National Competency Standards for "Metallurgy and Metal casting"

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

ACKNOWLEDGEMENT

National Vocational and Technical Training Commission (NAVTTC) extends its gratitude and appreciation to representatives of business, industry, academia, government agencies, provincial TEVTAs, sector skill councils and trade associations who spared time and extended their expertise for the development of National Vocational Qualifications for the trade of **Metallurgy and metal casting.** This work would not have been possible without the technical support of the above personnel.

NAVTTC initiated development of CBT&A based qualifications for 200 traditional / hi-tech trades under the Prime **Minister's Hunarmand Pakistan Program,** focusing on Development & Standardization of 200 Technical & Vocational Education & Training (TVET) Qualifications. NAVTTC efforts have received full support from the Ministry of Federal Education and Professional Training, 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, NAVTTC accepts the responsibility of all the errors and omissions still prevailing in the qualification document.

It is also noteworthy that development of Skill Standards is a dynamic and 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. NAVTTC will ensure to keep the qualifications abreast with the changing demands of both national and international job markets.

Dr. Nasir Khan,
Executive Director,
NAVTTC

1. Contents

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 (NAVTTC) 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	2nd Level National Certificate of level-5 Qualification, in "Metallurgy and Metal casting"
2	3rd Level National Certificate of level-5 Qualification, in "Metallurgy and Metal casting"
3	4th Level National Certificate of level-5 Qualification, in "Metallurgy and Metal casting"
4	5th 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	NVQF Level	Category	Estimated Contact Hr.			Credit Hr.
					Th.	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

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	

		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			`15	30	30	
		Total			33	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 (Electrolesis 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	

		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

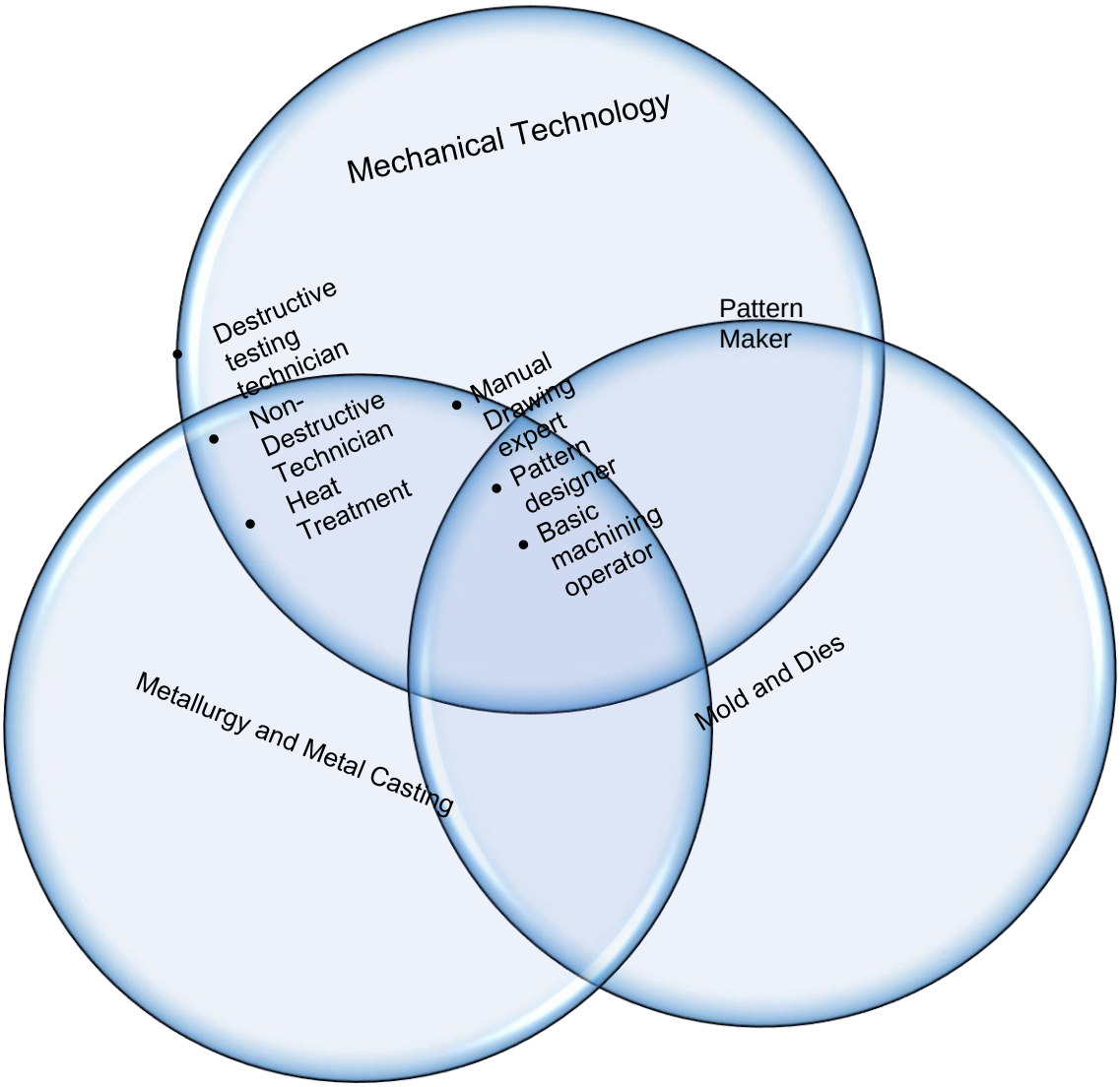
Sr.	Occupation	Duties/Competency Standards
	Level 2 **Technician in metallurgy and metal casting**	
1	**Manual Drawing Expert**	1. Perform Basic Manual Drawing 2. Construct different Engineering Curves. 3. Construct multi-view drawings
2	**Basic Machining Operator**	4. Perform metal/bench work 5. Perform 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

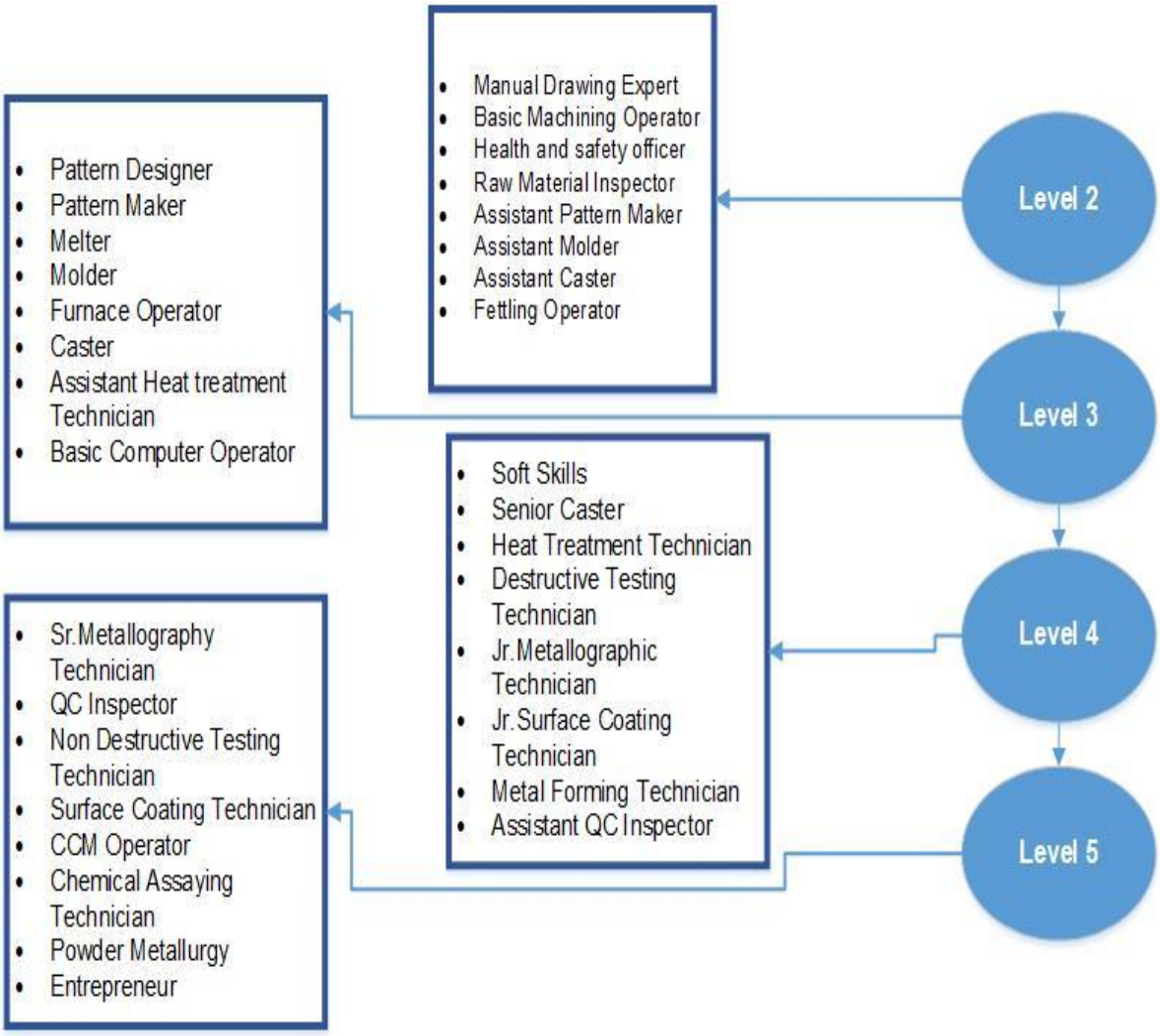
21	**Jr.Metallographic technician**	65. Perform Sectioning, Cutting and Rough Grinding 66. Perform Mounting Operation 67. Perform Fine Grinding Operation 68. Perform Fine Polishing Operation
22	**Jr.Surface coating technician**	69. Perform Galvanizing Coating 70. Perform Conversion Coating (Anodizing) 71. Perform Electrochemical Coating (Electroplating) 72. Perform Electrochemical Coating (Electrolesis 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**	98. Develop project proposal 99. Apply management and communication techniques 100. Create human resource management plan 101. Develop project management plan 102. Develop sales plan 103. Conduct research for customer needs and satisfaction 104. Manage finances 105. Identify and resolve problems 106. Create Manage profile on Non-Traditional Freelancing platform 107. Create Manage profile on Traditional Freelancing platform 108. Write professional proposal for projects 109. Develop communications skills

12. Mapping of the Qualification



13. Mapping of Occupations



14. Detail of Qualification and its Competency Standards

1. Engineering Drawing

CS 1 Perform Basic Manual Drawing

Overview: This competency standard covers the skills and knowledge required to draw single stroke capital vertical lettering, single stroke capital inclined lettering, horizontal, vertical and inclined lines, circles, half circles, radius, drawing center lines, centers, curves, and crossing of lines, construction of parallel-lines.

Competency Units	Performance Criteria
CU1. Draw single stroke capital vertical and inclined lettering.	**P1.** Prepare drawing sheet. **P2.** Select the tools. **P3.** Use proper pencil for lettering with holding techniques. **P4.** Draw boundaries lines as per standards. **P5.** Make title block **P6.** Draw upper and lower lines for lettering according to standards. **P7.** Start writing vertical lettering with different style like gothic, italic and free hand lettering.
CU2. Draw horizontal, vertical and inclined lines.	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw lines at 30, 45, 60,90and 120 angles.
CU3. Draw circles, half circles, radius with compass	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar

	P5. Divide the sheets in different equal parts. **P6.** Make different diameters circles and half circles.
CU4. Draw Lines	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw Center lines, **P7.** Draw parallel-lines **P8.** Draw perpendicular & bisects line **P9.** Draw equal division of lines **P10.** Make different angle curves. **P11.** Draw crossing line
CU5. Draw round corners, circles elements, quadrilaterals inside and outside circle.	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title block **P5.** Divide the sheets in different equal parts. **P6.** Make different dia circles. **P7.** Make inside and outside different types of diagrams that touch the circles at the tangent points.
CU6. Construct different triangles	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title block **P5.** Divide the sheets in different equal parts. **P6.** Draw Equilateral Triangle, Isosceles triangle, Scalene Triangle, Right Triangle, Obtuse Triangle, Acute Triangle.

