



National Competency Standards for “Foreman in Metallurgy and Metal casting” Level-4



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



National Competency Standards for “Metallurgy and metal casting”





ACKNOWLEDGEMENT

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 Qualifications for the trade of **Metallurgy and metal casting**. This work would not have been possible without the technical support of the above personnel.

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, which highly facilitated 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 ongoing process, and the 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.

**Dr. Nasir Khan,
Executive Director,
NAVTTTC**



Contents

1. Introduction	6
2. Purpose of the Qualification	7
3. Date of Validation	8
4. Date of Review.....	8
5. Codes of Qualifications	8
6. Members of Qualification Development Committee	9
7. Members of Qualification Validation Committee.....	10
8. Entry Requirements	11
9. Regulation of the Qualification and schedule of units	11
10. Summary of Competency Standards.....	11
11. Levelling and Packaging of the Qualification.....	15
12. Mapping of the Qualification	19
13. Mapping of Occupations.....	20
1. Soft Skills.....	21
CS 1 Manage the meetings.....	21
CS 2 Manage workforce planning	23
CS 3 Undertake project work.....	25
CS 4 Identify and communicate trends in career development	27
CS 5 Apply interpersonal skills.....	28
CS 6 Work safely in an office environment	30
CS 7 Maintain professionalism in workplace.....	31
2. Senior Caster.....	33
CS 8 Perform Shell Mold Casting	33
CS 9 Perform Investment Casting	36
3. Heat Treatment-II.....	39
CS 10 Perform stress relieving, austempering and martempering	39
CS 11 Perform Case Hardening process	41



4. Non Destructive Testing technician.....	44
CS 12 Perform Hardness Tests.....	44
CS 13 Perform Impact Tests	46
CS 14 Perform Mechanical Testing on Universal Testing Machine	48
CS 15 Perform Torsion Test and Fatigue test	51
5. Metallography Technician-I	53
CS 16 Perform Sectioning, Cutting and Rough Grinding	53
CS 17 Perform Mounting Operation	55
CS 18 Perform Fine Grinding Operation.....	57
CS 19 Perform Fine Polishing Operation	59
6. Surface Coating technician-I	61
CS 20 Perform Galvanizing Coating.....	61
CS 21 Perform Conversion Coating (Anodizing).....	64
CS 22 Perform Electrochemical Coating (Electroplating)	67
CS 23 Perform Electrochemical Coating (Electrolysis Electroplating)	70
7. Metal forming technician	74
CS 24 Perform rolling process	74
CS 25 Perform forging process	76
CS 26 Perform extrusion process.....	78
CS 27 Perform wire drawing and deep drawing process	80
8. QC Inspector-I	82
CS 28 Perform inspection.....	82
CS 29 Select and control inspection process and procedures	84
CS 30 Ensure calibration	86



1. Introduction

Metallurgy and metal casting is a manufacturing process. A liquid metal is somehow delivered into a mold (usually by a crucible) that contains a negative impression (i.e., a three dimensional negative image) of the intended shape in a process. The metal is poured into the mold through a hollow channel called a sprue. The metal and mold are then cooled, and the metal part (the casting) is extracted. Casting is most often used for making complex shapes that would be difficult or uneconomical to make by other methods.

Casting processes have been known for thousands of years, and have been widely used for sculpture (especially in bronze), jewelry in precious metals, and weapons and tools. Traditional techniques include lost-wax casting (which may be further divided into centrifugal casting and vacuum assist direct pour casting), plaster mold casting and sand casting.

The modern casting process is subdivided into two main categories: expendable and non-expendable casting. It is further broken down by the mold material, such as sand or metal, and pouring method, such as gravity, vacuum, or low pressure.

Being cognizant of this fact, National Vocational & Technical Training Commission (NAVTTTC) developed competency standards for metallurgy and metal casting under National Vocational Qualifications Framework (NVQF). These competency standards have been developed by a Qualifications Development Committee (QDC) and validated by the Qualifications Validation Committee (QVC) having representation from the leading development houses and research labs of the country.



2. Purpose of the Qualification

The competency based NVQ has been developed to train the unskilled men and women of Pakistan on the technical and entrepreneurial skills to be employed / self-employed and inevitably set sustainable impact on their lives by enhancing their livelihood income.

The purpose of these qualifications is to set professional standards for upcoming experts, who will serve as key elements enhancing quality of Pakistan’s manufacturing sector. The specific objectives of developing these qualifications are as under:

- Improve the professional competencies of individual in metallurgy and metal casting
- Capacitate the local community and trainers in modern CBT trainings, methodologies and processes as envisaged under NVQF
- Provide flexible pathways and progressions in metallurgy and metal casting
- Enable the trainees to perform their duties in efficient manner
- Establish a standardized and sustainable system of training in Pakistan
- Enabling the youth with greater employment opportunities



3. Date of Validation

The level 5 metallurgy and metal casting qualification has been validated on 12 to 16 January, 2021 at PITAC, Lahore, by the qualification validation committee (QVC) members.

4. Date of Review

The level 5 Computer networking and cloud computing qualification has been reviewed on 12-16 January, 2021 by the qualification validation committee (QVC) members.

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
1	2 nd Level National Certificate of level-5 Qualification, in “Metallurgy and Metal casting”
2	3 rd Level National Certificate of level-5 Qualification, in “Metallurgy and Metal casting”
3	4 th Level National Certificate of level-5 Qualification, in “Metallurgy and Metal casting”
4	5 th Level National Certificate of level-5 Qualification, in “Metallurgy and Metal casting”



6. Members of Qualification Development Committee

The following members participated in the qualification development process at PITAC, Lahore.

Date: 18 to 22 December 2020

S#	Name	Designation
1.	Muhammad Yasir	Deputy Director, NAVTTC
2.	Engr. Farooq Iftikhar	Jr.Engineer,PITMAEM Lahore
3.	Engr.Umer Farooq	Instructor P-TEVTA Swedish college, Gujrat
4.	Engr.Noman	Jr.Engineer PCSIR,Lahore
5.	Engr.Rashid Bashir	PCSIR,Lahore
6.	Engr.Salman Khalid Ch.	Assistant Director PITAC,Lahore
7.	Engr.Amina Irfan	Lecturer,UOL Lahore
8.	Engr.Asad Malik	Assistant director, PITAC Lahore
9.	Engr.Saba Sadiq	DACUM FACILITATOR,UOL Islamabad
10.		
11.		
12.		
13.		
14.		
15.		



7. Members of Qualification Validation Committee

The following members participated in the qualification development process at PITAC, Lahore.

Date:

S#	Name	Designation
1.	Muhammad Yasir	Deputy Director, NAVTTC
2.	Engr. Farooq Iftikhar	Jr.Engineer,PITMAEM Lahore
3.	Engr.Sohail	Instructor P-TEVTA Swedish college, Gujrat
4.	Engr.Noman	Jr.Engineer PCSIR,Lahore
5.	Engr.Rashid Bashir	PCSIR,Lahore
6.	Engr.Salman Khalid Ch.	Assistant Director PITAC,Lahore
7.	Engr.Saba Sadiq	DACUM FACILITATOR, Islamabad
8.		
9.		
10.		
11.		



8. Entry Requirements

Entry requirement for this level 5 qualification would be matric and certification of level 4 in metallurgy and metal casting.

9. Regulation of the Qualification and schedule of units

Not applicable

10. Summary of Competency Standards

Sr. No	Occupation	Competency Standards	NVQ F Level	Category	Estimated Contact Hr.			Credit Hr.
					T h.	Pr.	Total	
Technicain in metallurgy and metal casting-LEVEL 2								
1	Manual Drawing Expert	Perform Basic Manual Drawing	2	Technical	4	24	28	2.8
		Construct different Engineering Curves.			6	30	36	3.6
		Construct multi-view drawings			6	30	36	3.6
		Total			16	84	100	10
2	Basic Machining Operator	Perform metal/bench work	2	Technical	2	12	14	1.4
		Perform cutting on Metal Circular/Power Heck Saw			2	6	8	0.8
		Perform Grinding operation			2	9	11	1.1
		Perform Basic Lathe Machine Operations			4	21	25	2.5
		Perform Drilling Machine Operations			2	9	11	1.1
		Perform Shaper, Planar and Slotter Machining Operations			2	18	20	2
		Perform Milling Operations			3	18	21	2.1
		Total			17	93	110	11
3	Health and Safety Officer	Perform basic safety practices	2	Technical	10	15	25	2.5
		Apply basic Occupational Health & Safety regulations			10	15	25	2.5
	Total	20			30	50	5	
4	Raw Material Inspector	Carry out inspection and receiving of raw material	2	Technical	9	21	24	2.4
		Perform Raw Material Sampling			9	21	28	2.8
		Total			18	42	60	6
5	Assistant Pattern Maker	Operate general wood working machines	2	Technical	9	15	24	2.4
		Manufacture Wooden Pattern			6	15	21	2.1
		Manufacture polymer pattern			4	15	19	1.9
		Maintain tools and equipment			3	3	6	0.6
		Total			22	48	70	7



National Competency Standards for "Metallurgy and metal casting"



