- Flatter
- Swage
- Swage block
- Inspection tools



0715-MF&P 48. Perform Hydrostatic Extrusion Process

Overview: This competency standard covers the skills and knowledge required to perform cold hydrostatic extrusion, perform hot hydrostatic extrusion and carryout inspection of finished product.

Competency Units	Performance Criteria
CU1. Perform cold hydrostatic extrusion	P1. Arrange metal-forming dies as per standard P2. Select the suitable raw material for cold Hydrostatic Extrusion process P3. Inspect tools for correct installation P4. Carryout the cold hydrostatic extrusion process as per SOPs P5. Store the extruded product as per SOPs P6. Turn off the cold hydrostatic extrusion machine as per SOPs
CU2. Perform hot hydrostatic extrusion	P1. Arrange metal-forming dies as per standard P2. Select the suitable raw material for Hot Hydrostatic extrusion process P3. Inspect tools for standard installation P4. Pre-heat the Die prior to the hot Hydrostatic Extrusion process P5. Adjust the temperature of the Die, if required. P6. Carryout the hot extrusion process P7. Store the extruded product as per SOPs P8. Turn off the Hot hydrostatic extrusion machine as per SOPs
CU3. Carryout inspection of finished product	P1. Select samples to check conformance as per the requirement P2. Verify the dimensions of the finished products as per the given drawing P3. Carry out inspection of the finished extruded product as per Quality Standards. P4. Record the deviations, if any, with the given specifications P5. Report the deviations for corrective measures.

Knowledge & Understanding



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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 hydrostatic extrusion process
- K2.** Types of hydrostatic extrusion process (Cold and Hot)
- K3.** Types of lubricants used in extrusion process
- K4.** Temperature setting for hot extrusion process
- K5.** Importance of Thermal stress & Thermal Fatigue reduction for Hot Hydrostatic Extrusion process
- K6.** Inspection techniques
- K7.** Inspection tools

Critical Evidence(s) Required

The candidate must present evidence of practical observations showing their ability to perform injection and extrusion process. The observation measures include.

- Perform Cold hydrostatic extrusion with the given specification
- Perform Hot hydrostatic extrusion with the given specification
- Prepare inspection report for extruded job

Tools & Equipment

- Hydrostatic Extrusion Machine with accessories
- Dies
- Hand tools
- Lubricants
- Inspection tools



0715-MF&P 49. Perform Wire Drawing Process

Overview: This competency standard covers the skills and knowledge required to arrange tools and equipment for wire drawing through draw plate, Perform annealing of the given wire to be drawn, carryout pull through drawplate and perform wire drawing operation on metal blank.

Competency Units	Performance Criteria
CU1. Arrange tools and equipment for wire drawing through draw plate	P1. Arrange the required tools and equipment required for the process P2. Arrange raw material wire for wire drawing process as per requirement P3. Select the required tools and equipment for wire drawing process P4. Inspect the working condition of tools and equipment
CU2. Perform Annealing of the given wire to be drawn	P1. Heat the wire in the heating furnace up to required temperature P2. Set standard soaking time of the heat treatment furnace as per requirements P3. Stop the heating once the required temperature and soaking time is achieved. P4. Perform the cooling of raw material wire in furnace
CU3. Carryout pulling of wire through drawplate	P1. Install the draw plate as per standard P2. Fix the draw plate in the vise P3. Taper the proper length of the wire to be drawn P4. Lubricate the wire to be drawn P5. Select a hole in the draw plate slightly smaller than the diameter of raw material wire P6. Insert the taper end of wire in the back side of draw plate P7. Grasp the wire from the front of the plate with a draw tong or heavy duty pliers P8. Pull the wire through the plate P9. Maintain the constant speed to ensure the uniformity P10. Repeat the process with successively smaller holes



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	until the desired diameter is achieved
CU4. Perform wire drawing operation on metal blank	P1. Prepare the metal blanks as per requirement P2. Check the property of Blank as per standards P3. Set number of Dies according to requirement. P4. Set the drawing load as per requirement P5. Pull the wire through the metal blank P6. Carry out wire drawing as per standard P7. Measure the diameter of wire and confirm it with 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 Wire Drawing Process
- K2.** Describe the importance of annealing of wire to be drawn
- K3.** Describe the importance of lubrication of wire to be drawn
- K4.** Explain the purpose of hole selection of drawing plate
- K5.** Describe the difference between wire drawing and wire extrusion.