Knowledge & Understanding

- **K1.** Importance of Technical Drawing.
- **K2.** Symbols of engineering terminology.
- **K3.** Uses of technical Drawing tools
- **K4.** Type of Drawing
- **K5.** Application of Technical drawing

K6. Drawing Pencil, their grading, sharpening and using techniques.
K7. Style of letters.
K8. General rules for lettering
K9. Basic lines
K10. Importance of lines
K11. Common Types of lines and correct line weightage.
K12. Application of lines.
K13. Introduction to geometry
K14. Introduction to sketching techniques.
K15. Techniques of sketching straight lines in different directions.
K16. Define Triangles, Quadrilateral, and Polygons.

Tool & Equipment

- Graph and drawing sheet.
- Drawing board/table.
- T-Square
- Set Square.
- Templets.
- Compass.

CS 2 Construct different Engineering Curves

Overview: This competency standard covers the skills and knowledge required to Construct inscribe and circumscribe figures, Construct a pentagon, Hexagon and Octagon by circumscribe method, Construct a pentagon, Hexagon and Octagon by inscribe method, Construct a Tangents of circles (Inside & Outside) When the centre of the given circle is known and when the circle of centre is not known, Construct an Ellipse by Concentric Circle Method, Rectangle Method, Oblong Method, Arcs of Circle Method, Rhombus Method and Basic Locus Method.

Competency Units	Performance Criteria
CU1 Construct inscribe and circumscribe figures.	**P1.** Prepare drawing sheet. **P2.** Select the tools. **P3.** Draw boundaries lines as per standards. **P4.** Make title block **P5.** Divide the sheets in different equal parts. **P6.** Draw triangle, square, pentagon, hexagon and octagon according to dimension.
CU2 Construct Tangents of circles (Inside & Outside)	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw Tangents Inside of a circle When the centre of the circle is known. **P7.** Draw Tangents Inside of a circle When the centre of the circle is unknown **P8.** Draw Tangents outside of a circle When the centre of the circle is known **P9.** Draw Tangents outside of a circle When the centre of the circle is unknown
CU3 Construct Ellipse	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards.

	P4. Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw an Ellipse by Concentric Circle. **P7.** Draw an Ellipse by Rectangle Method **P8.** Draw an Ellipse by Oblong Method **P9.** Draw an Ellipse by Arcs of Circle Method **P10.** Draw an Ellipse by Rhombus Method. **P11.** Draw an Ellipse by Basic Locus Method
CU4 Construct a parabola curve	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw a parabola curve by Rectangle **P7.** Draw a parabola curve by Method of Tangents(Triangle Method) **P8.** Draw a parabola curve by Basic Locus Method
CU5 Construct a hyperbola curve	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw a hyperbola curve.
CU6 Construct a Archimedean Spiral curve	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw spiral curve.
CU7 Construct involute curve	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards.

	P4. Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw involute curve by square **P7.** Draw involute curve by rectangle **P8.** Draw involute curve by hexagon **P9.** Draw involute curve by circle.
CU8 Construct of cycloid, epicycloid, and hypocycloid	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw the generating circle and the base line equal to the circumference of the generating circle **P7.** Divide the circle and the base line in to equal number of parts **P8.** Complete the cycloid, epicycloids, and hypocycloid.

Knowledge & Understanding

K1. Techniques of sketching straight lines in different directions

K2. Define Triangles, Quadrilateral and Polygons

K3. Describe circular arc using different line method

K4. Describe circular arc

K5. Types of Geometric Shape

K6. Two-dimensional shapes

K7. Three-dimensional shapes

K8. Types of Geometric Shape

K9. Regular Polyhedrons

K10. Methods of drawing Tangents & Normal

K11. Describe ellipse

K12. Describe different methods of sketching ellipse

K13. Describe parabola

K14. Describe different methods of parabola

K15. Describe hyperbola curve

K16. Describe different methods of hyperbola curve.

K17. Describe spiral curve

K18. Describe involute curve

K19. Describe cycloid

K20. Describe epicycloids

K21. Describe hypocycloid

Tool and Equipment

- Graph and drawing sheet
- Drawing Board/Table
- Tee-Square
- Set Square
- Templets
- Compass

CS 3 Construct multi-view drawings

Overview: This competency standard covers the skills and knowledge required to Sketch Orthographic projection 1st angle, Sketch Orthographic projection 3rd angle, Sketch Oblique Drawing, Construct multi view drawing of Simple Bearing, Construct multi view drawing of Open Bearing, Sketch prism, Sketch cone and Draw pyramid.

Competency Units	Performance Criteria
CU1 Sketch Orthographic projection in 1st angle of Projection	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts. **P6.** Draw plan view **P7.** Draw front view **P8.** Draw side view
CU2 Sketch Orthographic projection 3rd angle of Projection	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts. **P6.** Draw plan view **P7.** Draw front view **P8.** Draw side view
CU3 Sketch Oblique Drawing	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts **P6.** Draw the front or side view of the object.
CU4 Construct multi view drawing of Simple Bearing.	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar

	P5. Divide the sheets in equal parts. **P6.** Draw plan view of simple bearing **P7.** Draw front view of simple bearing **P8.** Draw side view of simple bearing
CU5 Construct multi view drawing of Open Bearing	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts. **P6.** Draw plan view of open bearing **P7.** Draw front view of open bearing **P8.** Draw side view of open bearing
CU6 Sketch prism	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts. **P6.** Sketch prism
CU7 Sketch cone	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts. **P6.** Start with a horizontal oval **P7.** draw the two sides of a triangle which meets at a common point
CU8 Draw pyramid	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in equal parts. **P6.** Sketch pyramid

Knowledge & Understanding

K1. Explain Orthographic projection 1st angle.

K2. Explain Orthographic projection 3rd angle.

K3. Explain Oblique Drawing.

K4. Explain Multi view drawing of bearing.

K5. Explain Prism, Cone and pyramid

Tool and Equipment

- Graph and drawing sheet.
- Drawing Board/Table.
- Tea-Square
- Set Square.
- Templets.
- Geometry Box.

2. Basic Machining Operator

CS 4 Perform metal/bench work

Overview: Overview: This competency standard covers the skills and knowledge required to Develop Name Plate manually, Carry out Sawing, Prepare Inside Calliper, Prepare Bottle Opener, Prepare Dovetail Joint, Prepare Tri Square (small size), ,Cut Threads on Work Piece, Prepare Funnel, Prepare Drawer Handle, Cut Pipe Threads and Prepare spanner (small size).

Competency Units	Performance Criteria
CU1. Develop Name Plate manually	**P1.** Select marking tools **P2.** Hold the sheet in vice. **P3.** Cut sheet as per drawing **P4.** Perform surface finishing with file **P5.** Level the surface with tri-square **P6.** Mark the plate as per name requirements **P7.** Punch the marked area **P8.** Perform finishing with sand paper
CU2. Prepare Dovetail Joint	**P1**. Select marking tools **P2**. Cut sheet as per drawing **P3**. Perform surface finishing with file **P4**. Level the surface of both work pieces with tri-square **P5**. Mark both work pieces according to drawing **P6**. Create outer notch on work piece using flat file and hacksaw **P7**. Create inner notch using hacksaw and chisel **P8**. Compare both pieces by inserting outer notch into inner notch **P9**. Perform finishing with sand paper

CU3. Prepare Bottle Opener	**P1**. Select marking tools **P2**. Cut sheet as per drawing **P3**. Perform surface finishing with file **P4**. Level the surface with tri-square **P5**. Mark radius as per drawing **P6**. Develop radius as per drawing **P7**. Make the notch with round file **P8**. . Perform finishing with sand paper
CU4. Cut Threads on Work Piece with tap and die	**P1**.Identify different kind of taps & die according to requirement **P2**. Identify the work piece clamping method. **P3**. Apply tap and die alignment. **P4**. Apply lubricants while threading. **P5**. Avoid unwanted engraving and slips. **P6**. Identify proper threading procedure
CU5. Cut Pipe Threads	**P1**.Select marking tools **P2**. Cut pipe as per drawing **P3**. Select die as per pipe size **P5**. Set die into die holder **P6**. Select relevant vice for pipe clamping **P7**. Perform pipe threading using appropriate method **P8**. Perform finishing with sand paper
CU6. Prepare spanner (small size)	**P1**.Select marking tools **P2**. Cut sheet as per drawing **P3**. Perform surface finishing with file **P4**. Level the surface with tri-square **P5**. Mark radius as per drawing **P6**. Develop radius as per drawing **P7**. Make the notch with round file **P8**. Perform finishing with sand paper

CU7. Prepare Funnel	**P1**. Select marking tools **P2**. Cut sheet as per drawing **P3**. Perform surface finishing with file **P5**. Mark the sheet according to drawing **P6**. Cut the sheet with hand shear **P7**. Create radius of funnel using appropriate tools **P8**. Perform flat lock seam bend using bench vice **P9**.Perform finishing with sand paper.

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 basic measurement
- **K2.** Describe basic measuring /Marking /cutting tools
- **K3.** Describe clamping/holding methods.
- **K4.** Describe types of chisels
- **K5.** Understanding of chiseling process
- **K6.** Understanding of types of files.
- **K7.** Knowledge of radius gauge
- **K8.** Knowledge of different kind of taps & die according to requirement
- **K9.** Knowledge of calculation for drill size for internal threading
- **K10.** Knowledge about clamping of work piece.
- **K11.** Knowledge about threading by die and taps
- **K12.** Knowledge of standard bolts
- **K13.** Understanding proper use of hand shear
- **K14.** knowledge of flat lock seam end in metal sheet working

Tool & Equipment

- Work bench
- Bench vices
- Hammer
- Tri-square
- Hand hacksaw
- Scriber
- Vernier caliper
- Flat File
- Number/alphabet punch
- Round file
- Metal working chisel

- Punching tools
- Tap set
- Tap handle
- Pipe vice

CS 5 Perform cutting on Metal Circular and Power Hack Saw

Overview: This competency standard covers the skills and knowledge required to Carry out Sawing and Carry out Sawing at different angles

Competency Units	Performance Criteria
CU1. Cut material by using power hacksaw	**P1**.Mark the job according to given drawing **P2**. Select appropriate blade according to job requirement **P3**. Set blade in frame of hacksaw as per procedure **P4**. Ensure the work piece is clamped firmly and properly **P5**. Adopt methods and techniques for sawing that is appropriate to job requirement **P6**. Follow marked line during sawing to ensure accuracy.
CU2. Carry out Sawing at differet angles	**P1.** Mark the job according to given drawing **P2.** Select appropriate blade according to job requirement **P3.** Set blade in frame of metal circular saw as per procedure. **P4.** Ensure the blade tightness and rotating side. **P5.** Ensure the work piece is clamped firmly and properly **P6.** Adopt methods and techniques for sawing that is appropriate to job requirement **P7.** Follow marked line during sawing to ensure accuracy.

Knowledge & Understanding
K1. Describe basic measurement
K2. Describe types of hacksaw frames
K3. Describe basic measuring /Marking /cutting tools
K4. Describe clamping/holding methods
K5. Define methods and techniques of sawing.