6	Assistant Molder	Prepare sand mold for casting	2	Technical	10	24	34	3.4
		Perform core making			5	21	26	2.6
		Total			15	45	60	6
7	Assistant Caster	Maintain Safe Work Environment	2	Technical	4	9	13	1.3
		Perform Sand Casting			8	21	29	2.8
		Perform Gravity Die Casting			7	21	28	2.8
		Total			19	51	70	7
8	Fettling Operator	Fettle and trim metal casting	2	Technical	2	9	11	1.1
		Perform surface cleaning by sand blasting			4	12	16	1.6
		Perform shot blasting			5	15	20	2
		Perform cutting and grinding operations			3	9	12	1.2
		Perform basic welding operations			6	15	21	2.1
		Total			20	60	80	8
Total(Level 2)								
Assistant foremen in metallurgy and metal casting-LEVEL 3								
1	Pattern Designer	Manage graphic user interface	3	Technical	11	9	20	
		Develop 2D drawings			6	18	24	
		Develop 3D pattern design			8	18	26	
		Total			25	45	70	
2	Pattern Maker	Manufacture match plate gated pattern	3	Technical	8	21	20	
		Manufacture Pattern on CNC router			8	33	20	
		Total			16	54	70	
3	Melter	Work Safely with Molten Metal	3	Technical	6	6	12	1.6
		Melt Ferrous Material (Cast Steel) in Induction Furnace			8	24	32	2
		Melt Ferrous Material (Cast Iron) in Cupola Furnace			8	24	32	2
		Melt Non-Ferrous Material in Pit Furnace			6	18	24	2
		Total			28	72	100	7.6
4	Molder	Operate molding machines	3	Technical	7	33	30	1.5
		Operate core making machines			5	15	30	1.5
		Total			12	48	60	6
5	Furnace operator	Operate Non-Electric Melting Furnaces	3	Technical	10	30	40	4
		Operate Electric Melting Furnaces			10	30	40	4
		Total			20	60	80	8
6	Caster	Operate Pressure Die Casting	3	Technical	10	30	40	3
		Perform Centrifugal Casting Process			13	27	40	3
		Total			23	57	80	3
7	Assistant Heat Treatment Technician	Perform quenching, annealing and normalizing process	3	Technical	10	30	40	
		Perform Heat Treatment of Non-Ferrous Materials			10	30	40	
		Total			20	60	80	
8	Basic computer operator	Install/Use system software	3	Generic	4	9	13	
		Install / Use Application Software			3	9	12	
		Draft office document			4	12	16	



National Competency Standards for "Metallurgy and metal casting"



		Perform web browsing and manage emails			3	6	9	
		Total			14	36	50	
Foremen in metallurgy and metal casting-LEVEL 4								
1	Soft skills	Manage the meetings	4	Generic	5	15	20	2
		Manage workforce planning			5	15	20	2
		Undertake project work			5	15	20	2
		Identify and communicate trends in career development			5	15	20	2
		Apply interpersonal skills			5	15	20	2
		Work safely in an office environment			5	15	20	2
		Maintain professionalism in workplace			5	15	20	2
		Total			35	105	140	14
2	Senior Caster	Perform Shell Mold Casting	4	Technical	19	81	100	
		Perform Investment Casting			19	81	100	
		Total			38	162	200	
3	Heat treatment technician	Perform stress relieving, austempering and martempering	4	Technical	24	51	75	
		Perform Case Hardening process			21	54	75	
		Total			45	105	150	
4	Destructive Testing Technician	Perform Hardness Tests	4	Technical	8	30	38	
		Perform Impact Tests			6	24	30	
		Perform Mechanical Testing on Universal Testing Machine			16	48	64	
		Perform Torsion Test and Fatigue test			8	30	38	
		Total			38	132	170	
5	Jr.Metallographic technician	Perform Sectioning, Cutting and Rough Grinding	4	Technical	9	24	33	
		Perform Mounting Operation			9	24	33	
		Perform Fine Grinding Operation			15	24	39	
		Perform Fine Polishing Operation			5	30	30	
		Total			38	102	135	
6	Jr.Surface coating technican	Perform Galvanizing Coating	4	Technical	11	24	35	
		Perform Conversion Coating (Anodizing)			11	24	35	
		Perform Electrochemical Coating (Electroplating)			10	30	40	
		Perform Electrochemical Coating (Electrolysis Electroplating)			10	30	40	
		Total			42	108	150	
7	Metal forming technician	Perform forging process	4	Technical	8	27	35	3
		Perform extrusion process			6	24	30	3
		Perform wire drawing and deep drawing process			6	24	30	3
		Perform rolling process			8	27	35	3
		Total			28	102	130	12
8	Assistant QC Inspector	Perform inspection	4	Technical	9	21	30	
		Select and control inspection process and procedures			9	21	30	
		Ensure calibration			9	21	30	



National Competency Standards for "Metallurgy and metal casting"



		Total			27	63	90	
Associate Engineer in metallurgy and metal casting-LEVEL 5								
1	Sr.Metallography Technician	Perform Etching Operation	5	Technical	18	36	54	2
		Perform Microscopic Examination Operation			21	45	66	2
		Total			39	81	150	12
2	QC Inspector	Conduct process and product capability analysis	5	Technical	10	30		2
		Perform advanced statistical quality control			10	30		2
		Total			20	60	100	9
3	Non Destructive Testing Technician	Perform dye penetrant, magnetic and ultrasonic test	5	Technical	15	45	60	9
		Perform radiography and eddy current test			12	36	48	3
		Total			78	81	200	3
4	Service Coating Technician	Perform Vapor Deposition Coatings (PVD)	5	Technical	15	24	39	3
		Perform Vapor Deposition Coatings (CVD)			15	24	39	3
		Perform Thermal Spray Coatings (Plasma)			12	24	36	3
		Perform Thermal Spray Coatings (Electric Arc Value)			12	24	36	
		Perform Thermal Spray Coatings (LVOF)			12	24	36	
		Total			66	120	150	15
7	Powder Metallurgy	Handle Powder for required process	5	Technical	12	24	36	1.5
		Perform Consolidation Operation			12	24	36	1.5
		Perform Sintering Operation			18	24	42	1.5
		Perform Finishing Operations			12	24	36	1.5
		Total			54	96	150	6
8	Entrepreneur	Develop Project Proposal	5	Generic	6	9	15	1.5
		Apply management and communication techniques			3	9	12	1.2
		Create human resource management plan			3	9	12	1.2
		Develop project management plan			3	9	12	1.2
		Develop sales plan			6	9	15	1.5
		Conduct research for customer needs and satisfaction			3	6	9	0.9
		Manage finances			4	9	13	1.3
		Identify and resolve problems			4	9	13	1.3
		Create/Manage profile on Non-traditional Freelancing Platform			4	9	13	1.3
		Create/Manage profile on a Traditional Freelance Platform			3	9	12	1.2
		Write professional proposals for freelance projects			3	9	12	1.2
		Develop communication skills			3	9	12	1.2
		Total			45	105	150	15



11. Levelling and Packaging of the Qualification

Sr.	Occupation	Duties/Competency Standards
Level 2 Technician in metallurgy and metal casting		
1	Manual Drawing Expert	1. Perform Basic Manual Drawing 2. Construct different Engineering Curves. 3. Construct multi-view drawings
2	Basic Machining Operator	4. Perform metal/bench work 5. Perform cutting on Metal Circular/Power Heck Saw 6. Perform Grinding operation 7. Perform Basic Lathe Machine Operations 8. Perform Drilling Machine Operations 9. Perform Shaper, Planar and Slotter Machining Operations 10. Perform Milling Operations
3	Health and Safety Officer	11. Perform basic safety practices 12. Apply basic Occupational Health & Safety regulations
4	Raw Material Inspector	13. Carry out inspection and receiving of raw material 14. Perform raw material sampling
5	Assistant Pattern Maker	15. Operate general wood working machines 16. Manufacture Wooden Pattern 17. Manufacture match plate gated pattern 18. Maintain tools and equipment
6	Assistant Molder	19. Prepare sand mold for casting 20. Perform core making
7	Assistant Caster	21. Maintain Safe Work Environment 22. Perform Sand Casting 23. Perform Gravity Die Casting
8	Fettling Operator	24. Fettle and trim metal casting 25. Perform surface cleaning by sand blasting 26. Perform shot blasting 27. Perform cutting and grinding operations 28. Perform basic welding operations
Level 3 Assistant foremen in metallurgy and metal casting		
9	Pattern Designer	29. Manage graphic user interface 30. Develop 2D drawings 31. Develop 3D pattern design



10	Pattern Maker	32. Manufacture Polymer Pattern 33. Manufacture Pattern on CNC router
11	Melter	34. Work Safely with Molten Metal 35. Melt Ferrous Material (Cast Steel) in Induction Furnace 36. Melt Ferrous Material (Cast Iron) in Cupola Furnace 37. Melt Non-Ferrous Material in Pit Furnace
12	Molder	38. Operate molding machines 39. Operate core making machines
13	Furnace operator	40. Operate Non-Electric Melting Furnaces 41. Operate Electric Melting Furnaces
14	Caster	42. Operate Pressure Die Casting 43. Perform Centrifugal Casting Process
15	Assistant Heat Treatment Technician	44. Perform quenching, annealing and normalizing process 45. Perform Heat Treatment of Non-Ferrous Materials
16	Basic computer operator	46. Install/Use system software 47. Install / Use Application Software 48. Draft office document 49. Perform web browsing and manage emails
Level 4 Foremen in metallurgy and metal casting		
17	Soft Skills	50. Manage the meetings 51. Manage workforce planning 52. Undertake project work 53. Identify and communicate trends in career development 54. Apply interpersonal skills 55. Work safely in an office environment 56. Maintain professionalism in the workplace
18	Senior Caster	57. Perform Shell Mold Casting 58. Perform Investment Casting
19	Heat treatment technician	59. Perform stress relieving, austempering and martempering 60. Perform Case Hardening process
20	Destructive Testing Technician	61. Perform Hardness Tests 62. Perform Impact Tests 63. Perform Mechanical Testing on Universal Testing Machine 64. Perform Torsion Test and Fatigue test