Critical Evidence(s) Required

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

- Interpret drawings related to processes of Wire drawing and Wire extrusion
- Perform wire drawing through draw plate
- Perform wire drawing of a metal blank
- Use of PPEs according to hazard/job

Tools and Equipment

- Drawplate & Dies
- Bench vise
- Draw tongs
- Wire rolling mill
- Blank holders



6. **Heat Treatment Technician**

0715-MF&P 50. Perform Heat Treatment of Ferrous Materials

Overview: This competency standard covers the skills and knowledge required to perform hardening on Carbon Steel, perform tempering of hardened carbon steel, perform annealing on steel, perform normalizing of steel, perform Carburizing of Steel and perform stress relieving of Metal.

Competency Units	Performance Criteria
CU1. Perform hardening on Carbon Steel	P1. Prepare the samples of required size. P2. Place the sample in the furnace P3. Adjust the temperature of furnace and soaking time of the furnace according to steel grade. P4. Select a suitable quenching media. P5. Quench the samples in quenching media. P6. Interpret the results as per requirement
CU2. Perform tempering of hardened carbon steel	P1. Take hardened sample (as prepared in above experiment). P2. Place the sample in the furnace P3. Adjust the tempering temperature of furnace and soaking time of the furnace according to require microstructure. P4. Cool the specimen as per SOPs P5. Interpret the results as per requirement
CU3. Perform annealing on steel	P1. Prepare the samples of required size. P2. Place the sample in the furnace P3. Adjust the temperature and soaking time of the furnace according to steel grade. P4. Turn of the furnace and let the samples to cool in the furnace. P5. Remove the samples from furnace once the temperature drops to near room temperature. P6. Interpret the results as per requirement
CU4. Perform normalizing of steel	P1. Prepare the samples of required size. P2. Place the sample in the furnace P3. Adjust the temperature and soaking time of the furnace according to steel grade. P4. Turn off the furnace P5. Remove the samples from furnace and let them to cool in the air. P6. Interpret the results as per requirement
CU5. Perform Carburizing of	P1. Cut and prepare the samples of required sizes. P2. Pack the samples in carbonaceous material in steel box and seal the boxes by suitable method.



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Steel	P3. Place the boxes in the furnace P4. Heat the samples for suitable time and temperature. P5. Turn off the furnace and remove the steel boxes from furnace and recover the specimen. P6. Check hardness of the sample's core and case. P7. Interpret the results of hardness and microstructure.
CU6. Perform stress relieving of Metal	P1. Prepare the samples of required size. P2. Place the sample in the furnace. P3. Adjust the temperature and soaking time of the furnace as required P4. Turn off the furnace and let the sample to cool in the furnace P5. Remove the samples from furnace once the temperature reaches near room temperature. P6. Check hardness of the sample P7. Interpret the results as per standards

Knowledge & Understanding

- K1. Types of heat treatment of Steels
- K2. Microstructure of common heat treated metallic materials
- K3. Importance of hardness in heat treatment
- K4. Sample preparation techniques

Critical Evidence(s) Required

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

- Perform hardening on Carbon Steel
- Perform tempering of hardened carbon steel
- Perform annealing on steel
- Perform normalizing of steel
- Perform Carburizing of Steel
- Perform stress relieving of Metal

Tools & Equipment

- Heating furnace and accessories
- Hardness tester
- Long tongs



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- Quenching media
- Carburizing media
- Quenching bath
- PPEs



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0715-MF&P 51. Perform Heat Treatment of Non-Ferrous Materials

Overview: This competency standard covers the skills and knowledge required to Perform Solution Treatment and Aging of Non-Ferrous materials.