Tool &Equipment
Workbench
Bench vice
Tri-square
Hand hacksaw with blade
Scriber
Flat File
Vernier caliper
Punching tools
Power hacksaw

CS 6 Perform Grinding operation

Overview: This competency standard covers the skills and knowledge required to perform off-hand grinding and Sharp single point cutting tool on grinding

Competency Units	Performance Criteria
CU1 Perform off-hand grinding	P1. Select the proper size and shape of grinding wheel. P2. Hold the work piece firmly against the rotating wheel by placing it on the tool rest. P3. Use coolant at intervals to avoid over heating of the job. P4. Adopt technique and methods which are safe. P5. Produce component according to work operations. P6. Observe personal and workplace safety.
CU2 Sharp single point cutting tool on grinding	P1. Select the proper size and shape of grinding wheel. P2. Hold the work piece firmly against the rotating wheel by placing it on the tool rest. P3. Use coolant at intervals to avoid over heating of the job. P4. Adopt technique and methods which are safe. P5. Sharp the tool according to work requirements. P6. Observe personal and workplace safety.

Knowledge & Understanding

K1. Types of different grinding machines.
K2. Type, size and shape of wheels and abrasive.
K3. Technique of holding work piece against rotating wheel.
K4. Importance of using coolant.
K5. Methods and techniques for off-hand grinding.
K6. Selecting correct standing position during grinding.
K7. Specific safety precautions and guidelines.

Tool & Equipment

- D-type bevel protector
- Grinding Machine
- Personal Protective Equipment(PPE)
- Wheel Dresser stand
- Dresser

CS 7 Perform Basic Lathe Machine Operations

Overview: This competency standard covers the skills and knowledge required to Perform cantering operations, Perform facing Operations, Perform turning operations, Perform drilling

or boring operations, Perform step turning operations, Perform knurling Operations, Taper turning by tail stock off-set method, Taper turning by plain taper turning attachment, Taper turning by telescopic taper turning attachment and Perform Internal and External threading Operations

Competency Units	Performance Criteria
CU2. Perform facing Operations	P1. Select facing tools according to job requirement. P2. Mount and set the required work-holding devices, work piece and cutting tools. P3. Follow the correct specifications for the part or component to be produced. P4. Select safe procedures and tools to accomplish the work. P5. Adjust the operating parameters (e.g. speed and feed) of machine tool to achieve the work specification. P6. Ensure all safety mechanisms are in place.
CU3. Perform turning Operations	**P1**. Obtain and follow work specifications, drawings or sketches to accomplish the work. P2. Set up and adjust the machine as per work specifications and procedures. Perform turning operation as per requirement P3. Ensure the components produced have the required quality and within the specified dimensional accuracy. P4. Shut down the machine and equipment on conclusion of the machining activities.
CU4. Perform center drilling, drilling and boring operations	**P1**. Select drill or boring tools according to drawings. P2. Mount and set the required work-holding devices, work piece and cutting tools. P3. Adjust the RPM of machine according to the cutting speed. P4. Perform the boring operation according to the drawing. P5. Check quality of the component produced at different intervals. P6. Observe personal and workplace safety.

CU5. Perform step turning operations	**P1**. Mount and set the required work-holding devices, work piece and cutting tools. P2. Select and adjust appropriate speeds and feeds of turning machine. P3. Produce a component which matches the work specifications using appropriate methods and techniques. P4. Check quality of the component produced at different intervals. P5. Follow safety precautions to ensure safe work and to avoid any injury.
CU6. Perform knurling Operations	P1.Select the knurling tool according to drawing. P2. Set the tool and work piece in the machine according to procedure. P3. Adapt methods and techniques to produce proper knurling on work piece. P4. Select and adjust appropriate speeds and feeds of lathe machine. Use coolants during knurling to achieve smooth impression on work piece. P6. Observe personal and workplace safety.
CU6. Perform taper turning by compound rest method	P1. Obtain and follow work specifications, drawings or sketches to accomplish the work. P2. Set up and adjust the machine as per work specifications and procedures. P3. Calculate and set tilting angle of compound rest as per drawing requirement P4. Perform taper turning operation P3. Ensure the components produced have the required quality and within the specified dimensional accuracy. P4. Shut down the machine and equipment on conclusion of the machining activities.

CU7. Perform taper turning by tail stock off-set method	**P1.** Clamp out loosen tailstock. **P2.** Offset tailstock-required amount. **P3.** Centre cutting tool. **P4.** Setup cutting tool for parallel turning. **P5.** Starting at small diameter take excessive cuts until the taper is .05 to .06 in oversize. **P6.** Check taper for accuracy using a taper ring gauge. **P7.** Finish turn the taper to size and fit required.
CU8. Perform taper turning by plain taper turning attachment	**P1.** Remove the binding screw that cross slide to cross feed screw nut. **P2.** Tighten the lock screw and set cutting tool on center. **P3.** Set workpiece in lathe and mark length of taper. **P4.** Use binding screw to connect sliding block to side of taper attachment. **P5.** Select depth of feed cut by compound rest feed handle. **P6.** Take a light cut and recheck taper fit. **P7.** Finish turn and fit the taper to gauge.
CU10. Perform internal and external threading operations	**P1**. Mount and set the required work-holding devices, work piece and cutting tools. P2. Select and adjust appropriate speeds and feeds of turning machine. P3. Produce a component, which matches the work specifications using appropriate methods and techniques. P4. Check quality of the component produced at different intervals. P3.Use Proper cutting tool with required dimensions. P5. Follow safety precautions to ensure safe work and to avoid any injury.

Knowledge & Understanding

- **K1.** Safety precautions involved in work.
- **K2.** Methods and techniques of mounting and setting of work-piece.
- **K3.** Methods and techniques of adjusting operating parameters of machine tool.
- **K4.** Procedure of adjusting speed and feed.
- **K5.** Calculation of speed and feed.

K6. Use of holding and cutting tools
K7. Reading and interpreting work specifications, drawings and sketches.
K8. Method and technique of setting up and adjusting the machine.
K9. Techniques to check quality of component produced.
K10. Procedure of shutting down of machine and equipment after closure of activities.
K11. Safety precautions and procedures need to be observed during work.
K12. Types of drilling or boring tools and their function.
K13. Procedure of mounting and setting up of work-holding devices, work pieces and cutting tools.
K14. Method and technique of adjusting RPM of lathe machine.
K15. Safe boring procedures.
K16. Techniques of checking quality of components.
K17. Calculation of RPM.
K18. Safety precautions and procedures.
K19. Kinds of tapers.
K20. Types of taper turning methods.
K21. Calculation of tapers.
K22. Methods and techniques of adjusting speeds and feeds of turning machine.
K23. Method of checking quality of components produced.
K24. Specific safety guidelines and precautions.
K25. Types of knurling tools.
K26. Types of knurling.
K27. Procedure of setting tools and work piece in the machine.
K28. Methods of knurling.
K29. Procedure of adjusting speeds and feeds of lathe machine. Importance of using coolants during knurling.
K30. Safety precautions and guidelines.
K31. Knowledge of lathe operations
K32. Use of dial indicator
K33. Calculations for taper turnings
K34. Knowledge of lathe operations
K35. Types of threading tool.
K36. Types of threading.
K37. Procedure of setting tools and work piece in the machine.
K38. Methods of threading.

Tool & Equipment

- Lathe Machine
- Cutting Tools
- Measuring Tools
- Personal Protective Equipment
- Files
- Vernier Caliper
- Checking gauges
- Threading Tools

CS 8 Perform Drilling Machine Operations

Overview: This competency standard covers the skills and knowledge required to produce holes using drilling machine, Perform counter boring and counter sinking and perform machine reaming

Competency Units	Performance Criteria
CU1. Produce holes using drilling machine	**P1**. Observe personal and work place safety. P2. Set up drilling machine for producing holes according to job requirement. P3. Manipulate the machine tool controls safely and correctly in line with operational procedures. P4. Produce components to the required quality and within the specified dimensional accuracy. P5. Carry out quality sampling checks at suitable intervals. P6. Shut down the equipment to a safe condition on conclusion of the machining activities.
CU2. Perform counter boring and counter sinking	P1. Select relevant tools according to the information given in engineering drawings and job specifications. P2. Ensure tooling is correct in terms of size, shape, type, and grade for the work. P3. Position the work-piece in the drill in such a way that it is aligned, secured and stable during drilling. P4. Adjust speeds and feeds of drill in accordance with the size, type, and hardness of work-piece material, so that the drill performs optimum cutting without damage to work-piece.
CU3. Perform machine Reaming	P1. Observe personal and workplace safety. P2. Clamp work-piece in the vice properly. P3. Select reamer according to hole size and drawing requirements P4. Set reamer in the drill chuck according to procedure. P5. Use lubricants during reaming for smooth cutting.

	P6. Ensure proper alignment of the reamer during operations.

Knowledge & Understanding

K1. Safety precautions.
K2. Procedure of setting up of drilling machine.
K3. Safe procedure for operating drilling machines.
K4. Types of drilling machines.
K5. Selecting and adjusting speed and feed of drilling machine.
K6. Importance of coolants in drilling operations.
K7. Methods and techniques of quality checks.
K8. Different types of drilling tools and their implications.
K9. Importance of selecting right drilling tool for the job specifications.
K10. Methods and techniques for positioning the work-piece in the drill to ensure proper alignment and stability during drilling.
K11. Using speeds and feeds chart for different types of materials and their hardness.
K12. Specific safety precautions during boring and sinking operations.
K13. Safety precautions.
K14. Selecting reamer according to hole size.
K15. Types of reamers (straight teeth or helical teeth).
K16. Method of setting reamer in the drill chuck.
K17. Importance of using lubricants during reaming.
K18. Importance of alignment of the reamer during operations.

Tool & Equipment

- Drilling Machines
- Drill chuck with Key
- Machine Vice
- Marking Tools
- Measuring Tools
- Drill Sleeve and Socket
- Personal Protective Equipment
- Counter drill
- Cutting oil
- Tri square
- Measuring Tool

CS 9 Perform Shaper, Planar and Slotter Machining Operations

Overview: This competency standard covers the skills and knowledge required to produce a squared shape work piece, Produce V shaped work piece, Machining a Rack Gear, T-slot Machining, Machining Irregular Surfaces, Machining External Keyways and Machining internal Keyways

Competency Units	Performance Criteria
CU1. Produce a squared shape work piece	P1. Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident. P2. Dial the machine vice according to job requirement. P3. Select point cutting tool and set machine as per requirements. P4. Mount cutting tool and work piece in the machine. P5. Check quality of the component at suitable intervals. P6. Shut down the machine at safe position after finishing the work.
CU2. Produce V shaped work piece	P1. Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident. P2. Dial the machine vice according to job requirement. P3. Select point cutting tool and set machine according to job requirements. P4. Mount cutting tool and work piece in the machine. P5. Check quality of the component at suitable intervals. P6. Shut down the machine in safe position after finishing the work
CU3. Machining a Rack Gear	P1. Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident. P2. Dial the machine vice according to job requirement. P3. Select point cutting tool and set machine according to job requirements. P4. Mount cutting tool and work piece in the machine. P5. Set the job/Tool Movement According to specified speed P6. Check quality of the component at suitable intervals.