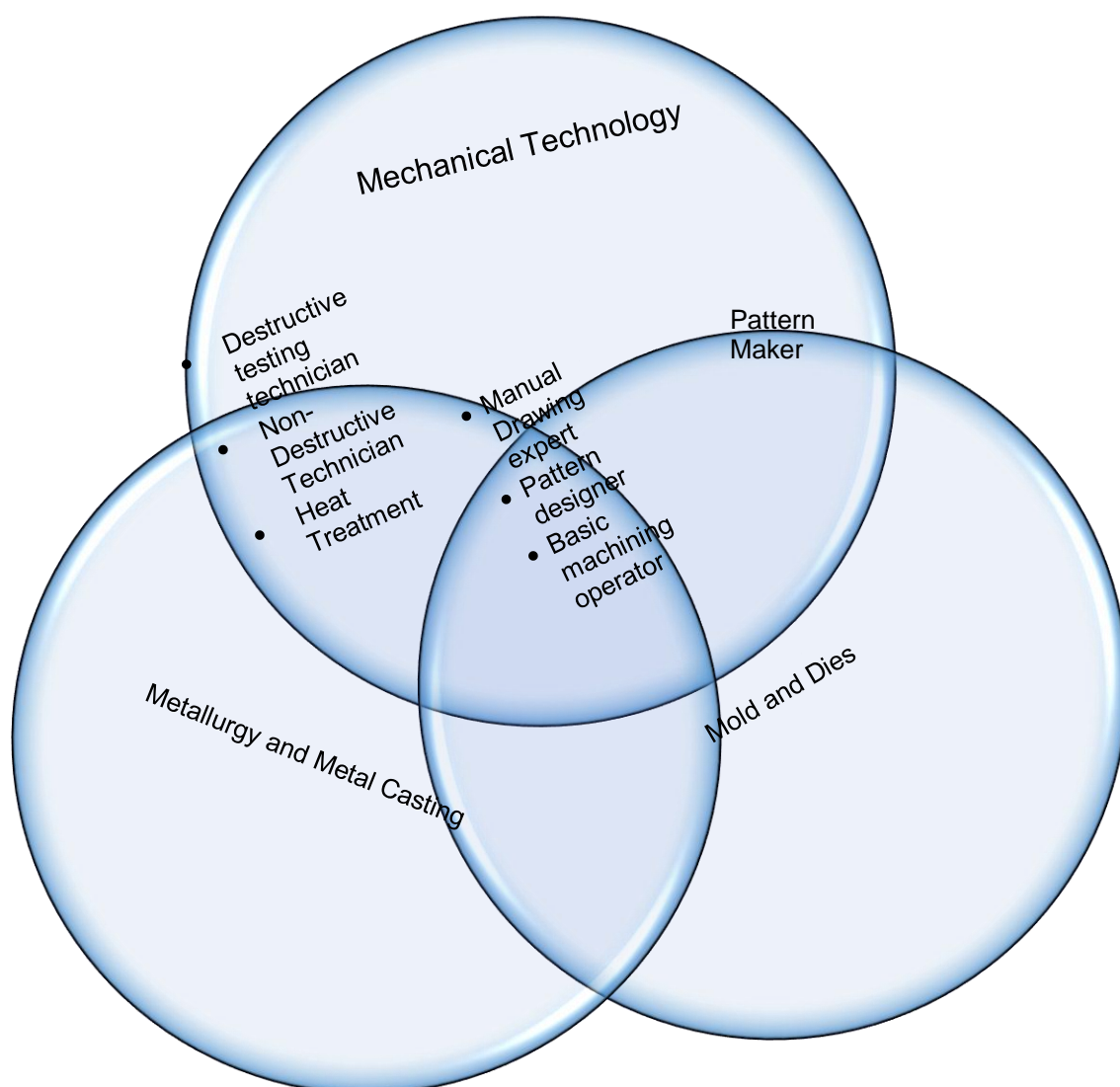
21	Jr.Metallographic technician	65. Perform Sectioning, Cutting and Rough Grinding 66. Perform Mounting Operation 67. Perform Fine Grinding Operation 68. Perform Fine Polishing Operation
22	Jr.Surface coating technician	69. Perform Galvanizing Coating 70. Perform Conversion Coating (Anodizing) 71. Perform Electrochemical Coating (Electroplating) 72. Perform Electrochemical Coating (Electrolysis Electroplating)
23	Metal forming technician	73. Perform forging process 74. Perform extrusion process 75. Perform wire drawing and deep drawing process 76. Perform rolling process
24	Assistant QC Inspector	77. Perform inspection 78. Select and control inspection process and procedures 79. Ensure calibration
Level 5 Associate Engineer in metallurgy and metal casting		
25	Sr.Metallography Technician	80. Perform Etching Operation 81. Perform Microscopic Examination Operation
26	QC Inspector	82. Conduct process and product capability analysis 83. Perform advanced statistical quality control
27	Non Destructive Testing Technician	84. Visual 85. LPT MPT 86. UT Rt Eddy current
28	Service Coating Technician	87. Perform Vapor Deposition Coatings (PVD) 88. Perform Vapor Deposition Coatings (CVD) 89. Perform Thermal Spray Coatings (Plasma) 90. Perform Thermal Spray Coatings (Electric Arc Value) 91. Perform Thermal Spray Coatings (LVOF)
29	CCM operator	92.
30		93.
31	Powder Metallurgy	94. Handle Powder for required process 95. Perform Consolidation Operation 96. Perform Sintering Operation 97. Perform Finishing Operations



32	Entrepreneur	<ul style="list-style-type: none">98. Develop project proposal99. Apply management and communication techniques100. Create human resource management plan101. Develop project management plan102. Develop sales plan103. Conduct research for customer needs and satisfaction104. Manage finances105. Identify and resolve problems106. Create Manage profile on Non-Traditional Freelancing platform107. Create Manage profile on Traditional Freelancing platform108. Write professional proposal for projects109. Develop communications skills
----	--------------	---

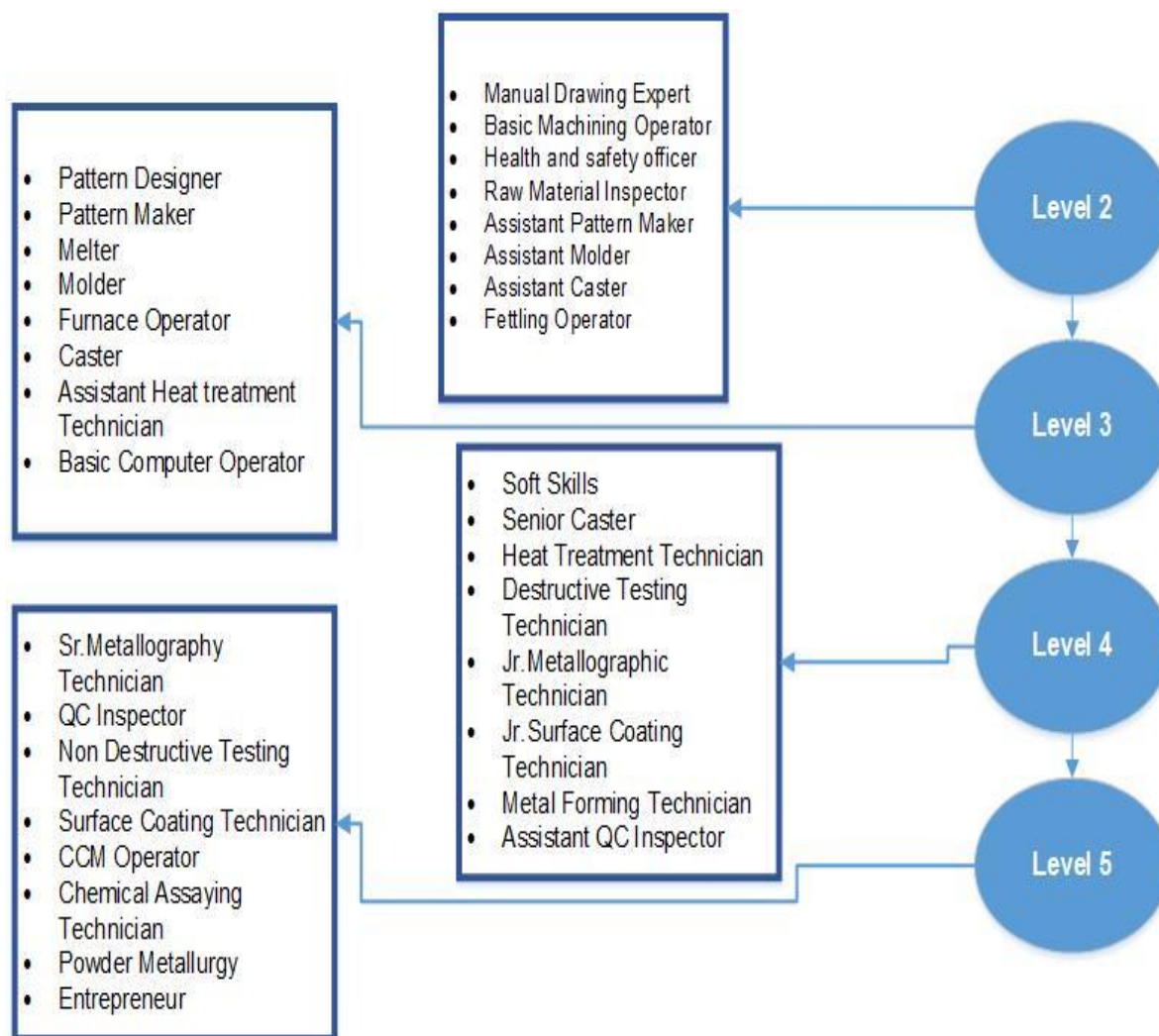


12. Mapping of the Qualification





13. Mapping of Occupations





14. Detail of Qualification and its Competency Standards

Level 4

1. Soft Skills

CS 1 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
1. 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>
2. 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>
3. 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 underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes:

- Outline meeting terminology, structures, arrangements
- Outline responsibilities of the chairperson and explain group dynamics in relation to managing meetings
- Describe options for meetings including In-person/physical, teleconferencing, web-conferencing and using webcams
- 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



CS 2 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. Define objectives to retain required skilled labor P4. Define objectives for workforce diversity and cross-cultural management P5. Obtain agreement and endorsement for objectives and establish targets 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 P4. Implement succession planning model to ensure desirable workers are developed and retained P5. 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
--	---

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:

- Explain current information about external labor supply relevant to the specific industry or skill requirements of the organization
- Outline industrial relations relevant to the specific industry
- 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.



CS 3 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. Define 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. Control and 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



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

- Give examples of project management tools and how they contribute to a project
- Outline types of documents and other sources of information commonly used in defining the parameters of a project
 - Explain processes for identifying and managing risk in a project
 - Explain the organization’s procedures and processes that are relevant to managing a project including:
 - a) lines of authority and approvals
 - b) quality assurance
 - c) human resources
 - d) budgets and finance
 - e) recordkeeping
 - f) reporting
- 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



CS 4 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
1. 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>
2. 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>
3. 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:

- Diversity and its potential effects on career choices
- Outline human psychological development and needs in relation to career development
- Outline relevant policy, legislation, codes of practice and standards relevant to career development
- Explain recruitment and selection processes in the context of career development services
- Describe a range of data gathering and research techniques
- Explain techniques used to analyze trends.