Competency Units	Performance Criteria
CU1. Perform Solution Treatment	<p>P1. Handle the workpiece with appropriate care</p> <p>P2. Place the workpiece in the furnace</p> <p>P3. Adjust the temperature and soaking time of the furnace according to the material type and size.</p> <p>P4. Turn of the furnace once the required temperature and soaking time is achieved.</p> <p>P6. Remove the workpiece from the furnace and quench into the quenching media.</p> <p>P7. Clean the workpiece and referred it to the next section.</p>
CU2. Perform Aging	<p>P1. Handle the workpiece with appropriate care</p> <p>P2. Place the workpiece in the furnace</p> <p>P3. Adjust the temperature and soaking time of the furnace according to the type and size of the material.</p> <p>P4. Turn of the furnace once the required temperature and soaking time is achieved.</p> <p>P5. Let the workpiece to cool in the furnace.</p> <p>P6. Remove the workpiece from the furnace, once the temperature drops to room temperature.</p> <p>P7. Clean the workpiece and referred it to the next section.</p>

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.** Differentiate between ferrous and non-ferrous materials
- K2.** Properties of Aluminum metal and its alloys



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- K3.** Properties of Copper metal and its alloys
- K4.** Describe Soaking time
- K5.** Purposes of heat treatment of non-ferrous alloys
- K6.** Describe heat treatment furnace
- K7.** Describe quenching media used for non-ferrous materials
- K8.** Describe Aging.

Tools & Equipment

- Heating furnace and accessories
- Solution treatment bath
- Hardness tester
- Long tongs
- Quenching bath
- PPEs



7. **Destructive Testing Technician**

0715-MF&P 52. Carryout Hardness Testing

Overview: This competency standard covers the skills and knowledge required to Measure hardness of the specimen by using Brinell Hardness Test, Measure hardness of the specimen by using Rockwell Hardness Test and Measure hardness of the specimen by using Vickers Hardness Test

Competency Units	Performance Criteria
CU1. Measure hardness of the specimen by Brinell Hardness Test	<p>P1. Prepare the surface of standard specimen as per requirement.</p> <p>P2. Inspect the working mode of the Brinell Hardness Testing Machine.</p> <p>P3. Select the indenter and Load as per standard.</p> <p>P4. Place the specimen on anvil with safety precautions.</p> <p>P5. Apply load on the specimen for standard time period.</p> <p>P6. Calculate the Brinell Hardness number with formula or directly note from the gauge according to design of the machine.</p>
CU2. Measure hardness of the specimen by Rockwell Hardness Test	<p>P1. Prepare the surface of standard specimen as per requirement.</p> <p>P2. Inspect the working mode of the Rockwell Hardness Testing Machine.</p> <p>P3. Select the Scale of the machine (A, B or C) depending upon the material.</p> <p>P4. Place the specimen on anvil with safety precautions and apply minor load.</p> <p>P5. Apply major load on the specimen according to the scale of the machine.</p> <p>P6. Note the Rockwell Hardness number from gauge.</p>
CU3. Measure hardness of the specimen by Vickers Hardness Test	<p>P1. Prepare the surface of standard specimen as per requirement.</p> <p>P2. Inspect the working mode of the Vickers Hardness Testing Machine.</p> <p>P3. Select the Load as per standard depending upon the material.</p> <p>P4. Place the specimen on anvil with safety precautions.</p>



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	<p>P5. Apply load on the specimen for standard time period.</p> <p>P6. Note the Vickers Hardness number from the gauge.</p>
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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 mechanical properties.
- K2.** Define destructive test.
- K3.** Define Hardness.
- K4.** Describe Brinell hardness test procedure
- K5.** Enlist different limitations of Brinell hardness test.
- K6.** What is the formula of Brinell hardness number?
- K7.** What is the standard method of writing Brinell hardness number?
- K8.** Enlist different advantages of Rockwell hardness test over Brinell hardness test.
- K9.** Describe Rockwell hardness test procedure
- K10.** What is the standard method of writing Rockwell hardness number?
- K11.** Compare A, B and C Scales of Rockwell hardness test.
- K12.** Describe Vickers hardness test procedure.
- K13.** What are different ways of writing Vickers Hardness number?