	P7. Shut down the machine in safe position after finishing the work
CU4. T-slot Machining	P1. Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident. P2. Dial the machine vice according to job requirement. P3. Select point cutting tool and set machine according to job requirements. P4. Mount cutting tool and work piece in the machine. P5. Check quality of the component at suitable intervals. P6. Shut down the machine in safe position after finishing the work
CU5. Machining Irregular Surfaces	P1. Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident. P2. Dial the machine vice according to job requirement. P3. Select point cutting tool and set machine according to job requirements. P4. Mount cutting tool and work piece in the machine. P5. Use Different feed and speed of cutting and different points according to given drawing P6. Check quality of the component at suitable intervals. P7. P6. Shut down the machine in safe position after finishing the work
CU6. Machining External Keyways	P1. Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident. P2. Dial the machine vice according to job requirement. P3. Select point cutting tool and set machine according to job requirements. P4. Mount cutting tool and work piece in the machine. P5. Check quality of the component at suitable intervals. P6. Shut down the machine in safe position after finishing the work

CU6. Machining internal Keyways	P1. Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident. P2. Dial the machine vice according to job requirement. P3. Select point cutting tool and set machine according to job requirements. P4. Mount cutting tool and work piece in the machine. P5. Check quality of the component at suitable intervals. P6. Shut down the machine in safe position after finishing the work

Knowledge & Understanding

- **K1.** List safety hazards related with the shaper machine operations.
- **K2.** Use of Dial indicator
- **K3.** Method of mounting of cutting tool
- **K4.** Checking of right angle with the tri square.
- **K5.** Explain square facing procedure.
- **K6.** Safety guidelines and procedures.
- **K7.** Safety checks for operating shaper machine.
- **K8.** Interpreting information given in the engineering drawings and job specifications
- **K9.** Checking of angle with the bevel protector.
- **K10.** V-Shape cutting procedure.

Tool & Equipment

- Shaper, Planar or Slotter
- Machine Vice
- Tri square
- Vernier Caliper
- Dial indicator with magnet stand
- Point cutting tools
- Personal Protective Equipment
- Bevel protector

CS 10 Perform Milling Operations

Overview: This competency standard covers the skills and knowledge required to Prepare Blank for Generating the Gear, Select Tools and Equipment for Gear Cutting, Produce a square shaped work piece, Generate spur gear (Direct Indexing) On Milling Machine, Generate spur gear (Differential Indexing) On Milling Machine, Generate Helical Gear On Milling Machine, Perform slotting or grooving on work piece, Perform drilling or boring using milling machine, Milling a T slot, Bevel gear cutting on milling machine, Practice of spur rack cutting and Practice of helical rack cutting.

Competency Units	Performance Criteria
Cu1. Produce a square shaped work piece	P1. Identify safety hazards related with milling operations and take appropriate steps to avoid any injury or accident. P2. Dial the machine vice according to job requirement. P3. Select cutters and set machine as per requirements. P4. Mount cutters and work piece in the machine. P5. Produce a part matching the process plan and the part print specifications. P6. Check quality of the component at suitable intervals. P7. Shut down the machine at safe position after finishing the work.
Cu2. Perform slotting or grooving on work piece	P1. Identify safety hazards related with milling operations and take appropriate steps to avoid any injury or accident. P2. Set the work piece in machine vice according to procedure. P3. Select the appropriate cutter as per specifications. P4. Adjust the milling cutter for slotting and grooving. P5. Determine the touching point of the work piece. P6. Produce slotting or grooving on the workpiece to the required quality. P7. Check quality of the component at suitable intervals. P8. Shut down the machine at safe position after finishing the work. P9. Observe personal and workplace safety at all time.

Cu3. Perform drilling or boring using milling machine	P1. Identify safety hazards related with milling operations and take appropriate steps to avoid any injury or accident. P2. Select drill or boring tools according to drawings. P3. Mount and set the required work-holding devices, work piece and cutting tools. P4. Adjust the RPM of machine according to the standard chart. P5. Perform the boring operation according to the drawing. P6. Check quality of the component produced at different intervals. P7. Shut down the machine at safe position after finishing the work. P8. Observe personal and workplace safety at all time.
Cu4. Milling a T slot	**P1.** Layout position of a T slot. **P2.** Square vertical milling machine with machine table. **P3.** Mount work in milling machine. **P4.** Machine the center slot to proper depth of T slot by end mill. **P5.** Remove end mill and mount proper t slot cutter. **P6.** Machine lower part of the slot.
Cu5. Bevel gear cutting on milling machine.	**P1.** Cut The materials to size **P2.** Cut workpiece with lathe that is shaped into a gear blank. **P3.** Cut gear with a Coniflex generator. **P4.** Remove Burrs on the teeth with a deburring machine.
Cu6. Generate spur gear On Milling Machine.	**P1.** Select gear cutter and indexing plate on a milling machine **P2.** Mount indexing plate on indexing head. **P3.** Centre indexing head and its tailstock. **P4.** Fix indexing head and tail stock on milling table. **P5.** ENGAGE worm shaft from worm wheel **P6.** Adjust speed feed and direction of the cutter.

	P7. Mount Gear blank on mandrel. **P8.** Hold one side of mandrel on chuck of indexing head and other side in tail stock **P9.** Start machine and carry out cutter at zero point vertically. **P10.** Carry out cutter at zero point horizontally. **P11.** Apply depth for rough cut and engage machine automatically in longitudinal direction **P12.** Move table back at zero point. **P13.** Apply full depth for final cut and engage machine automatically in forward direction. **P14.** Repeat the process simultaneously until tooth is obtained.

Knowledge & Understanding

K1. List safety hazards related with the milling machine operations.
K2. Use of dial indicator
K3. Method of mounting the cutters
K4. Checking of right angle with the tri- square.
K5. Explain square milling procedure.
K6. Safety guidelines and procedures.
K7. Safety checks for operating milling machine.
K8. Interpreting information given in the engineering drawings and job specifications.
K9. Knowledge of spur gear design
K10. Identifying safety hazards associated with milling machine operations.
K11. Quality checks procedures and techniques.
K12. Types of drill or boring tools and their function.
K13. Procedure of mounting and setting up of work-holding devices, work pieces and cutting tools.
K14. Method and technique of adjusting RPM of milling machine.
K15. Safe Boring and milling procedures.
K16. Techniques of checking quality of components.
K17. Bevel gear design
K18. Spur rack and gear design
K19. Helical rack design

Tools & Equipment

- Measuring and Marking Tools
- Surface Table
- Machine Vice
- Tri square
- Vernier Caliper
- Dial indicator with magnet stand
- Milling cutters
- Personal Protective Equipment
- Milling machine and its accessories
- Slotting cutter
- Depth gauge
- End mil cutter
- Boring unit
- Boring tools
- Drill
- Internal Micrometer

3. Health, Safety and Environment

CS 11 Perform health, safety and environment practices

Overview: This competency standard covers the skills and knowledge required to Ensure personal protective equipment (PPE), Protect Tools and Equipment, Maintain First aid Box, Ensure Safeguard of Machines, Prepare for emergencies, Respond to emergencies, Monitor activities of people, vehicles, and other equipment in area.

Competency Units	Performance Criteria
CU1. Identify hazards relevant to your task	**P1.** Identify hazards correctly in accordance with OHS standards **P2.** Identify safety signs and symbols **P3.** Identify unsafe act and conditions
CU2. Ensure personal protective equipment (PPE)	**P1**. Arrange PPEs as per requirement **P2.** Wear proper PPE as per nature of job **P3.** Store PPE at appropriate place after use
CU3. Protect Tools and Equipment	**P1**. Ensure insulation of tools and equipment **P2.** Store tools and equipment safely **P3.** Clean tools on a regular basis before stacking
CU4. Maintain First aid Box	**P1**. Ensure availability of first aid box **P2.** Check first aid box for requisite emergency medicines **P3.** Check expiry date of medicines **P4**. Perform first aid treatment against electric shock **P5.** Perform first aid treatment / bandages against minor injuries
CU5. Ensure Safeguard of Machines	**P1.** Check safety guards of machine **P2.** Check brake of machines **P3.** Check controlling devices of machine **P4.** Perform test operation on machine
CU6. Prepare for emergencies	**P1.** Take emergency response training **P2.** Ensure emergency response exercises **P3.** Adopt first aid, cardio for respiratory, resuscitation, and CPR

CU7. Respond to emergencies	**P1.** Follow emergency plan **P2.** Communicate instructions **P3.** Assess risk and determine course of action **P4.** Operate emergency equipment and supplies
CU8. Monitor activities of people,vehicles, and other equipment in area	**P1.** Identify movement of others in work area **P2.** Respond to signals or traffic control person **P3.** Communicate with site person
CU9. Investigate incident at workplace	**P1.** Identify incidents causes **P2.** Collect relevant data for evidences **P3.** Analyze the accident and plan a control measure **P4.** Implement the plan

Knowledge & Understanding

K1. Define Hazard.
K2. Describe types of hazard.
K3. Knowledge and proper use of Personal Protective Equipment (PPE).
K4. Describe Typical worksite Hazards.
K5. Describe factors affecting Health & Safety in the workplace.
K6. Knowledge about First-Aid-Box.
K7. Usage of first aid box
K8. Accident history in different types of industries
K9. Environment safety

Critical Evidence(s) Required

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

- Prepare a list of PPEs
- Demonstrate the use of at least one of the PPEs in front of assessor as per assessors directions
- Perform first aid treatment against electric shock/minor injury.
- Explain safety procedure at workplace
- Differentiate between safe and unsafe tools

Tool and Equipment

1. Steel-toed footwear,
2. Hard hat,
3. Safety gloves,
4. Appropriate safety glasses,
5. High visibility vest,
6. Hearing protection,
7. Breathing apparatus,
8. De-electric boots and gloves for protection from electrical shock.
9. Fall protection, and other applicable PPE
10. Site emergency response plan,
11. Fire extinguishers,
12. Fire blankets,
13. Respirators, masks,
14. Fire hoses,
15. First aid kits, stretchers,
16. Safety standard books

CS 12 Apply basic Occupational Health & Safety regulations

Overview: This competency standard covers the skills and knowledge required to Adopt Health & Safety regulations, Encourage primary safety program, Adopt Environmental Regulation and Adopt company policies and procedures.

Competency Units	Performance Criteria
CU1. Adopt Health & Safety regulations.	P1. **Identify rights & responsibilities regarding safety** P2. **Interpret regulations & guidelines specific to Heavy Machines.** P3**. Interpret common safety rules and tips.** P4**. Identify employer safety rules and policies.**
CU2. Encourage primary safety program	**P1**. Motivate by regulation. **P2**. Motivate by ethics, legitimate concern **P3**. Motivate by cost of lost time and injury Claims. **P4**. Motivate by liability
CU3. Adopt Environmental Regulation	**P1.** Locate applicable permits on job site **P2.** Ensure work friendly environment **P3.** Adopt environmental regulations
CU4. Adopt company policies and procedures	**P1.** Ensure company policy and procedures **P2.** Adopt company procedures
CU5. Follow federal, provincial/ territorial, and municipal legislation	**P1.** Locate relevant section and legislation **P2.** Seek clarification of legislation **P3.** Adopt regulation of the area
CU6. Attain health & safety training	**P1.** Take required health and safety training **P2.** Implement work place hazardous materials information system (WPHMIS) **P3.** Adopt first aid, cardio for respiratory, resuscitation, and CPR

Knowledge & understanding

Describe Occupational Health & Safety Regulations.

Explain health and environmental law that can be implemented on workplace.

Critical Evidence(s) Required

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

- Prepare a list of federal/provincial law related to safety at workplace.
- Explain environmental and health safety regulation.

Tool and Equipment

1. Steel-toed footwear,
2. Hard hat,
3. Safety gloves,
4. Appropriate safety glasses,
5. High visibility vest,
6. Hearing protection,
7. Breathing apparatus,
8. De-electric boots and gloves for protection from electrical shock.
9. Fall protection, and other applicable PPE
10. Site emergency response plan,
11. Fire extinguishers,
12. Fire blankets,
13. Respirators, masks,
14. Fire hoses,
15. First aid kits, stretchers,
16. Safety Standard books

4. Raw Material Inspector

CS 13 Carry out inspection and receiving of raw material

Overview: This competency standard covers the skills and knowledge required to understand supplier documentation, unloading of raw material, conformance of raw material and receiving log.