CS 5 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
1. 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
2. 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
3. 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:

- 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



- **Communication techniques and micro-skills including:**
 - attending behaviors active listening, reflection of content feeling, summarizing
 - questioning skills open, closed, simple and compound questions
 - client observation skills
 - noting and reflecting skills
 - providing client feedback
- **Components of the communication process including:**
 - encoder
 - decoder
- **Primary factors that impact on the communication process including:**
 - context
 - participants
 - rules
 - messages
 - channels
 - noise
 - feedback
- **Communication barriers and resolution strategies, including:**
 - environmental
 - physical
 - individual perceptions
 - cultural issues
 - language
 - age issues
 - disability
- **Observational techniques including:**
 - facial expressions
 - non-verbal behavior
 - posture
 - silence
- **Ways including:**
 - visual in which different people absorb information
 - auditory
 - kinesthetic
- **Impacts of trauma and stress on the communication process, including on:**
 - concentration and attention
 - memory
 - Intelligence
 - use of verbal and written language
 - use of body language
 - challenging within the counseling session
- **Self-evaluation practices, including:**
 - how to recognize own biases
 - Impact of own values on the counseling relationship



CS 6 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
1. 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
2. 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. Identify and implement workplace procedures and work instructions for controlling risks P4. Report emergency incidents and injuries to designated persons P5. Maintain emergency contact list
3. 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
4. Follow safety procedures	P1. Identify and report emergency incidents P2. Follow organizational procedures for responding to emergency incidents P3. Check of 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:

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



CS 7 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
1. 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
2. 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
3. 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).
4. 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:

- Application of good manners and right conduct
- Basic practices for oral and personal hygiene
- Common products used for oral and personal hygiene
- Outline the company code of conduct/values



National Competency Standards for “Metallurgy and metal casting”



- Outline the Company regulations, performance and ethical standards
- Work responsibilities/job functions
- Communication skills
- Workplace hygiene standards



2. Senior Caster

CS 8 Perform Shell Mold Casting

Overview: This competency standard covers the skills and knowledge required to Read and Understand to Arrange pattern for casting, Create shell mold for casting, Assemble mold for casting, Cast molten metal in mold, Perform cooling process, Remove casting from mold.

Competency Units	Performance Criteria
CU1. Arrange pattern for casting	P1. Handle a two-piece metal pattern in the shape of desired part P2. Use aluminum for low volume production of patterns / graphite for casting reactive materials
CU2. Create shell mold for casting	P3. Heat each pattern half to 175-370°C as per standard operating procedures P4. Coat pattern with a lubricant to facilitate removal process P5. Clamp the heated pattern to a dump box containing a mixture of sand and a resin binder P6. Invert the dump box allowing sand-resin mixture to coat the pattern P7. Create shell around the heated pattern while curing the mixture in an oven P8. Eject the shell from the pattern
CU3. Assemble mold for casting	P9. Insert cores in the mold as per requirement P10. Join the two shell halves together P11. Clamp the halves to form a complete shell mold P12. Place the shell mold into a flask supported by a backing material
CU4. Cast molten metal in mold	P13. Pour molten metal from ladle into the gating system P14. Ensure the mold is securely clamped together while the molten metal is poured P15. Fill the mold cavity completely with the melt
CU5. Perform cooling process	P16. Allow molten metal to cool for standard time in the mold P17. Carry out solidification of melt into the shape of the final casting



CU6. Remove casting from mold	P18. Break the mold after the metal is cool down P19. Shake out any sand from the mold P20. Trim any excess metal from the feed system P21. Carry out visual inspection of casting P22. Prepare observation data sheet(ODS) and report to concerned department
--------------------------------------	---

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.** Understand shell mould casting process
- K2.** Demonstrate shell mould 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:

- Identify welding requirements according to welding symbols given in the manufacturing drawings
- Identify material specifications according to manufacturing drawing
- Identify bill of material (BOM) according to manufacturing drawing
- Interpret dimensional tolerances according to manufacturing drawing
- Assemble and tack weld parts according to manufacturing drawing

Tools and Equipment

- ❖ Clamping device
- ❖ Dump box
- ❖ Shell
- ❖ Mold
- ❖ Dies
- ❖ Transfer Ladles
- ❖ Tongs
- ❖ crucible
- ❖ Dies



National Competency Standards for “Metallurgy and metal casting”



- ❖ Die coats
- ❖ Metal holding pot
- ❖ Furnace
- ❖ Transfer ladles
- ❖ PPE



CS 9 Perform Investment Casting

Overview: This competency standard covers the skills and knowledge required to Read and Understand to Arrange pattern for casting, Create mold for casting, Cast molten metal in mold, Perform post-casting operations.

Competency Units	Performance Criteria
CU1. Arrange pattern for Casting	<p>P1. Arrange wax patterns as per requirement</p> <p>P2. Use cores to form any internal features on the pattern if required</p> <p>P3. Attach patterns to a central wax gating system (sprue, runners, and risers) to form a tree-like assembly</p>
CU2. Create mold for casting	<p>P1. Place wax tree-like assembly into mold flask</p> <p>P2. Prepare slurry by mixing ceramic powder with water and stir it homogenously</p> <p>P3. Perform degassing of slurry in vacuum chamber</p> <p>P4. Pour slurry into the flask to coat the wax pattern tree</p> <p>P5. Bake the shell as per standard to form a ceramic shell around the patterns and gating system</p> <p>P6. Remove the wax leaving a hollow ceramic shell that acts as a one-piece mold</p>
CU3. Cast molten metal in mold	<p>P1. Pre-heat mold in a furnace as per SOP</p> <p>P2. Apply protective coating to mold as per standard</p> <p>P3. Pour molten metal from a ladle into the gating system of the mold</p> <p>P4. Carry out complete filling of the mold cavity with liquid melt as per standard operating procedure</p>
CU4. Perform post-casting operations	<p>P5. Allow for adequate solidification time into the shape of the final casting</p> <p>P6. Break the ceramic mold and remove the casting as per SOP</p> <p>P7. Separate the parts from the gating system by either sawing or cold breaking (using liquid nitrogen)</p> <p>P8. Perform finishing operations such as grinding or sandblasting to smooth the part at the gates</p>



	P9. Clean up work area and equipment and dispose of waste according to environmental 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.** identification of precious metals and alloys
- K2.** calculations for proportions/quantities of alloys
- K3.** data recording procedures
- K4.** consequences of poor work practices
- K5.** melting points of various metals/alloys
- K6.** furnace start-up and shut-down procedures
- K7.** housekeeping and equipment cleaning procedures
- K8.** safe work practices and procedures
- K9.** identifying metals and their alloys
- K10.** weighing metals and their alloys
- K11.** setting up, checking and operating equipment
- K12.** maintaining furnace temperatures
- K13.** heating metals and alloys
- K14.** applying safe casting procedures
- K15.** working within heating timeframe constraints

Critical Evidence(s) Required

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

- Identify welding requirements according to welding symbols given in the manufacturing drawings
- Identify material specifications according to manufacturing drawing
- Identify bill of material (BOM) according to manufacturing drawing
- Interpret dimensional tolerances according to manufacturing drawing
- Assemble and tack weld parts according to manufacturing drawing

Tools and Equipment

- ❖ Shell Coater
- ❖ Engineered Drying machines
- ❖ Slurry Tanks
- ❖ Fluid-Bed Tanks



National Competency Standards for “Metallurgy and metal casting”



- ❖ Shell Handlers
- ❖ Casting Handlers
- ❖ Barrel Sanders
- ❖ Fluidized Bed Sanders
- ❖ Grinders
- ❖ Cut-Off Machines
- ❖ Automated Casting Finishing Cells
- ❖ Casting Positioner



3. Heat Treatment-II

CS 10 Perform stress relieving, austempering and martempering

Overview: This competency standard covers the skills and knowledge required to perform stress relieving, austempering and martempering.

Competency Units	Performance Criteria
CU4. Perform stress relieving	<p>P1. Handle the job as per SOP</p> <p>P2. Place the job in the furnace</p> <p>Control the temperature of the furnace as per given job</p> <p>Set standard soaking time of the heat treatment cycle as per given job</p> <p>Turn off the furnace, once the required temperature and soaking time is achieved.</p> <p>P5. Remove the job from the furnace and cool in the air.</p> <p>P6. Clean the job and prepare observation data sheet.</p>
CU5. Perform Austempering treatment on steel	<p>P1. Handle the job as per SOP</p> <p>P2. Place the workpiece in the furnace</p> <p>P3. Adjust the temperature in the austenitic range and soaking time of the furnace according to steel grade and size.</p> <p>P4. Turn of the furnace once the required temperature and soaking time is achieved.</p> <p>P5. Let the workpiece to quench in a salt bath maintained at a temperature above the martensitic start (MS) range.</p> <p>P6. Hold the workpiece in a salt bath till the complete transformation of bainite.</p> <p>P7. Remove the workpiece from the salt bath and cool in the air.</p> <p>P7. Clean the workpiece and referred it to the next section.</p>
CU6. Perform Martempring treatment of steel	<p>P1. Handle the workpiece with appropriate care</p> <p>P2. Place the workpiece in the furnace</p> <p>P3. Adjust the temperature above the upper critical range and soaking time of the furnace according to steel grade and size.</p> <p>P4. Turn off the furnace, once the required temperature and soaking time is achieved.</p>



	<p>P5. Remove the workpiece from furnace and quenched in a salt bath, kept at a temperature of 150-300°C.</p> <p>P6. Hold the workpiece in bath, until the temperature becomes uniform throughout the cross section of workpiece.</p> <p>P7. Remove the workpiece from salt bath and cooled in air to room temperature.</p> <p>P8. 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:

Knowledge & Understanding

K1. Types of carbon steel.

K2. Explain the effect of carbon on hardness.

K3. Explain Iron-Carbon diagram

K4. Explain the effect of heat treatment on the formation of different phases.