Critical Evidence(s) Required

- Measure hardness of the specimen by using Brinell Hardness Test
- Measure hardness of the specimen by using Rockwell Hardness Test
- Measure hardness of the specimen by using Vickers Hardness Test

Tools and Equipment

- Brinell Hardness Testing Machine
- Rockwell Hardness Testing Machine
- Vickers Hardness Testing Machine
- Measuring instruments
- Accessories for surface cleaning



0715-MF&P 53. Carryout Impact Testing

Overview: This competency standard covers the skills and knowledge required to Measure toughness of the specimen by using Izod Impact Test and Measure Toughness of the specimen by using Charpy Impact Test

Competency Units	Performance Criteria
CU1. Measure toughness of the specimen by Izod Impact Test	<p>P1. Check the dimensions of Izod specimen with the help of measuring instrument as per ASTM standard.</p> <p>P2. Inspect the working mode of the izod impact testing machine.</p> <p>P3. Adjust the initial position of the hammer.</p> <p>P4. Calculate the initial potential energy of the hammer.</p> <p>P5. Clamp the standard specimen in the anvil by keeping standard length out of the anvil.</p> <p>P6. Drop the hammer to strike it with standard specimen.</p> <p>P7. Calculate the final potential energy of the hammer.</p> <p>P8. Calculate the toughness of the specimen material by calculating difference of initial and final energy of the hammer.</p>
CU2. Measure Toughness of the specimen by Charpy Impact Test	<p>P1. Check the dimensions of Charpy specimen, received from workshop, with Vernier calliper as per ASTM standard.</p> <p>P2. Inspect the working mode of the charpy impact testing machine.</p> <p>P3. Adjust the initial position of the hammer.</p> <p>P4. Calculate the initial potential energy of the hammer.</p> <p>P5. Clamp the standard specimen in the anvil by keeping standard length out of the anvil.</p> <p>P6. Drop the hammer to strike it with standard specimen.</p> <p>P7. Calculate the final potential energy of the hammer.</p> <p>P8. Calculate the toughness of the specimen material by calculating difference of initial and final energy of the hammer.</p>

Knowledge & Understanding

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



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includes the knowledge of:

- K1.** Define impact load.
- K2.** Define toughness.
- K3.** Define potential Energy
- K4.** Difference of ASTM standard and ISO Standards for Izod impact test specimen.
- K5.** Difference of ASTM standard and ISO Standards for Charpy impact test specimen.
- K6.** Describe Izod impact test procedure.
- K7.** Describe Charpy impact test procedure.

Critical Evidence(s) Required

- Measure toughness of the specimen by using Izod Impact Test
- Measure Toughness of the specimen by using Charpy Impact Test

Tools and Equipment

- Izod impact testing machine
- Charpy impact testing machine
- Measuring devices



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0715-MF&P 54. Perform Mechanical Testing on Universal Testing Machine

Overview: This competency standard covers the skills and knowledge required to Measure tensile properties of the specimen, Measure Compressive strength of the specimen, Measure the Bending strength of specimen and Measure Shear strength of the specimen

Competency Units	Performance Criteria
CU1. Measure tensile properties of the specimen	<p>P1. Inspect the dimensions of standard specimen with the help of measuring instruments.</p> <p>P2. Mark the gauge length points on the specimen.</p> <p>P3. Measure the initial cross sectional area of the specimen.</p> <p>P4. Select the gripping device as per standard specimen.</p> <p>P5. Inspect the functioning condition of the gripping device.</p> <p>P6. Grip the specimen in gripping device according to standard.</p> <p>P7. Attach the extensometer with the specimen if required.</p> <p>P8. Apply the load on the specimen up to fracture.</p> <p>P9. Note the values of applied load after specific intervals.</p> <p>P10. Note the extension produced against the noted applied load.</p> <p>P11. Calculate stress and strain from the values of load and extension.</p> <p>P12. Sketch stress strain curve.</p> <p>P13. Calculate the required mechanical properties.</p>
CU2. Measure Compressive strength of the specimen	<p>P1. Inspect the dimensions of standard specimen with the help of measuring instruments.</p> <p>P2. Calculate the initial cross sectional area of the specimen.</p> <p>P3. Prepare the end surfaces of the specimen.</p> <p>P4. Inspect the working condition of fixtures used for compression.</p> <p>P5. Fix the specimen, between fixtures, in the machine.</p> <p>P6. Apply the load on the specimen up to surface failure.</p> <p>P7. Note the value of load at which surface get failure.</p> <p>P8. Calculate compressive stress.</p> <p>P9. Record the results.</p>
CU3. Measure the Bending strength	<p>P1. Inspect the dimensions of standard specimen with the help of measuring instruments.</p>