Competency Units/Task	Performance Criteria/Step
CU1. Maintain receiving log	**P1.** Check received date **P2.** Check PO number **P3.** Check description **P4.** Check weight in kg **P5.** Check lot number **P6.** Check quantity received **P7.** Check shipment supplier **P8.** Check shipment carrier
CU2. Arrange unloading of raw material	**P1.** Identify raw material requiring specific unloading procedures. **P2.** Unload raw material using manual handling or appropriate lifting equipment. **P3.** Process carrier or supplier documentation according to standard operating procedures.
CU3. Confirm the quality and quantity of received raw material	**P1.** Verify quantity of raw material as per SOP according to type of raw material. **P2.** Check quality of raw material as per SOP according to type of raw material. **P3.** Identify incorrect and damaged raw material **P4.** Carry out appropriate action according to standard operating procedures. **P5.** Generate store receiving receipt as per SOP
CU4. Store received raw materials	**P1.** Prepare raw material for storage according to standard operating procedures. **P2.** Apply signs, codes or labels according to standard operating procedures. **P3.** Complete inventory records documentation **P4.** Identify storage location

	P5. Store raw material in correct location using appropriate materials handling techniques **P6.** Prepare report for record keeping and circulate 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. Define relevant legislation, regulations and codes
K2. Describe receiving log
K3. Understand SOP.
K4. Describe material handling equipment.
K5. Describe inventory.

Critical Evidence(s) Required

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

- Follow SOP's of raw material received
- Update raw material receiving log
- Identify material handling equipment required to transfer raw material

Tools and Equipment

- Material handling equipment
- Check sheet
- Log book

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CS 14 Perform Raw Material Sampling

Overview: This competency standard covers the skills and knowledge required to Read and understand sampling of metal scrap, alloys, molding material, refractory material for lining and documentation for inspection

Competency Units/Task	Performance Criteria/Step
CU1. Carry out sampling of metal scrap	**P1.** Collect random samples for testing from raw material **P2.** Deliver sample to laboratories **P3.** Sort various metal scrap as per requirement **P4.** Stack conformed metal scrap as per requirement **P5.** Provide required metal scrap to melting technician **P6.** Prepare report for record keeping and circulate to concerned department
CU2. Carry out sampling of alloying materials	**P1.** Collect random samples of alloying materials for testing **P2.** Deliver samples to laboratories **P3.** Sort Ferrous and non-ferrous alloys as per the requirement **P4.** Stack conformed Ferrous and non-ferrous alloys as per the requirement **P5.** Provide required Ferrous and non-ferrous alloys to melting section
CU3. Perform sampling of molding materials	**P1.** Collect random samples for testing as per requirement **P2.** Deliver samples to laboratories **P3.** Sort various molding materials(silica sand, molasses, sodium silicate, mold coating and Co2 gas) as per the requirement **P4.** Stack conformed molding materials as per requirement **P5.** Provide required molding materials to appropriate personnel. **P6.** Prepare report for record keeping and circulate to concerned department
CU4. Perform sampling of refractory material for lining	**P1.** Collect random samples for testing as per requirement **P2.** Deliver sample to laboratories **P3.** Sort various refractory material for lining (basic lining and acidic lining, refractory bricks, tundish refractory blocks, refractory nozzles,) as per the requirement **P4.** Stack refractory conformed materials as per requirement **P5.** Provide required refractory material for lining to appropriate

	personnel. **P6.** Prepare report for record keeping and circulate to concerned department
CU5. Complete documentation for inspection	**P1.** Compile reports of raw material **P2.** Compile reports of conformance **P3.** Compile reports of non-conformance **P4.** Compile ledger books regarding consumption **P5.** Provide reports to supervisor **P6.** Prepare weekly/monthly report for record keeping and circulate to reporting officer

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 sampling
- **K2.** Describe random sampling
- **K3.** Define metal scrap
- **K4.** Define ferrous and non- ferrous alloys
- **K5.** Explain molding materials
- **K6.** Define refractory materials for lining
- **K7.** Explain conformance and non-conformance report

Critical Evidence(s) Required

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

- Identify metal scrap
- Identify ferrous and non-ferrous alloys
- Identify molding materials
- Identify refractory materials for lining

Tools and Equipment

- ❖ Check sheets

5. Pattern Maker-I

CS 15 Operate general wood working machines

Overview: This competency standard covers the skills and knowledge required about pattern and its types, layout of the pattern ,advantages , allowances used in pattern making, pattern making tools and equipment, wood working machines proper use of measuring instruments, maintaining measuring instruments.

Competency Units	Performance Criteria
CU1. Operate Circular saw machine	**P1.** Energize the machine **P2.** Adjust height of circular saw asper requirements **P3.** Adjust ripping fence as per requirement **P4.** Place saw guard **P5.** Operate machine as per SOP **P6.** Perform wood cutting job **P7.** Practice standard health and safety procedures
CU2. Operate thickness planner machine	**P1.** Energize the machine **P2.** Adjust the table with screw as per requirement **P3.** Lower the feed roller as required for wood planks **P4.** Adjust feed control as per requirement **P5.** Operate machine as per SOP **P6.** Perform wood cutting job **P7.** Practice standard health and safety procedures
C3. Operate Band saw machine	**P1.** Energize the machine **P2.** Adjust the guide up/down as per thickness requirement of wood **P3.** Operate machine as per SOP **P4.** Perform wood cutting job **P5.** Practice standard health and safety procedures
CU4. Operate Jointer Planner machine	**P1.** Energize the machine **P2.** Adjust the machine blade **P3.** Adjust the table using rear and front wheels as per requirement **P4.** Adjust the Degree of fence as per requirement **P5.** Operate machine as per SOP

	P6. Perform the job **P7.** Practice standard health and safety procedures
CU5. Operate Disc Sander machine	**P1.** Energize the machine **P2.** Adjust the angle of table as per job requirement **P3.** Ensure the clockwise movement of sander disc **P4.** Adjust the table for tapper or draft angle as per requirement **P5.** Operate machine as per SOP **P6.** Perform the job **P7.** Ensure the clockwise movement of sander disc **P8.** Practice standard health and safety procedures
CU5. Operate wood working lathe	**P1.** Hold the job on machine between tail stock and head stock **P2.** Adjust horizontal metal rail **P3.** Slide sand paper against the still-spinning object for smooth surface **P4.** Set the position of shaping tool **P5.** Switch on the machine **P6.** Adjust RPM of machine **P7.** Perform the job as per drawing **P8.** Practice standard health and safety 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 types of Pattern,

K2. Define allowance and allowances used for pattern making

K3. Types of woods used for pattern making

K4. Advantages and Disadvantage of metallic pattern.

K5. Describe pattern making machines.

K6. Brief note on wood work lath.

K7. Describe types of chisels and their uses.

K8. Describe CNC machine operations.

K9. Define pattern drafting.

K10. Describe flat pattern techniques.

K11. Tools required for pattern making.

K12. Importance of pattern making.

K13. Different types of wood working machine

K14. What are the pattern making techniques?

K15. Process of making pattern

K16. Types of wood work saws

K17. Methods of preserving wooden pattern.

Tools & Equipment

- Vernier caliper
- Deodar wood
- Hacksaw
- Tri square
- Steel tape
- Vernier caliper
- Wood work lathe
- Chisels
- Wood work files
- CNC router machine
- Paper
- Varnish
- Wood block
- Abrasive paper.
- Paint
- Wood router machine tool
- Pattern material
- Measuring instruments
- Turning tool
- Hammer
- Spanner
- Plane drill
- Wood saw

- CNC router
- Cutting tools
- Wood work files

CS 16 Manufacture Wooden Pattern

Overview: This competency standard covers the skills and knowledge required about pattern and its types, layout of the pattern ,advantages and disadvantages of different type of patterns, allowances used in pattern making, pattern making tools and equipment, and finishing of pattern.

Competency Units	Performance Criteria
CU1. Interpret Drawing of given Pattern	**P1.** Interpret the Pattern drawing **P2.** Recognize basics of lines used in pattern drawings **P3.** Identify manufacturing requirements according to drawings
CU2. Prepare layout of wood pattern	**P1.** Calculate pattern parameters(angles, tapers, clearances and shrinkage) **P2.** Add allowances (shrinkage, machining, draft,) as required **P3.** Select appropriate timber/composites for pattern layout as per specifications **P4.** Add core prints, loose piece pattern in layout as per requirements **P5.** Mark Top, Bottom, Side, and elevation view on layout **P6.** Cut the extra material using appropriate cutting tools **P7.** Use appropriate tool for required job (drilling, cutting tapping, flat, round edges)
CU3. Construct wood pattern	**P1.** Assemble parts of pattern **P2.** Mark material and develop construction as per specifications **P3.** Utilize appropriate hand held and power tools **P4.** Produce pattern components according to size and shape **P5.** Identify permanent joint use Glue, Nails **P6.** Identify temporary joints use dowel pins **P7.** Assemble the pattern symmetrically
CU4. Apply pattern color scheme	**P1.** Apply black colour to the surfaces to be left unfinished **P2.** Apply Red colour to the surfaces to be machined **P3.** Apply yellow colour on core prints

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 following knowledge:

- **K1.** Describe types of Pattern,
- **K2.** Define allowance and allowances used for pattern making
- **K3.** Types of woods used for pattern making
- **K4.** Advantages and Disadvantage of metallic pattern.
- **K5.** Describe pattern-making machines.
- **K6.** Brief note on woodwork lath.
- **K7.** Describe types of chisels and their uses.
- **K8.** Describe CNC machine operations.
- **K9.** Define pattern drafting.
- **K10.** Describe flat pattern techniques.
- **K11.** Tools required for pattern making.
- **K12.** Importance of pattern making.
- **K13.** Different types of pattern
- **K14.** What are the pattern making techniques?
- **K15.** Process of making pattern
- **K16.** Types of wood work saws
- **K17.** Methods of preserving wooden pattern.

Tools & Equipment

- Vernier caliper
- Deodar wood
- Hacksaw
- Tri square
- Steel tape
- Vernier caliper

- Wood work lath
- Chisels
- Wood work files
- CNC router machine
- Paper
- Varnish
- Wood block
- Abrasive paper.
- Paint
- Wood router machine tool
- Pattern material
- Measuring instruments
- Turning tool
- Hammer
- Spanner
- Plane drill
- Wood saw
- CNC router
- Cutting tools
- Wood work files

CS 17 Manufacture Polymer Pattern

Overview: This competency standard covers the skills and knowledge required about pattern and its types, layout of the pattern ,advantages and disadvantages of different type of patterns , pattern materials, polymer patterns allowances used in pattern making, pattern making tools and equipment, and finishing of pattern.