Critical Evidence(s) Required

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

- Identify the required temperature w.r.t desired treatment.
- Identify the soaking time w.r.t the size of workpiece.
- Identify the cooling medium w.r.t the desired treatment

Tools & Equipment

- ❖ Heating Furnaces
- ❖ Long tong
- ❖ Quenching bath



CS 11 Perform Case Hardening process

Overview: This competency standard covers the skills and knowledge required to Perform Flame hardening, Induction hardening treatment, Carburising and Nitriding treatment on carbon steels, Alloy steels and cast iron

Competency Units/Task	Performance Criteria/Step
CU1. Perform Flame hardening	<p>P1. Place the workpiece in flame exposed area</p> <p>P2. Wear the safety gloves and goggles.</p> <p>P3. Adjust the oxyacetylene flame torch.</p> <p>P4. Heat the surface of workpiece as per standard time.</p> <p>P5. Quench the workpiece in quenching media as per job requirement</p> <p>P1. Perform tempering of job as per requirement</p> <p>P6. Clean the workpiece and prepare report of all findings</p>
CU2. Perform Induction hardening	<p>P1. Install induction coil as per job requirement</p> <p>P2. Supply water to induction coil and quenching medium</p> <p>P3. Switch on the main power supply</p> <p>P4. Check the cooling system of electric panel</p> <p>P5. Set the frequency of heating machine as per job requirement</p> <p>P6. Place the specimen between the heating coil</p> <p>P7. Adjust the vertical movement of attachment as per job requirement</p> <p>P8. Adjust water flow of heating coil</p> <p>P9. Energize the heating coil</p> <p>P10. Control the heat-up time as per job requirement</p> <p>P11. Quench the job in quenching media</p> <p>P12. Remove the job from attachments</p> <p>P13. Perform tempering of job as per requirement</p> <p>P14. Clean the job and referred them to the next section.</p>
CU3. Perform pack carburizing	<p>P2. Handle the job as per standard</p> <p>P3. Pack the job in carbonaceous material in steel box and seal the boxes by suitable method.</p> <p>P4. Place the steel box in heating furnace.</p> <p>P5. Heat the job for suitable time and temperature.</p> <p>P6. Turn off the furnace after standard heat treatment cycle</p>



	<p>P7. Remove the steel box from furnace, and recover the specimen.</p> <p>P8. Place the job in heat treatment furnace</p> <p>P9. Switch on the furnace</p> <p>P10. Carry out heat treatment cycle for hardening</p> <p>P11. Allow soaking time as per job requirement</p> <p>P12. Quench the job in quenching medium as per requirement</p> <p>P13. Perform tempering of job as per requirement</p> <p>P14. Clean the job and refer to the next section.</p>
CU4. Perform Gas Nitriding	<p>P1. Energize the furnace as per SOP</p> <p>P2. Set the pressure of feed gas(NH₃,N₂,H₂)</p> <p>P3. Place the sample in the furnace.</p> <p>P4. Adjust the Ammonia (NH₃) environment in the furnace.</p> <p>P5. Adjust the temperature and soaking time of the furnace.</p> <p>P6. Turn off the furnace after completion of the process</p> <p>P7. Remove the samples from furnace</p> <p>P8. Clean the samples and referred them to the next section.</p>
CU5. Perform liquid Nitriding	<p>P1. Energize the furnace as per SOP</p> <p>P2. Prepare cyanide salt bath in a suitable container</p> <p>P3. Dip the sample in salt bath with appropriate fixtures</p> <p>P4. Adjust the required temperature of the salt bath</p> <p>P5. Allow soaking time as per job requirement</p> <p>P6. Remove the sample from furnace once the temperature reaches to the required range.</p> <p>P7. Immerse the sample in salt bath for a prescribed time.</p> <p>P8. Remove the sample from salt bath, clean it 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:

Knowledge & Understanding

K1. Induction heating principle



K2. Explain oxyacetylene flame heating zones

K3. Explain cast iron, carbon steel and alloy steel

K4. Explain surface hardening

K5. Explain the preparation of salt bath

Critical Evidence(s) Required

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

- Identify the surface hardening depth in induction heating
- Identify the surface hardening depth in flame hardening
- Identify the holding time in the heat exposed area
- Identify the quenching medium
- Identify the case hardening treatment

Tools & Equipment

- ❖ Induction heating coil or apparatus
- ❖ Oxyacetylene torch
- ❖ Gas cylinders
- ❖ Quenching bath
- ❖ Salt bath
- ❖ Long tong



4. Non Destructive Testing technician

CS 12 Perform Hardness Tests

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/Task	Performance Criteria/Step
CU1. Measure hardness of the specimen by using 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 using 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 using 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> <p>P5. Apply load on the specimen for standard time period.</p> <p>P6. Note the Vickers Hardness number from the gauge.</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 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

Tools and Equipment

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



CS 13 Perform Impact Tests

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/Task	Performance Criteria/Step
CU1. Measure toughness of the specimen by using 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 using 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 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

Tools and Equipment

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



CS 14 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/Task	Performance Criteria/Step
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 of specimen	<p>P1. Inspect the dimensions of standard specimen with the help of measuring instruments.</p> <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.

K11. Describe working of UTM.

Critical Evidence(s) Required

Tools and Equipment

- ❖ Universal Testing Machine
- ❖ Measuring Instruments



CS 15 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.



Tool and Equipment

- ❖ Torsion test machine
- ❖ Fatigue test machine
- ❖ Measuring Instruments



5. Metallography Technician-I

CS 16 Perform Sectioning, Cutting and Rough Grinding

Overview: This competency standard covers the skills and knowledge required to Perform Sectioning, Cutting and basic Grinding operations for Metallography of Metallic materials.

Also determine Sectioning, Cutting and basic grinding requirements, Check the operations of equipment, Perform visual inspection to finish operations.

Competency Units/Task	Performance Criteria/Step
CU1. Perform labeling, and marking	<p>P7. Label the identification number to recognize specimen identity.</p> <p>P8. Perform proper documentation with date & time in log book.</p> <p>P9. Record the initial conditions of Specimen.</p> <p>P10. Use the measuring tool for marking.</p> <p>P11. Mark the cutting area with permanent marker, to be sectioned or cut.</p>
Perform Sectioning & Cutting Operation	<p>P1. Adopt standard safety practice and procedure for handling sectioning operation.</p> <p>P2. Gripe the specimen area of interest, which will be easier in handling during grinding and polishing.</p> <p>P3. Select of the abrasive blade depend upon material type.</p> <p>P4. Identify proper cutting requirement and the correct selection of abrasive type, bonding, and size; as well as proper cutting speed, load and coolant.</p> <p>P5. The sectioning operation can be obtained by abrasive cutting (metals and metal matrix composites), diamond wafer cutting (ceramics, electronics, biomaterials, minerals), or thin sectioning with a microtome (plastics).</p>
Perform Rough Grinding Operation	<p>P1. Adopt standard safety practice and procedure for handling rough grinding operation.</p> <p>P2. Select of the abrasive blade depend upon material type.</p> <p>P3. Gripe the specimen in hands then place on abrasive wheel.</p>



	P4. Remove the sharp edges and corner of specimen.
--	---

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:

K14. Define purpose of labeling and documentation.

K15. Describe safety symbols for acid chemical.

K16. Explain sectioning techniques

K17. Define General marking.

K18. Define fine rough grinding.

K19. Define cutting materials

Critical Evidence(s) Required

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

- Identify metallographic requirements for cutting according international standards given in the ASTM.
- Identify material specifications for rough grinding according to metallographic standard requirements
- Identify cutting materials according to metallographic standard
- Assemble cutting machine according to metallographic standard

Tools and Equipment

- ❖ cutting tools & equipment
- ❖ rough grinding tools & equipment



CS 17 Perform Mounting Operation

Overview: This competency standard covers the skills and knowledge required to Perform Mounting operations for Metallography of Metallic materials. Also determine Mounting requirements, Check the operations of equipment.

Competency Units/Task	Performance Criteria/Step
CU1.Perform Mounting Operation	<p>P1. Identify the mounting method as per requirement of metallographic standards.</p> <ul style="list-style-type: none">• Cold Mounting.• Hot Mounting. <p>P2. Adopt standard safety practice and procedure for handling</p>
CU2. Perform Cold Mounting Operation	<p>P7. Select the specimen side or face, which will be study.</p> <p>P8. Place that side toward bottom of the mounting cup.</p> <p>P9. Prepare the castable mounting material by mixing material A and B.</p> <p>P10. Make past of mounting material by proper mixing.</p> <p>P11. Lubricating the mounting cup by oil.</p> <p>P12. Pour the mixture in mounting cup and leave it for settling.</p> <p>P13. Remove the mounted specimen and ready for next step of metallography.</p>
CU3. Perform Hot Mounting Operation	<p>P1. Switch on the hot mounting machine.</p> <p>P2. Select the area or side of specimen to be mounted.</p> <p>P3. Place that side toward bottom of the mounting die.</p> <p>P4. Measure the mounting material according to standard requirement.</p> <p>P5. Transfer the mounting material into the mounting die.</p> <p>P6. Select the mounting load according to standard and apply.</p> <p>P7. Adjust the mounting temperature as per standard.</p> <p>P8. Select the time for mounting.</p> <p>Remove the specimen from die and ready for next step.</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 purpose of Mounting.
- K2.** Describe safety symbols for cutting.
- K3.** Explain cold mounting techniques
- K4.** Define General grit size ranges
- K5.** Define hot mounting.
- K6.** Define types of mounting materials
- K7.** Explain mounting pressure and temperatures for

Critical Evidence(s) Required

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

- Identify mounting requirements according international standards given in the ASTM.
- Identify mounting time and temperature specifications for cold and hot mounting according to metallographic standard.
- Identify mounting materials according to metallographic standard
- Assemble hot mounting machine step according to metallographic standard

Tools and Equipment

- ❖ Mounting tools & equipment
- ❖ Measuring devices
- ❖ Hand held calculator



CS 18 Perform Fine Grinding Operation

Overview: This competency standard covers the skills and knowledge required to Perform Fine Grinding Operation operations for Metallography of Metallic materials. Also determine Fine Grinding Operation requirements, Check the operations of equipment.