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of specimen	<p>P2. Inspect the working condition of bend test fixture.</p> <p>P3. Fit the bend test fixture in the machine.</p> <p>P4. Adjust the span between two rollers of the fixture according to the length of the specimen.</p> <p>P5. Fit the mandrel in the machine.</p> <p>P6. Place the specimen on the rollers of the fixture.</p> <p>P7. Apply the load on the specimen up to maximum selected bend.</p> <p>P8. Note the bending force.</p> <p>P9. Measure bending strength by using formula.</p> <p>P10. Record the results.</p>
CU4. Measure Shear strength of the specimen	<p>P1. Inspect the dimensions of standard specimen with the help of measuring instruments.</p> <p>P2. Calculate the cross sectional area of the Specimen.</p> <p>P3. Prepare the machine for test.</p> <p>P4. Install the fixture of shear test.</p> <p>P5. Place the sample within the fixture.</p> <p>P6. Apply the load for single shear or double shear test.</p> <p>P7. Set the machine speed according to sample.</p> <p>P8. Note the maximum/breaking force.</p> <p>P9. Calculate shear strength.</p> <p>P10. Record the results.</p>

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 stress.
- K2.** Define strain.
- K3.** Describe types of loads.
- K4.** Describe the types of stress.
- K5.** Describe the types of strain.
- K6.** Describe difference of ferrous and non-ferrous materials.
- K7.** Describe the yield strength of materials.
- K8.** Describe Ultimate strength of materials.
- K9.** Describe breaking strength of Materials.
- K10.** Describe the different parts of the UTM.



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K11. Describe working of UTM.

Critical Evidence(s) Required

- Measure tensile properties of the specimen
- Measure Compressive strength of the specimen
- Measure the Bending strength of specimen
- Measure Shear strength of the specimen

Tools and Equipment

- ❖ Universal Testing Machine & Accessories
- ❖ Measuring Instruments
- ❖ Specimens
- ❖ Computer with software
- ❖ Extensometer
- ❖ Gripping Jaws
- ❖ Holders



0715-MF&P 55. Perform Torsion Test and Fatigue test

Overview: This competency standard covers the skills and knowledge required to Measure torsion strength of specimen and Measure fatigue strength of specimen

Competency Units	Performance Criteria
CU1. Measure torsion strength of specimen	<p>P1. Inspect the Prepared sample according to the requirements of machine and standard.</p> <p>P2. Check the working mode of the machine.</p> <p>P3. Fix the sample in the fixture.</p> <p>P4. Adjust speed, torque angle and time of machine as per material requirement.</p> <p>P5. Draw torque vs angle graph.</p> <p>P6. Calculate torsion strength.</p> <p>P7. Observe fractured surface of the specimen.</p> <p>P8. Record the results.</p>
CU2. Measure fatigue strength of specimen	<p>P1. Inspect the Prepared specimen according to standard.</p> <p>P2. Check the working mode of the machine.</p> <p>P3. Grip the samples in fixture.</p> <p>P4. Apply load as per material requirement.</p> <p>P5. Re-zero rotation counter.</p> <p>P6. Turn on the machine and start the test.</p> <p>P7. Observe number of rotation once the material breaks.</p> <p>P8. Calculate fatigue strength by using formula.</p>

Knowledge & Understanding

- K1.** Define torque.
- K2.** Define moment of inertia.
- K3.** Write torsion equation.
- K4.** Describe procedure of torsion test.
- K5.** Define Fatigue load.
- K6.** Define Fatigue Strength.
- K7.** Describe the procedure of fatigue test.

Critical Evidence(s) Required

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



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- Measure Torsion and Fatigue Strength of given material

Tools and Equipment

- Torsion test machine
- Fatigue test machine
- Measuring Instruments