Competency Units	Performance Criteria
CU1. Interpret Drawing of given Pattern	**P1.** interpret the Pattern drawing **P2.** Recognize basics of lines used in pattern drawings **P3.** Identify manufacturing requirements according to drawings
CU2. Prepare polymer pattern	**P1.** Identify polymer for pattern layout **P2.** Select appropriate parting agent **P3.** Apply parting agent as per specifications **P4.** Add allowances (shrinkage, machining, draft,) as required **P5.** Add core prints, loose piece pattern in layout as per requirements **P6.** Mark Top, Bottom, Side, and elevation view on layout **P7.** Cut the extra material using appropriate cutting tools **P8.** Use appropriate tool for required job (drilling, cutting tapping, flat, round edges)
CU3. Construct polymer pattern	**P9.** Select appropriate polymer material **P10.** Mix hardener with polymer to correct ratio as per requirement **P11.** Ensure air is not entrapped in application **P12.** Ensure safe practice regarding excess of heat generating and de lamination **P13.** Strip and inspect the pattern/core box **P14.** Apply appropriate method to patterns and core boxes **P15.** Check polymer tools for conformance to specifications
CU4. Apply pattern color scheme	**P16.** Apply black colour to the surfaces to be left unfinished **P17.** Apply Red colour to the surfaces to be machined **P18.** Apply yellow colour to the core prints

Knowledge & Understanding

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

of:

K1. Describe types of Pattern,
K2. Define allowance and allowances used for pattern making
K3. Types of woods used for pattern making
K4. Advantages and Disadvantage of metallic pattern.
K5. Describe pattern making machines.
K6. Brief note on wood work lath.
K7. Describe types of chisels and their uses.
K8. Describe CNC machine operations.
K9. Define pattern drafting.
K10. Describe flat pattern techniques.
K11. Tools required for pattern making.
K12. Importance of pattern making.
K13. Different types of pattern
K14. Different type of pattern materials
K15. What are the pattern making techniques?
K16. Process of making pattern
K17. Types of wood work saws
K18. Methods of preserving wooden pattern.

Tools & Equipment

- Vernier caliper
- Deodar wood
- Hacksaw
- Tri square
- Steel tape
- Vernier caliper
- Wood work lath
- Chisels
- Wood work files
- CNC router machine
- Paper
- Varnish

- Wood block
- Abrasive paper.
- Paint
- Wood router machine tool
- Pattern material
- Measuring instruments
- Turning tool
- Hammer
- Spanner
- Plane drill
- Wood saw
- CNC router
- Cutting tools
- Wood work files

CS 18 Maintain tools and equipment

Overview: This competency standard covers the skills and knowledge required about pattern and its types, layout of the pattern ,advantages , allowances used in pattern making, pattern making tools and equipment, proper use of measuring instruments, maintaining measuring instruments.

Competency Units	Performance Criteria
CU1. Perform right job on right tool	**P1.** Identify right tool for right job **P2.** Perform the job, carefully using the instrument **P3.** Clean the instrument properly **P4.** Practice standard health and safety procedures
CU2. Practice House keeping	**P1.** Store instruments in appropriate location **P2.** Lubricate instrument properly to avoid corrosion **P3.** Identify the damaged tools **P4.** Repair the damaged tools **P5.** Handle instrument carefully **P6.** Protect instruments from exposure to high temperature **P7.** Use instruments for designated jobs only **P8.** Practice standard health and safety 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 types of Pattern,
K2. Define allowance and allowances used for pattern making
K3. Types of woods used for pattern making
K4. Advantages and Disadvantage of metallic pattern.
K5. Describe pattern making machines.
K6. Brief note on wood work lath.
K7. Describe types of chisels and their uses.
K8. Describe CNC machine operations.
K9. Define pattern drafting.

K10. Describe flat pattern techniques.

K11. Tools required for pattern making.

K12. Importance of pattern making.

K13. Different types of pattern

K14. What are the pattern making techniques?

K15. Process of making pattern

K16. Types of wood work saws

K17. Methods of preserving wooden pattern.

Tools & Equipment

- Vernier caliper
- Deodar wood
- Hacksaw
- Tri square
- Steel tape
- Vernier caliper
- Wood work lath
- Chisels
- Wood work files
- CNC router machine
- Paper
- Varnish
- Wood block
- Abrasive paper.
- Paint
- Wood router machine tool
- Pattern material
- Measuring instruments
- Turning tool
- Hammer
- Spanner
- Plane drill
- Wood saw
- CNC router

- Cutting tools

6. Molder-I

CS 19 Prepare sand mold for casting

Overview: This competency standard covers the skills and knowledge required to basic moulding with two-piece pattern in sand molding for metal casting process.

Competency Units	Performance Criteria
• **CU1. Prepare sand for molding**	**P1.** Prepare green sand by using sieve sand with riddle **P2.** Add additives as per requirements(Binders, Bentonite, Coal dust) **P3.** Sprinkle Water as required **P4.** Perform mixing of sand with hand tools or in Muller mixer machine
• **CU2. Produce mold by hand using two piece/split pattern**	**1.** Place pattern on molding platform **P2.** Place drag part of the mold and ram molding sand by rammer. **P3.** Roll over the drag part and strike off extra green sand. **P4.** Place other half of the pattern (with dowel) and match it **P5.** Place pouring basin at appropriate place **P6.** Place runner at appropriate place. **P7.** Place gate at appropriate place **P8.** Create a parting line by pouring parting sand on drag part. **P9.** Place cope part and sprue pin on runner. **P10.** Add riddled molding sand and ram using rammer. **P11.** Remove extra sand using strike off bar **P12.** Make vents for gas escaping with vent wire at appropriate place. **P13.** Remove cope part and make pouring gate with gate cutter. **P14.** Make cavity by drawing out pattern halves politely. **P15.** Repair mold as required **P16.** Place cope with locating plug

Knowledge & Understanding

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

K1. Basic Molding
K2. Molding and its types.
K3. Properties of green sand
K4. Molding accessories.
K5. Repairing mound and its precautions.
K6. Cleaning process
K7. Molding machines
K8. Molding techniques
K9. Gating system

Tools & Equipment

- Shovel
- Riddle
- Lifter
- Trovel
- Gate cutter
- Molding box
- Sprue pin
- Runner
- Sprue pin
- Vent wire
- rammer
- Shovel
- Riddle
- Lifter
- Trovel
- Gate cutter
- Molding box
- Sprue pin
- rammer
- Sodium silicate

- CO2 cylinder
- Silica sand
- Molding tools
- Three piece pattern

CS 20 Perform core making

Overview: This competency standard covers the skills and knowledge required to Practice of making round core, Practice of making half core and Practice of baking and assembling half core.

Competency Units	Performance Criteria
CU1. Prepare sand for core making	**P1.** Prepare core sand by using sieve with riddle **P2.** Add additives and water as per requirements **P3.** Perform mixing of sand with hand tool or in Muller mixer machine
CU2. Develop round core	**P1.** Mix riddle sand with molasses as per required and heat to attain molasses sand properties **P2.** Fill split box with core sand. **P3.** Ram core and do venting. **P4.** Remove clamp and split core box.
CU3. Practice of making core.	**P1.** Mix riddle sand with molasses as per required. **P2.** Get core box and fill it core sand. **P3.** Ram sand in core cavity and strike off excessive sand. **P4.** Place core on metallic core plate and put plate in oven. **P5.** Switch off oven and draw out baked core.
CU4. Perform baking of core	**P1.** Connect batch type core baking oven with electricity. **P2.** Set core on core plate and place it oven. **P3.** Set heating temperature. **P4.** Draw out core from oven **P5.** Laminate small parting line for proper finishing

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. Core

K2. Types of core

K3. Properties of molasses sand

K4. Types of core venting

K5. Steps for core making

K6. Methods of supporting core

K7. Core making accessories

Tools & Equipment

- Molding tools
- Split box
- core sand
- Molding tools
- Split box
- Left and right hand core box.
- Two halves of core

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7. Caster-I

CS 21 Maintain Safe Work Environment

Overview: This competency standard covers the skills and knowledge required to identify the risks at work place, create a safe and friendly work place and ensure equipment sorting.

Competency Units	Performance Criteria
CU1. Identify the risks at work place	**P1.** Identify activities which can cause potential injury **P2.** Identify areas in the plant which are potentially hazardous **P3.** Conduct regular checks with support of the maintenance team **P4.** Identify potential hazards due to wear and tear of machine **P5.** Inform the concerned authorities about the potential risks **P6.** Create awareness amongst other by sharing information on the identified risks
CU2. Create a safe and friendly work place	**P7.** Follow Safety, Health and Environment related practices developed by the organization **P8.** Ensure relevant safety signs are placed on the shop floor **P9.** Operate the machine using the recommended Personal Protective Equipment (PPE) at workplace **P10.** Maintain a clean and safe working environment near work place **P11.** Attend all safety and fire drills to be self aware of safety hazards **P12.** Ensure that the waste material is kept in the designated area
CU3. Ensure equipment sorting	**P13.** Sort the tools/ equipment/ parts in designated area as per work instructions **P14.** Segregate the items which are labeled as red tag items for the process area **P15.** Stack the various types of boxes and containers as per the size/ utility to avoid any fall of items/ breakage **P16.** Return the extra material and tools to the designated sections

	P17. Follow the floor markings/ area markings used for demarcating the various sections in the plant as per standards

Knowledge & Understanding

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

K1. basic 5S procedures
K2. know various types 5S practices followed in various areas
K3. understand the 5S checklists provided in the department/ team
K4. skills to identify useful & non useful items
K5. labels , signs & colours used as indicators
K6. how to sort and store various types of tools, equipment, material etc.
K7. to identify various types of waste products
K8. understand the impact of waste/ dirt/ dust/unwanted substances on the process
K9. best ways of cleaning & waste disposal
K10. understand the importance of standardization in processes

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

- Layout tools
- Steel-toed footwear
- Hard hat
- Safety gloves
- Appropriate safety glasses
- Fall protection, and other applicable PPE
- Site emergency response plan
- Fire extinguishers

CS 22 Perform Sand Casting

Overview: This competency standard covers the skills and knowledge required to Read and Understand to determine sand casting requirements, Check the operations of equipment, Perform sand casting process, Monitor casting process parameters, Perform visual inspection to finish casting.

Competency Units	Performance Criteria
CU1. Identify sand casting requirements	**P1.** Identify casting process for completing the work order **P2.** Identify various casting parameters like temperature, pouring speed before starting the process **P3.** Identify the equipment availability as per requirement
CU2. Perform pre-casting operations	**P4.** Check the tilting operation of casting ladles **P5.** Set casting parameters as per requirement **P6.** Ensure melt is ready for casting **P7.** Perform pre-heating of the molds **P8.** Perform pre-heating of the ladle
CU3. Perform sand casting process	**P9.** Position the ladle in line with molds as per standard **P10.** Tilt the ladle to pour melt into the molds **P11.** Perform un-interrupted pouring during casting **P12.** Maintain down sprue level during pouring as per SOPs **P13.** Ensure metal stream inoculation for each mold
CU4. Monitor casting process parameters	**P14.** Measure casting temperature if required to prevent deviation from desired specifications **P15.** Analyze any irregularity in the process to take preventive steps **P16.** Minimize metal spillage in the work area
CU5. Perform post casting operations	**P17.** Shake out casting from molds **P18.** Inspect the final metal casting as prescribed in work order **P19.** Send the casting for further processing in terms of chipping, fettling, wedge cutting etc.

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. casting defects and how they are generated, how they can be prevented,

K2. different raw materials, ferrous alloys and consumables used in the melt shop
K3. furnace operation, melting process, charging method
K4. handling hot liquid iron, furnace lining process and control
K5. metallurgical properties of the metal used in the process
K6. effect of operators work on casting quality at in house and at customers

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

- Crucible ring
- Tongs
- Personal protection gears
- Refractory bricks
- Pouring Ladles
- Transfer ladles
- Lid pole
- Refractory Lined 150 kg Teapot Ladle With Handler
- Ladle Pre Heater
- Overhead Chain Conveyer
- Iron rods

❖

CS 23 Perform Gravity Die Casting

Overview: This competency standard covers the skills and knowledge required to Read and Understand to Prepare equipment for casting, Carry out manual pouring, Remove extra materials, Clean die after casting.