Competency Units/Task	Performance Criteria/Step
CU3. Perform Fine Grinding on Handy Met	<p>P7. Adopt standard safety practice and procedure for handling.</p> <p>P8. Select the set of emery or abrasive paper according to their grit size.</p> <p>P9. Start grinding on paper from 60 to 1200 grit size.</p> <p>P10. Use water during grinding operation.</p> <p>P11. Rotate the specimen at 90 degree after short intervals in manual operation and continuously ground until the scratches from previous grinding direction are removed.</p> <p>P12. Replace paper on requirement.</p>
CU3. Perform Grinding on semi/ fully automatic machine	<p>P1. Identify grinding material specifications (Grit number) according to metallographic standard and type of specimen.</p> <p>P2. Adopt standard safety practice and procedure for handling.</p> <p>P3. Attach or past the abrasive paper on grinding wheel of grinding machine. Grinding step is accomplished by decreasing the abrasive grit size (60 to 1200).</p> <p>P4. Open tape water to lubricating the grinding operation.</p> <p>P5. Rotate the specimen at 90 degree after short intervals in manual operation and continuously ground until the scratches from previous grinding direction are removed.</p> <p>P6. Thoroughly clean the specimen between each abrasive grit size in automated operation.</p> <p>P7. Change the abrasive paper if necessary.</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 purpose of fine grinding in Metallography.
- K2.** Describe safety symbols.
- K3.** Explain fine grinding techniques
- K4.** Define General grit size ranges.
- K5.** Define grinding materials
- K6.** Explain lubrication in fine grinding.
- K7.** Explain fine grinding steps.

Critical Evidence(s) Required

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

- Identify fine grinding requirements according international standards given in the ASTM.
- Identify material specifications for fine grinding according to metallographic standard requirements
- Identify fine grinding materials according to metallographic standard
- Assemble fine grinding machine connections according to metallographic standard

Tools and Equipment

- ❖ grinding tools & equipment
- ❖ lubricating oil
- ❖ abrasive papers.



CS 19 Perform Fine Polishing Operation

Overview: This competency standard covers the skills and knowledge required to Perform Fine Grinding Operation operations for Metallography of Metallic materials. Also determine Fine Grinding Operation requirements, Check the operations of equipment.

Competency Units/Task	Performance Criteria/Step
CU4. Perform Polishing Operation Manually	<p>P1. Identify polishing material specifications (micron number) according to metallographic standard and type of specimen.</p> <p>P2. Adopt standard safety practice and procedure for handling.</p> <p>P3. Attach napped polishing cloth on wheel of machine.</p> <p>P4. Polishing is accomplished by decreasing down the abrasive micron number (09 to 01).</p> <p>P5. Lubricating the grinding operation with special oil.</p> <p>P6. Rotate the specimen at 90 degree after short intervals in manual operation and continuously ground until the scratches from previous polishing direction are removed. Change the abrasive cloth if required.</p>
CU4. Perform Polishing Operation Automatically	<p>P1. Identify polishing material specifications (micron number) according to metallographic standard and type of specimen.</p> <p>P2. Adopt standard safety practice and procedure for handling.</p> <p>P3. Attach napped polishing cloth on wheel of machine.</p> <p>P4. Polishing is accomplished by decreasing down the abrasive micron number (09 to 01).</p> <p>P5. Lubricating the grinding operation with special oil.</p> <p>P6. Thoroughly clean the specimen between each abrasive grit size in automated operation.</p> <p>P7. Change the abrasive cloth if required.</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 purpose of fine polishing in Metallography.
- K2.** Describe safety symbols.
- K3.** Explain fine polishing techniques
- K4.** Define General micron size ranges
- K5.** Define polishing cloths.

Critical Evidence(s) Required

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

- Identify fine polishing requirements according international standards given in the ASTM.
- Identify material specifications for fine polishing according to metallographic standard requirements
- Identify fine polishing materials according to metallographic standard
- Assemble fine polishing machine connections according to metallographic standard

Tools and Equipment

- ❖ polishing tools & equipment
- ❖ Diamond paste.
- ❖ Lubricating oil.



6. Surface Coating technician-I

CS 20 Perform Galvanizing Coating

Overview: This competency standard covers the skills and knowledge required to perform galvanizing of steel materials and observing operational sequence and parameters.

Competency Units/Task	Performance Criteria/Step
CU1. Perform cataloging	<p>P12. Perform documentation of the initial conditions of Specimen and recognize its identity.</p> <p>P13. Adopt standard safety practice and procedure for handling.</p> <p>P14. Prepare job layout according to process requirements</p>
CU2. Perform Cleaning Operation	<p>P1. Carry out cleaning process as per standard requirement.</p> <p>P2. Adopt standard safety practice and procedure for chemical handling.</p> <p>P3. Select the specimen side/face for coating</p> <p>P4. Prepare caustic cleaning solution for treatment with a hot alkali solution to remove dirt and oil.</p> <p>P5. Place specimen in the solution for standard time then remove and rinsing with water.</p> <p>P6. Prepare pickling cleaning solution where the surface rust and scales are removed by using a hydrochloric acid solution.</p> <p>P7. Place specimen in the solution for specific time then remove and rinsing with water.</p> <p>P8. Prepare flux solution where the surface oxides are removed and protected from further oxidation risks.</p> <p>P9. Place specimen in the solution for specific time.</p> <p>P10. Remove the specimen from bath and ready for next step.</p>
CU3. Perform Drying Operation	<p>P13. Place the specimen on the drying holders or fixtures.</p> <p>P14. Arrange specimen in sequence with all safety factors</p> <p>P15. Use hot air blower for drying the specimen.</p>
CU4. Perform Galvanize coating Operation	<p>P7. Identify galvanizing material specifications (Zn or Al %) according to standard and type of galvanizing coating on specimen.</p>



	<p>P8. Adopt standard safety practice and procedure for handling process.</p> <p>P9. Prepare molten metal bath to react specimen surface with molten material.</p> <p>P10. Place specimen in the bath for given time</p> <p>P11. Remove specimen from bath and detract the excess coating material through pressurized air</p>
CU5. Perform quenching Operation	<p>P1. Identify quenching material specifications according to standard and type of galvanizing coating on specimen.</p> <p>P2. Adopt standard safety practice and procedure for handling process.</p> <p>P3. Prepare mild sodium dichromate solution in the bath to prevent the onset of wet storage staining during the early life of galvanizing.</p> <p>P4. Place specimen in the bath for given time then remove.</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:

- K20.** Define purpose of galvanizing.
- K21.** Describe safety symbols for acid chemical.
- K22.** Explain drying and quenching techniques
- K23.** Define General coating thickness ranges
- K24.** Define cleaning types.
- K25.** Define galvanizing materials.
- K26.** Explain galvanizing time and temperatures.
- K27.** Define galvanizing of metals specimen.
- K28.** Explain cleaning steps.

Critical Evidence(s) Required

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

- Identify galvanizing requirements according international standards given in the ASTM.



- Identify cleaning specifications for galvanizing according to standard requirements
- Identify raw materials according to standard.
- Interpret coating examination according to standard.
- Assemble cleaning and galvanizing baths according to standard.

Tools and Equipment

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



CS 21 Perform Conversion Coating (Anodizing)

Overview: This competency standard covers the skills and knowledge required to perform Conversion Coatings of steel materials and observing operational sequence and parameters.

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



	<p>P4. Place the lead sheets or plates on the opposite sides of bath. (Act as cathodes)</p> <p>P5. Connect the both lead plates to electric supply.</p> <p>P6. Place Ti rod or wood coiled with Al wire in the middle of bath. (Act as Anode)</p> <p>P7. Connect the bar to electric supply.</p> <p>P8. Arrange them in sequence and order don't touch each other.</p> <p>P9. Hang the specimen with wire to anode.</p>
CU4. Perform Coating Operation	<p>P1. Identify anodizing specifications.</p> <p>P2. Adopt standard safety practice and procedure for handling process.</p> <p>P3. Switch on rectifier and adjust required current density.</p> <p>P4. Allow coating deposition for specific time.</p> <p>P5. Agitate the bath with air bubbles system.</p> <p>P6. Bath temperature should be maintain from 20-25C.</p> <p>P7. Switch off rectifier and remove specimen.</p>
CU5. Perform Drying Operation	<p>P1. Place specimen in the drying oven.</p> <p>P2. Set temperature the switch on oven.</p> <p>P3. Remove specimen after specific time for drying.</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:

- K29.** Define purpose of anodizing.
- K30.** Describe safety symbols for acid chemical.
- K31.** Explain drying techniques
- K32.** Define General coating thickness ranges
- K33.** Define cleaning types.
- K34.** Define anodizing materials.
- K35.** Explain anodizing time and temperatures.
- K36.** Explain cleaning steps.



Critical Evidence(s) Required

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

- Identify anodizing requirements according international standards given in the ASTM.
- Identify cleaning specifications for anodizing according to standard requirements
- Identify raw materials according to standard.
- Interpret coating examination according to standard.
- Assemble cleaning and anodizing baths according to standard.

Tools and Equipment

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



CS 22 Perform Electrochemical Coating (Electroplating)

Overview: This competency standard covers the skills and knowledge required to perform Electrochemical Coatings of steel materials and observing operational sequence and parameters.