Competency Units	Performance Criteria
CU1. Prepare equipment for casting	**P1.** Mix die coat in correct proportion. **P2.** Maintain die temperatures at the correct level. **P3.** Use appropriate safety clothing and apparatus **P4.** Apply die coat in correct sequence according to standard operating procedures. **P5.** Place die correctly on machine **P6.** Handle closing of die correctly. **P7.** Attach clamps as per requirement **P8.** Attach air-cooling to the die as specified if required.
CU2. Carry out manual pouring	**P9.** Select appropriate pouring tool **P10.** Take melt from furnace **P11.** Pour melt in die while ensuring the minimal porosity and lamination. **P12.** Make allowance for adequate cooling time **P13.** Pour at a continuous and appropriate rate during filling. **P14.** Monitor die coating condition **P15.** Re-spray die coat as required
CU3. Remove extra materials	**P16.** Remove cast parts from the die **P17.** Store parts in a manner that minimises damage **P18.** Remove flash from the die surface.
CU4. Clean die after casting	**P19.** Operate shot blaster in a safe manner according to standard **P20.** Apply remedial action as required to standard operating procedures. **P21.** Dross / De-gas furnace to standard operating procedures.

	P22. Clean work area of coating **P23.** Clean shot residue to appropriate standard.

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.** die coat function(s) in gravity die casting
- **K2.** correct proportions and consistency of die coats
- **K3.** correct identification of die coat materials
- **K4.** procedures for raising the temperature of the die to the correct level and maintaining the required temperature
- **K5.** procedures to be followed when pouring molten metal to produce sound castings
- **K6.** causes of defects in castings
- **K7.** curing times for castings of various volumes and materials
- **K8.** timing of die coat application and quantity of die coat to be used for different applications
- **K9.** correct procedures for removing castings from the die and storing of castings
- **K10.** die condition and need for shot blasting
- **K11.** shot blaster operating procedures
- **K12.** use and application of personal protective equipment
- **K13.** 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 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

- ❖ Dies/Molds
- ❖ Flask
- ❖ die coats
- ❖ temperature sensors

- Tongs
- Personal protection gears
- Pouring Ladles
- Transfer ladles
- Overhead Chain Conveyer
- Shot blaster
- PPE

8. Fettling Operator

CS 24 Fettle and trim metal casting

Overview: This competency standard covers the skills and knowledge required to Read and understand to carry out safety practices for fettling operations, Select correct tool and equipment and fettle excess particle from casted part

Competency Units/Task	Performance Criteria/Step
CU1. Carry out safety practices for fettling operations	**P1.** Ensure personal protective equipment(PPE) as per job requirement **P2.** Handle cast part as per SOP **P3.** Maintain balance position of cast part during lifting to avoid any incident **P4.** Ensure safe workplace for fettling process
CU3. Select correct tool and equipment	**P1.** Select appropriate hand held tools and power tools for removing excess material from casting **P2.** Select appropriate repairing tool **P3.** Select appropriate hand and power tool for cutting and grinding **P4.** Identify appropriate equipment for surface cleaning
CU3. Fettle excess metal from cast part	**P1.** Perform visual inspection to identify excess material for removal process **P2.** Mark excess material area for removal process **P3.** Fettle excess metal (runners, risers and flashing) as per standard operating procedures.

	P4. Verify the required specification after fettling process of excess metal **P5.** Record and report the casting defects 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:

K8. Accept/reject/rework criteria
K9. Fettling requirements
K10. Fettling tools
K11. Fettling standards
K12. Handling and storage requirements
K13. Use and application of personal protective equipment
K14. Safe work practices and procedures
K15. Hazards and control measures associated with fettling and trimming metal castings/forgings
K16. Excess metals suitable for recycling

Critical Evidence(s) Required

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

- Interpret written instruction sketches and drawings
- Identify castings
- Inspect castings visually
- Fettling and trimming metal castings
- Conduct a final inspection

Tools and Equipment

- Hand tools (Dedicated tools for fettling and trimming: files, chisels, hammers etc.)
- Power tools (Saws, croppers, grinding disks/belts (including grades), swing and pedestal grinders etc.)

CS 25 Perform surface cleaning by sand blasting

Overview: This competency standard covers the skills and knowledge required to determine job requirements, set up equipment and prepare surface using abrasive blasting.

Competency Units/Task	Performance Criteria
CU1. Determine job cleaning requirements	P1. Determine work requirements from job sheet, instructions or other predetermined specifications in accordance with standard operating procedures. P2. Identify appropriate abrasive blasting process, equipment and blasting media to meet job specification. P3. Prepare work site for surface cleaning activities
CU2. Set up equipment	P1. Arrange appropriate equipment and related consumables P2. Set up equipment in accordance with manufactures specifications and standard operating procedures. P3. Select correct rust inhibitor for sand blasting as per requirement P4. Carry out pre-operational checks on equipment P5. Rectify faults to execute the sand blasting.
CU3. Perform surface cleaning	P1. Carry out abrasive media disposal in accordance with standard operating procedures. P2. Set air pressure as per requirement P3. Place sample in chamber P4. Operate blasting equipment in accordance with standard operating procedures. P5. Undertake emergency shut-down procedures P6. Remove and clean specimen P7. Clean blasting equipment
CU4. Inspect specimen	P1. Inspect specimen in accordance with requirement P2. Record casting defect after cleaning operation and report in accordance with standard operating procedures. P3. Record all post operation results

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. Reason for selecting the chosen sequence of operations
K2. Blasting equipment and media required
K3. Equipment, consumables for various methods
K4. Importance of using an appropriate rust inhibitor
K5. Process for undertaking pre-operational checks
K6. Procedures or using abrasive blasting equipment
K7. Procedures for abrasive media disposal
K8. Procedures for maintaining and storing blasting equipment
K9. Recording/reporting procedures; faulty equipment
K10. Checking prepared surfaces
K11. Rectification techniques
K12. Safe work practices and procedures
K13. Hazards and control measures related to abrasive blasting

Critical Evidence(s) Required

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

- undertake numerical operations within the scope of this unit
- select blasting equipment and media
- set up equipment and consumables
- select rust inhibitor
- conduct pre-operational checks
- prepare surfaces using abrasive blasting
- disposing of abrasive media
- maintain blasting equipment
- identify, record and report the faults
- inspect prepared surface
- perform rectification work
- check for conformance to specifications

Tools and Equipment

- Blasting media (Abrasives, shot, glass beads, sand, steel shot, garnet, and other mediums accepted by industry and all regulatory bodies)

- Rust inhibitor (A substance which, when added to a corrosive liquid in small amounts, reduces the rate of corrosion)
- Blasting equipment (Electric and diesel compressors, blast pots, blast rooms, centrifugal blast machines, water pressure washers to 35,000 kpa, air hoses and nozzles, and specified hand and power tools, etc.)

CS 26 Perform shot blasting

Overview: This competency standard covers the skills and knowledge required to Identify shot blasting equipment, Shot blasting equipment, Shot blast the floor and Clean-up work area and tool.

Competency Units/Task	Performance Criteria/Step
CU1. Identify shot blasting equipment	**P1.** Comply with applicable legislative , OHS and organisational requirements relevant to the use of shot blasting equipment **P2.** Select shot blasting equipment and shot size consistent with the needs of the job **P3.** Check shot blasting equipment for serviceability and safety **P4.** Recognise sources of power supply
CU2. Perform shot blasting	**P1.** Identify shot media in accordance with standard operating procedures. **P2.** Set air pressure as per requirement **P3.** Place sample in chamber **P4.** Operate blasting equipment in accordance with standard operating procedures. **P5.** Undertake emergency shut-down procedures **P6.** Remove and clean specimen **P7.** Clean blasting equipment
CU4. Inspect specimen	P4. Inspect specimen in accordance with requirement P5. Record casting defect after cleaning operation and report in accordance with standard operating procedures. **P4.** Record all post operation results

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. State or Territory OHS legislation, regulations, standards and codes of practice relevant to shot blasting

K2. organizational and site standards, requirements, policies and procedures for the use of shot blasting equipment

K3. types of shot blasters and procedures for their safe use, operation and maintenance

K4. shot blaster attachments, their uses, limitations and maintenance requirements

K5. characteristics, uses and limitations of the available shot sizes

K6. environmental protection requirements

K7. established communication channels and protocols

K8. problem identification and resolution

Critical Evidence(s) Required

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

- Perform shot blasting as per given instructions.

Tools and Equipment

- Types of shot blasting equipment
- Sources of power supply
- Attachments
- Fittings and fixtures
- Personal protective equipment

CS 27 Perform cutting and grinding operations

Overview: This competency standard covers the skills and knowledge required to Read and Understand

Competency Units/Task	Performance Criteria/Step
CU1. Carry out Sawing	**P1.** Mark the job according to given drawing **P2.** Select appropriate blade according to job requirement **P3.** Set blade in frame of hacksaw as per procedure **P4.** Ensure the work piece is clamped firmly and properly **P5.** Adopt methods and techniques for sawing that is appropriate to job requirement by using Hand Hacksaw **P6.** Adopt methods and techniques for sawing that is appropriate to job requirement by using Power Hacksaw **P7.** Follow marked line during sawing to ensure accuracy.
CU2. Perform off-hand grinding	**P1.** Select the proper size and shape of grinding wheel. **P2.** Hold the work piece firmly against the rotating wheel by placing it on the tool rest. **P3.** Use coolant at intervals to avoid over heating of the job. **P4.** Adopt technique and methods which are safe. **P5.** Produce component according to work operations. **P6.** Observe personal and workplace safety.
CU3. Perform swing grinder operation	**P1.** Select the suitable size and type of grinding wheel. **P2.** Mount the work piece over the holding devices to ensure proper clamping. **P3.** Dress the wheel as per requirement. **P4.** Identify reference points on work piece before grinding. **P5.** Adjust depth of cut according to speed of machine table. **P6.** Use coolant continuously to avoid over heating of the job. **P7.** Observe personal and workplace safety.
	P1.

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. Type and size of wheels and abrasive.
K2. Method of dressing of grinding wheel.
K3. Work holding methods which include:
a. Magnet Table
b. Vice
c. Angle Plate
d. Machine base
K4. Importance of using coolant.
K5. Methods and techniques for surface grinding.
K6. Selecting right standing position during grinding.
K7. Specific safety precautions and guidelines.
K8. Describe the different type of dressing tools.
K9. Describe the purposes of dressing
K10. Describe oxy-acetylene Welding Manually
K11. Explain various types of welding processes
K12. Explain advantages of GMAW
K13. Describe the principle of MIG welding
K14. Describe basic measurement
K15. Describe types of hacksaw frames
K16. Describe basic measuring /Marking /cutting tools
K17. Describe clamping/holding methods
K18. Define methods and techniques of sawing.
K19.