Competency Units/Task	Performance Criteria/Step
CU1. Perform cataloging	<p>P4. Perform proper documentation of the initial conditions of Specimen and recognize its identity.</p> <p>P5. Adopt standard safety practice and procedure for handling.</p> <p>P6. Prepare job layout according to process requirements</p>
CU. Perform Polishing	<p>P1. Adopt standard safety practice and procedure for handling.</p> <p>P2. Select of the abrasive blade depend upon material type.</p> <p>P3. Gripe the specimen in hands then place on abrasive wheel.</p> <p>P4. Remove the sharp edges and corner of specimen.</p> <p>P5. Select the set of emery or abrasive paper according to their grit size.</p> <p>P6. Start grinding on paper from 60 to 1200 grit size.</p> <p>P7. Use water during grinding operation.</p> <p>P8. Rotate the specimen at 90 degree after short intervals in manual operation and continuously ground until the scratches from previous grinding direction are removed.</p> <p>P9. Replace paper on requirement.</p>
CU2. Perform Cleaning Operation	<p>P11. Identify the Cleaning process as per requirement of standards.</p> <p>P12. Adopt standard safety practice and procedure for chemical handling.</p> <p>P13. Select the specimen side or face, which will be coating.</p> <p>P14. Prepare degreasing cleaning solution where steel is treated with solution which removes common dirt and oils.</p> <p>P15. Place specimen in the solution for specific time then remove and rinsing with water.</p> <p>P16. Prepare pickling solution where the surface rust and scales are removed by using alkaline or acidic solution.</p> <p>P17. Place specimen in the solution for specific time then remove and rinsing with water.</p>



	P18. Remove the specimen from bath and ready for next step.
CU3. Perform Solution Preparation	<p>P1. Take glass beaker or polythene tank.</p> <p>P2. Adopt standard safety practice and procedure for handling chemical process.</p> <p>P3. Filled half with distil or deionized water.</p> <p>P4. Add acid and metal salts into solution then mix it slowly and stir it.</p>
CU3. Set up Coating bath	<p>P1. Add prepared solution in the bath of S.S.</p> <p>P2. Adopt standard safety practice and procedure for handling process.</p> <p>P3. Alternatively Arrange the Cu rods for anode and cathode system setup and insulate it.</p> <p>P4. Hang the anode sheets or plates with hooks on anode bar of bath. (Act as Anodes)</p> <p>P5. Connect the plates to electric supply.</p> <p>P6. Hang the cathode specimen with hooks on cathode bar of bath. (Act as cathode)</p> <p>P7. Connect the bar to electric supply.</p> <p>P8. Arrange them in sequence and order don't touch each other.</p>
CU4. Perform Coating Operation	<p>P1. Identify electroplating specifications.</p> <p>P2. Adopt standard safety practice and procedure for handling process.</p> <p>P3. Switch on rectifier and adjust required current density.</p> <p>P4. Allow coating deposition for specific time.</p> <p>P5. Bath temperature should be maintain from 20-25C.</p> <p>P6. Switch off rectifier and remove specimen.</p> <p>P7. Maintain the PH value of electrolyte as per requirement</p>
CU5. Perform Drying Operation	<p>P1. Place specimen in the drying oven.</p> <p>P2. Set temperature the switch on oven.</p> <p>P3. Remove specimen after specific time for drying.</p>



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:

- K37.** Define purpose of Electroplating.
- K38.** Describe safety symbols for acid chemical.
- K39.** Explain drying techniques
- K40.** Define General coating thickness ranges
- K41.** Define cleaning types.
- K42.** Define electrolyte materials.
- K43.** Explain electroplating time and temperatures.
- K44.** Explain cleaning steps.

Critical Evidence(s) Required

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

- Identify electroplating requirements according international standards given in the ASTM.
- Identify cleaning specifications for electroplating according to standard requirements
- Identify raw materials according to standard.
- Interpret coating examination according to standard.
- Assemble cleaning and electroplating baths according to standard.

Tools and Equipment

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



CS 23 Perform Electrochemical Coating (Electrolysis Electroplating)

Overview: This competency standard covers the skills and knowledge required to perform electrolysis electroplating of steel materials and observing operational sequence and parameters.

Competency Units/Task	Performance Criteria/Step
CU1. Perform cataloging	<p>P1. Perform proper documentation of the initial conditions of Specimen and recognize its identity.</p> <p>P2. Adopt standard safety practice and procedure for handling.</p> <p>P3. Prepare job layout according to process requirements</p>
CU. Perform Polishing	<p>P1. Adopt standard safety practice and procedure for handling.</p> <p>P2. Select of the abrasive blade depend upon material type.</p> <p>P3. Gripe the specimen in hands then place on abrasive wheel.</p> <p>P4. Remove the sharp edges and corner of specimen.</p> <p>P5. Select the set of emery or abrasive paper according to their grit size.</p> <p>P6. Start grinding on paper from 60 to 1200 grit size.</p> <p>P7. Use water during grinding operation.</p> <p>P8. Rotate the specimen at 90 degree after short intervals in manual operation and continuously ground until the scratches from previous grinding direction are removed.</p> <p>P9. Replace paper on requirement.</p>
CU2. Perform Cleaning Operation	<p>P1. Identify the Cleaning process as per requirement of standards.</p> <p>P2. Adopt standard safety practice and procedure for chemical handling.</p> <p>P3. Select the specimen side or face, which will be coating.</p>



	<p>P4. Prepare degreasing cleaning solution where steel is treated with solution which removes common dirt and oils.</p> <p>P5. Place specimen in the solution for specific time then remove and rinsing with water.</p> <p>P6. Prepare pickling solution where the surface rust and scales are removed by using alkaline or acidic solution.</p> <p>P7. Place specimen in the solution for specific time then remove and rinsing with water.</p> <p>P8. Remove the specimen from bath and ready for next step.</p>
CU3. Perform Solution Preparation	<p>P1. Take glass beaker or polythene tank.</p> <p>P2. Adopt standard safety practice and procedure for handling chemical process.</p> <p>P3. Filled half with distil or deionized water.</p> <p>P4. Add reducing agent and metal salts into solution then mix it slowly and stir it.</p> <p>P5. Component act as catalyst.</p> <p>P6. Add prepared solution in the bath of S.S or glass beaker.</p> <p>P7.</p>
CU4. Perform Coating Operation	<p>P1. Identify Electroless electroplating specifications.</p> <p>P2. Adopt standard safety practice and procedure for handling process.</p> <p>P3. Hang specimen with Cu/Al wire then immerse in the bath.</p> <p>P4. Use burner or hot plate for heat up solution.</p> <p>P5. Bath temperature should be maintain from 80-85C.</p> <p>P6. Allow coating deposition for specific time.</p> <p>P7. Maintain the PH value of electrolyte as per requirement.</p>
CU5. Perform	<p>P1. Place specimen in the drying oven.</p>



Drying Operation	P2. Set temperature the switch on oven. P3. Remove specimen after specific time for drying.
-------------------------	--

Knowledge & Understanding

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

- K45.** Define purpose of Electrolysis electroplating.
- K46.** Describe safety symbols for acid chemical.
- K47.** Explain drying techniques
- K48.** Define General coating thickness ranges
- K49.** Define cleaning types.
- K50.** Define electrolyte materials.
- K51.** Explain Electrolysis electroplating time and temperatures.
- K52.** Explain cleaning steps.

Critical Evidence(s) Required

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

- Identify electrolysis electroplating requirements according international standards given in the ASTM.
- Identify cleaning specifications for electrolysis electroplating according to standard requirements
- Identify raw materials according to standard.
- Interpret coating examination according to standard.
- Assemble cleaning and electrolysis electroplating baths according to standard.

Tools and Equipment

- ❖ Drying tools & equipment
- ❖ electrolysis electroplating tools & equipment
- ❖ Cleaning tools & equipment
- ❖ Baths & equipment



National Competency Standards for “Metallurgy and metal casting”



- ❖ Measuring devices
- ❖ Hand held calculator
- ❖ Chemical & Glass wares



7. Metal forming technician

CS 24 Perform rolling process

Overview: This competency standard covers the skills and knowledge required to Perform Cold and Hot rolling process as per given requirement.

Competency Units	Performance Criteria
CU1. Perform Cold rolling process as per given requirement	<p>P15. Ensure occupation health safety and environment standards as per requirement</p> <p>P16. Check the Property of Materials</p> <p>P17. Measure the strip dimensions.</p> <p>P18. Set parameters (pressure, current, speed, time temperature cycle, concentration, tension) according to coil specifications</p> <p>P19. Handle command for carrying out the operation</p> <p>P20. Perform Rolling operation with Two-High Rolling Mills</p> <p>P21. Perform Rolling operation with Three-High Rolling Mills</p> <p>P22. Perform Rolling Operation with Four High Rolling Mills</p> <p>P23. Perform Rolling Operation with Shape rolling</p> <p>P24. Monitor the process parameters during operation e.g. RPM, temperature, line tension, pressure, concentration, line speed, coating thickness, etc.</p> <p>P25. Unload the strip and measure the dimensions and properties of Materials.</p>
CU2. Perform Hot rolling process as per given requirement	<p>P14. Ensure occupation health safety and environment standards as per requirement</p> <p>P15. Check the Property of Materials</p> <p>P16. Measured the strip dimensions.</p> <p>P17. Preheat the strip for Hot rolling.</p> <p>P18. Set parameters (pressure, time) according to coil specifications</p> <p>P19. Handle command for carrying out the operation</p> <p>P20. Perform Rolling operation with Two-High Rolling Mills</p> <p>P21. Perform Rolling operation with Three-High Rolling Mills</p>



	<p>P22. Monitor the process parameters during operation e.g. RPM, temperature, line tension, pressure, concentration, line speed, coating thickness, etc.</p> <p>P23. Unload the strip and measure the dimensions and properties of Materials.</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:

- K53.** Define metal forming process
- K54.** Describe types of metal forming processes (bulk deformation and sheet metalworking)
- K55.** Explain types of sheet metalworking (bending, deep or cup drawing, shearing processes and miscellaneous processes)
- K56.** Explain types of rolling process
- K57.** Describe material behavior in metal forming processes
- K58.** Explain temperature in metal forming
- K59.** Explain strain rate sensitivity
- K60.** Explain friction and lubrication in metal forming
- K61.** Describe Basic safety practices regarding rolling process

Critical Evidence(s) Required

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

-

Tools and Equipment

- Measuring Tools
- Two-High Rolling Mills
- Three-High Rolling Mills
- Reheating Furnaces



CS 25 Perform forging process

Overview: This competency standard covers the skills and knowledge required to Perform Open and Closed Die Forging (Cold, Hot).

Competency Units/Task	Performance Criteria/Step
Cu1. Perform Open Die Forging (Cold, Hot)	<p>P1. Ensure occupation health safety and environment standards as per requirement</p> <p>P2. Prepare the metal stock.</p> <p>P3. Check the Property of stock.</p> <p>P4. Check the Property of Materials</p> <p>P5. Measure the stock dimensions.</p> <p>P6. Select the Open dies according to requirement.</p> <p>P7. Preheat the stock for hot forging operation.</p> <p>P8. Apply the forced multiple times to get desired shape</p> <p>P9. Perform Finishing operations.</p>
Cu2. Perform closed/impression die Forging(Cold, Hot)	<p>P1. Ensure occupation health safety and environment standards as per requirement</p> <p>P2. Check the Property of Materials</p> <p>P3. Measured the stock dimensions.</p> <p>P4. Select the open and closed dies according to Shape requirement.</p> <p>P5. Preheat the stock for hot forging operation.</p> <p>P6. Apply force through moveable die to get desired shape</p> <p>P7. Perform Finishing operations</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 metal forming process
- K2.** Hot Forging and Cold Forging
- K3.** Types of open dies and closed dies

Critical Evidence(s) Required



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

- Identify

Tools and Equipment

- Measuring Tools
- Open Dies
- Closed Dies
- Presses
- Reheating Furnaces



CS 26 Perform extrusion process

Overview: This competency standard covers the skills and knowledge required to Perform Hot and cold extrusion.

Competency Units/Task	Performance Criteria/Step
Cu1. Perform Cold Extrusion	<p>P1. Ensure occupation health safety and environment standards as per requirement</p> <p>P2. Prepare the metal blanks.</p> <p>P3. Check the property of Blank.</p> <p>P4. Select the suitable die according to your Requirements.</p> <p>P5. Select the suitable Punch according to your Requirement.</p> <p>P6. Perform forward extrusion</p> <p>P7. Perform backword extrusion</p> <p>P8. Perform hydrostatic extrusion.</p> <p>P9. Compare The output with your Requirements.</p> <p>P10. Perform Finishing operation</p>
Cu2. Perform Hot Extrusion	<p>P1. Ensure occupation health safety and environment standards as per requirement</p> <p>P2. Prepare the metal blanks.</p> <p>P3. Check the Property of Blank.</p> <p>P4. Preheat the stock for hot forging operation.</p> <p>P5. Select the suitable die according to your Requirements.</p> <p>P6. Select the suitable Punch according to your Requirement.</p> <p>P7. Perform forward extrusion</p> <p>P8. Perform backword extrusion</p> <p>P9. Perform hydrostatic extrusion</p> <p>P10. Compare the output with your Requirements.</p> <p>P11. Perform Finishing operation</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 metal forming process

K2. Describe types of metal forming processes (bulk deformation and sheet metalworking)



- K3.** Describe types of bulk deformation(rolling, forging, extrusion and wire and bar drawing)
- K4.** Explain types of sheet metalworking(bending, deep or cup drawing, shearing processes and miscellaneous processes)
- K5.** Explain types of types of extrusion
- K6.** /Describe material behavior in metal extrusion processes
- K7.** Explain temperature in extrusion process
- K8.** Explain strain rate sensitivity
- K9.** Explain friction and lubrication in extrusion.

Critical Evidence(s) Required

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

- Identify

Tools and Equipment

- Measuring Tools
- Dies
- Punches
- Reheating Furnaces
-



CS 27 Perform wire drawing and deep drawing process

Overview: This competency standard covers the skills and knowledge required to Perform Wire Drawing operation and perform deep drawing operation.

Competency Units/Task	Performance Criteria/Step
CU1. Perform Wire Drawing operation	<p>P1. Ensure occupation health safety and environment standards as per requirement</p> <p>P2. Prepare the metal blanks.</p> <p>P3. Check the Property of Blank.</p> <p>P4. Set No of Dies according to requirement.</p> <p>P5. Perform wire drawing operation.</p> <p>P6. Measure the dimeter of wire and match it with requirements.</p>
CU2. Perform Deep Drawing operation	<p>P1. Ensure occupation health safety and environment standards as per requirement</p> <p>P2. Prepare the metal blanks.</p> <p>P3. Check the Property of Blank.</p> <p>P4. Chose the die according to your requirement.</p> <p>P5. Set the Blank Holder</p> <p>P6. Select the punch and set the punch Travel distance.</p> <p>P7. Apply the require force through punch and get the final output.</p> <p>P8. Perform Measuring and finishing operation.</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 metal forming process
- K2.** Describe types of metal forming processes (bulk deformation and sheet metal working)
- K3.** Describe types of bulk deformation (rolling, forging, extrusion and wire and bar drawing)
- K4.** Explain Bending, Straightening, Friction, Compression and Tension.
- K5.** What is difference Between wire drawing and Extrusion
- K6.** Difference between Wire Drawing and Deep drawing.
- K7.** Types Of punches
- K8.** Types Of dies.



- K9.** Explain types of sheet metal working (bending, deep or cup drawing, shearing processes and miscellaneous processes)
- K10.** Explain types of rolling process
- K11.** Explain types of forging process
- K12.** Explain types of extrusion process
- K13.** Describe material behavior in metal forming processes
- K14.** Explain temperature in metal forming
- K15.** Explain strain rate sensitivity
- K16.** Explain friction and lubrication in metal forming

Critical Evidence(s) Required

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

- Perform wire drawing operation.
- Perform deep drawing operation.

Tools and Equipment

- Punches
- Dies
- Blank Holder



8. QC Inspector-I

CS 28 Perform inspection

Overview: This competency standard covers the skills and knowledge required to understand products and process inspection, record keeping and feedback provision.

Competency Units/Task	Performance Criteria/Step
CU1. Inspect products and process	<p>P1. Test casting defects for conformance to specifications in accordance with standard operating procedures.</p> <p>P2. Test forging defects for conformance to specifications in accordance with standard operating procedures.</p> <p>P3. Test molding process for conformance to specifications in accordance with standard operating procedures.</p> <p>P4. Test Heat treatment process for conformance to specifications in accordance with standard operating procedures.</p>
CU2. Keep records	<p>P1. Ensure identification of conforming products</p> <p>P2. Ensure identification of non-conforming products</p> <p>P3. Ensure identification of conforming process</p> <p>P4. Ensure identification of non-conforming process</p> <p>P5. Maintain records accurately using standard operating procedures</p>
CU3. Provide feedback	<p>P1. Test products after rework or repair</p> <p>P2. Inspect products after rework or repair</p> <p>P3. Measure products after rework or repair</p> <p>P4. Report Deficiencies or deviations according to standard operating procedures.</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 the procedures as defined by job instructions to be used to check conformance to specifications

K2. define data to be recorded and the frequency of recording required



- K3.Explain the consequences of not keeping accurate records**
- K4.Describe non-conformances of given products that can be removed by rework/repair in accordance with job instructions**
- K5.Define hazards and control measures associated with performing basic inspection activities**
- K6.Explain tests of casting defects**
- K7.Explain tests of forging defects**
- K8.Explain application of personal protective equipment**
- K9.Explain safe work practices and procedures**

Critical Evidence(s) Required:

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

- Identify casting defects
- Identify forging defects
- Make conformance reports
- Make non-conformance reports
- describe safe working conditions while analyzing casting defects
- Describe the importance of record keeping

Tools and Equipment:

- ❖ Inspection tools and equipment
- ❖ PPE



CS 29 Select and control inspection process and procedures

Overview: This competency standard covers the skills and knowledge required to understand the selection of inspection test and procedures along with their controls.

Competency Units/Task	Performance Criteria/Step
CU1. Select inspection/test procedures	P1. Understand incoming inspection P2. Understand in-process and in-product control inspection P3. Understand final inspection P4. Select appropriate methods of inspection P5. Implement appropriate methods of inspection P6. Ensure desired outcome by monitoring inspection process and procedures
CU2. Control inspection/test environment and equipment	P1. Monitor Environmental conditions to ensure reliability of tests and results P2. Check Equipment/instruments for correct calibration P3. Ensure calibration of equipment/instruments initiated or undertaken against appropriate standard as required P4. Maintain calibration record as per standard operating procedures P5. Check validity of previous results in case of finding out of calibration equipment P6. Report as per standard operating procedures

Knowledge & Understanding

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

- K1. Describe a range of inspection methods and their application**
- K2. Define the appropriate inspection method for the process/product**
- K3. Explain procedures for implementing inspection methods**
- K4. Define the desired/target outcomes of the inspection/test procedures**
- K5. Explain reasons for discrepancies/trends**
- K6. Define procedures for monitoring inspection/test procedures**

Critical Evidence(s) Required:

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



National Competency Standards for “Metallurgy and metal casting”



- Identify and implement various method of inspection

Tools and Equipment:

- ❖ Inspection instruments



CS 30 Ensure calibration

Overview: This competency standard covers the skills and knowledge required to Read and understand the calibration of mechanical equipment, instruments and tools, mechanical testing machines and mechanical machines

Competency Units/Task	Performance Criteria/Step
CU1. Ensure calibration of mechanical equipment	P1. Understand calibration. P2. Understand pressure calibration P3. Understand temperature calibration P4. Understand flow calibration P5. Understand electrical calibration P6. Understand mechanical calibration P7. Identify the standards required for calibration of each mechanical equipment P8. Ensure the calibration of each mechanical equipment P9. Keep record of calibrated and non- calibrated equipment.
CU2. Ensure calibration of mechanical machines	P1. Understand calibration P2. Understand Transducer calibration P3. Understand Data system calibration P4. Understand Physical end-to-end calibration P5. Identify the standards required for calibration of each mechanical machines P6. Ensure the calibration of mechanical machines P7. Keep record of calibrated and non- calibrated machines
CU3. Ensure calibration of mechanical instruments and tools	P1. Understand calibration. P2. Identify the standards required for calibration of each mechanical instruments and tools P3. Ensure the calibration of mechanical instruments and tools P4. Keep record of calibrated and non- calibrated instruments and tools
CU4. Ensure calibration of mechanical testing machines	P1. Understand calibration. P2. Identify the standards required for calibration of each mechanical testing machines P3. Ensure the calibration of mechanical testing machines P4. Keep record of calibrated and non- calibrated mechanical testing machines



--	--

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 calibration

K2. Describe how to calibrate testing machines

K3. Explain the calibration of measuring equipment, tools and equipment

K4. Explain safe workplace practices

Critical Evidence(s) Required:

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

- Identify calibrated and non-calibrated mechanical instruments and tools
- Identify calibrated and non-calibrated mechanical machines
- Identify calibrated and non-calibrated mechanical testing machines
- Identify calibrated and non-calibrated mechanical equipment

Tools and Equipment:

- ❖ Measuring tools and instruments
- ❖ Measuring equipment