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

- Work bench
- Bench vice
- Tri-square
- Hand hacksaw with blade
- Scriber
- Flat File
- Vernier caliper
- Punching tools
- Offhand Grinding Machine
- Bench vices
- Hammer
- Scriber
- Vernier calliper
- Set of spanners
- Angle Grinding Machine
- Surface Grinding
- Machine

- Holding Devices
- Wheel Dresser
- Grinding Wheels
- Wheel Dresser Stand
- Measuring Tools
- Adjustable Wrench
- Allen Key Set

CS 28 Perform basic welding operations

Overview: This competency standard covers the skills and knowledge required to

Competency Units/Task	Performance Criteria/Step
CU4. Perform oxy-acetylene flame cutting operations	**P1.** Take Work piece as per drawing **P2.** Straiten it with the help of hammer and anvil if required **P3.** Set the flame of welding cutting torch in oxidizing flame as per standard **P4.** Start cutting for one side of work piece **P5.** Maintain standard distance between welding torch nozzle and work piece **P6.** Complete the cut as per standard
CU1. Perform Oxy Acetylene Welding	**P1.** Open gas cylinder with the help of cylinder key **P2.** Adjust pressure of both gas cylinders with the help of regulator **P3.** Open acetylene gas knob of welding torch **P4.** Ignite acetylene gas with help of spark lighter **P5.** Open oxygen gas knob of welding torch **P6.** Set work piece as per standard **P7.** Perform fore hand welding method **P1.** Perform post welding operations
CU2. Perform Shielded Metal Arc Welding (SMAW)	**P1.** Adjust welding parameters (current, voltage etc.) as per welding procedure specifications/job requirement to produce acceptable weld **P2.** Maintain gap between electrode and base metal as per standard practices **P3.** Carry out welding as per given metal properties. **P4.** Deposit root pass as per welding procedure specifications/job requirements **P5.** Deposit filling passes as per welding procedure specifications/job requirements **P6.** Deposit capping pass as per welding procedure specifications/job requirements **P7.** Check root, filling and capping passes for any visual discontinuities as per acceptance standards

	P8. Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
CU3. Perform Soldering Operation	**P1.** Perform marking as per drawing **P2.** Cut the metal sheet according to drawing using shearing machine **P3.** Straighten the material with help of hammer **P4.** File work if required **P5.** Perform soldering operation as per standard
CU1. Perform Brazing Operation	**P1.** Perform marking as per drawing **P2.** Cut the metal sheet according to drawing using shearing machine **P3.** Straighten the material with help of hammer **P4.** File work if required **P5.** Open gas cylinder with the help of cylinder key **P6.** Adjust pressure of both gas cylinders with the help of regulator **P7.** Select the correct size of the nozzle **P8.** Set flame to carburizing flame as per standard **P9.** Use copper filler rod as filler metal **P10.** Perform brazing as per standard
CU2. CU4. Perform Post Welding Operations	**P1.** Carry out finishing work of welds following standard procedures **P2.** Inspect weld visually and mark any visual defects, as required **P3.** Carry out repair work in accordance with approved procedures, as required **P4.** Clean work area in accordance with workplace safety practices **P1.** Maintain and store tools/equipment/consumable materials in accordance with organization 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 the knowledge of:

K1. Explain various types of welding processes
K2. Explain advantages of GMAW
K3. Describe the principle of MIG welding
K4. Explain various welding positions
K5. List Personal Protective Equipment required for MIG welding and state their use
K6. Demonstrate the method to correctly wear PPE
K7. Explain Specifications/ classification of electrode/s required for the job
K8. Explain safe working practices to be followed while carrying out MIG welding
K9. Identify hazards associated with MIG welding and take remedial measures
K10. Define Electrical parameters like (voltage, current etc.) and their effects on weld
K11. Explain Welding techniques as per WPS/instruction sheet
K12. Describe Welding procedure specifications (WPS)
K13. Describe Method of Pre- heating of base metal
K14. Describe Fillet lap joint
K15. Describe Tee-fillet joint
K16. Describe Corner joint
K17. Describe Butt joint
K18. Explain Polarity setting according to standard specifications
K19. Explain the factors to be considered in TIG welding like type and thickness of the base metal, current type and polarity, type of shielding gas to be used
K20. Define Visual welding defects
K21. Describe Welding codes and standards
K22. State the purpose of using shielding gas in TIG welding
K23. Identify various gases/combination of gases for shielding
K24. Gas Tungsten Arc Welding (GTAW)
K25. Describe soldering
K26. Describe sheet metal gauge
K27. Explain disadvantages of soldering
K28. Describe brazing
K29. Define carburizing flame
K30. Define neutral flame
K31. Define oxidizing flame
K32.

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

- Solder gun
- Solder wire
- Oxygen cylinder
- Acetylene gas cylinder
- Pressure regulators
- Cylinder key
- Welding torch
- Rubber house pipe
- Back fire arrester
- Flash back arrester
- Marking tools
- Copper Filler rod
- Spark lighter
- Steel wire brush

LEVEL 3

9. Pattern Designer

CS 29 Manage graphic user interface

Overview: This competency standard covers the skills and knowledge required to install software, create new file, and create basic drawing.

Competency Units	Performance Criteria
CU1. Install software and Create New File	**P4.** Install latest software version **P5.** Create New Template **P6.** Save the File **P7.** Create Drawing **P8.** Select units as per requirements **P9.** Select drawing Limits
CU2. Create Basic Drawings	**P1.** Select Coordinate System as per requirements **P2.** Draw a rectangle using line command **P3.** Draw an ARC **P4.** Draw a circle with given requirements **P5.** Draw a circle with 3-P touching outer corner of Equilateral Triangle **P6.** Use the Erase Command

Knowledge & Understanding: This competency standard will provide knowledge related to

K1. Basic Drawing Settings
K2. Unit setting
K3. Limits setting
K4. User coordinate system Workspace setting
K5. Object Snap Settings
K6. Basic Commands and Concepts Angles and lines
K7. Differentiate between absolute, relative and polar system
K8. DIMSTYLE and MTEXT commands
K9. HATCHING concepts in AutoCAD
K10. Differentiate between CHAMFER and FILLET command
K11. Types of Array
K12. OFFSET, CIRCLE and ROTATE short commands
K13. Zooming options
K14. Tools palettes window
K15. Design centre
K16. Scale and paper sizes
K17. Modify dimension style and text size according to paper size
K18. Backup file

Tool & Equipment

- Computer with all accessories
- AutoCAD software disk

- Models

CS 30 Develop 2D drawings

Overview: This competency standard covers the skills and knowledge required to Develop and prepare 2D objects

Competency Units	Performance Criteria
CU1. Develop 2D Objects	**P1.** Setup drawing interface for required specifications **P2.** Setup user interface settings for required specifications **P3.** Save AutoCAD drawing files in different file formats (DWG, PDF, and JPG). **P4.** Create 2D Objects with given measurements **P5.** Edit 2D Objects to meet set standards
CU2. Prepare Final Set of 2D Drawings	**P1.** Use appropriate command and tools to develop 2D Drawing **P2.** Develop 2D Drawing with given project specifications and measurements **P3.** Create title block layout as required **P4.** Plot drawing on scale according to required size and orientation

Knowledge & Understanding

K1. Basic Drawing Settings
K2. Unit setting
K3. Limits setting
K4. User coordinate system Workspace setting
K5. Object Snap Settings
K6. Basic Commands and Concepts Angles and lines in AutoCAD.
K7. Differentiate between absolute, relative and polar system
K8. DIMSTYLE and MTEXT commands
K9. HATCHING concepts in AutoCAD
K10. Differentiate between CHAMFER and FILLET command
K11. Types of Array
K12. OFFSET, CIRCLE and ROTATE short commands
K13. Zooming options
K14. Tools palettes window
K15. Design center

K16. Scale and paper sizes
K17. Modify dimension style and text size according to paper size
K18. Backup file

Tool and Equipment

- Computer with all accessories
- AutoCAD software disk
- Models

CS 31 Develop 3D pattern design

Overview: This competency standard covers the skills and knowledge required to develop 3D objects, manipulate and Edit 3D objects and render 3D objects.

Competency Units	Performance Criteria
C1. Develop 3D Objects	**P1.** Setup & save 3D drawing interface for required specifications. **P2.** Setup 3D user interface settings for required specifications. **P3.** Create 3D objects with given measurements.
C2. Manipulate 3D objects using 3D Editing Tools	**P1.** Modify 3D objects in line with the requirements. **P2.** Make customized 3D models according to the requirement of given job. **P3.** Convert 3D Face objects into a single mesh objects.
C3. Render 3D Model	**P1.** Apply material to required 3D Model as per given specification **P2.** Apply lights to get the requisite scene of required 3D model **P3.** Assign cameras to execute different views of required 3D Model. **P4.** Render and print the 3D model according to required size & orientation. **P5.** Apply texture to 3D model as per given specification.

Knowledge & Understanding

K1. 3D modelling in AutoCAD

- 3D solids,
- surfaces,
- meshes, and
- Wireframe objects.
- Differentiate between Surface Modelling and Solid Modelling.

K2. 3D face and Edges

- Boolean operation concepts
- Subtraction
- Intersection
- Union

K3. 3D Navigate control

- Functions of different camera settings.

- Importance of scene creation
- Pre-set views such as isometric, top, bottom, front, left, etc.
- Perspective projection and parallel projection
- Walk
- Constrained Orbit

K4. Material and light control

K5. Planner mapping

K6. Texture map

K7. Opacity control

K8. Render context

K9. Render sampling

Tool and Equipment

- Computer with all accessories
- AutoCAD software disk
- Models

10. Pattern Maker-II

CS 32 Manufacture match plate gated pattern

Overview: This competency standard covers the skills and knowledge required about pattern and its types, layout of the pattern ,advantages and disadvantages of different type of patterns , allowances used in pattern making, pattern making tools and equipment, and finishing of pattern.

Competency Units	Performance Criteria
CU1. Interpret Drawing of given Pattern	**P1.** interpret the Pattern drawing **P2.** Recognize basics of lines used in pattern drawings **P3.** Identify manufacturing requirements according to drawings
CU2. Prepare layout of pattern	**P1.** Identify wood for pattern layout using full scale **P2.** Add allowances (shrinkage, machining, draft,) as required **P3.** Add core prints, pattern in layout as per requirements **P4.** Mark Top, Bottom, Side, and elevation view on layout **P5.** Use appropriate tool for required job (drilling, cutting tapping, flat, round edges)
CU3. Construct wooden match plate pattern	**P1.** Ensure wooden plate size according to mold box **P2.** Adjust guide pin bush according to mold box **P3.** Mount wooden pattern on wooden plate **P4.** Mount runner and in-gate on wooden plate in alignment with pattern **P5.** Add 5-10 degree draft allowance on in-gate and runner bar as per required **P6.** Create in-gate neck on pattern side **P7.** Assemble pattern parts as per specifications **P8.** Ensure safety practices to avoid any incident

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

K1. Describe types of pattern

K2. Define allowance and allowances used for pattern making

K3. Types of woods used for pattern making

K4. Advantages and Disadvantage of metallic pattern.

K5. Describe pattern-making machines.

K6. Brief note on woodwork lath.

K7. Describe types of chisels and their uses.

K8. Describe CNC machine operations.

K9. Define pattern drafting.

K10. Describe flat pattern techniques.

K11. Tools required for pattern making.

K12. Importance of pattern making.

K13. Different types of pattern

K14. What are the pattern making techniques?

K15. Process of making pattern

K16. Types of wood work saws

K17. Methods of preserving wooden pattern.

Tools & Equipment

- Vernier caliper
- Deodar wood
- Hacksaw
- Tri square
- Steel tape
- Vernier caliper
- Wood work lath
- Chisels
- Wood work files
- CNC router machine
- Paper
- Varnish
- Wood block
- Abrasive paper.
- Paint
- Wood router machine tool
- Pattern material
- Measuring instruments

- Turning tool
- Hammer
- Spanner
- Plane drill
- Wood saw
- CNC router
- Cutting tools
- Wood work files

CS 33 Manufacture Pattern on CNC Router

Overview: This competency standard covers the skills and knowledge required about pattern and its types, layout of the pattern ,advantages and disadvantages of different type of patterns, allowances used in pattern making, pattern making tools and equipment, and finishing of pattern.

Competency Units	Performance Criteria
CU1. Prepared CAD/CAM Data	**P1.** Prepare the drawing in CAD system **P2.** Add allowance as per requirement **P3.** Send the drawing in CAD/CAM system
CU2. Perform CNC Operation	**P1.** Arrange a wood block as per required size **P2.** Clamped the wooden block on the table of CNC router **P3.** Select the cutting tool as per material and operation. **P4.** Enter the raw material detail **P5.** Check the tool off setting **P6.** See the simulation before starting the work **P7.** Locate the pattern. **P8.** Press the push bottom to start the operation **P9.** Draw out pattern from fixture **P10.** Operate the machine as per SOP **P11.** Practice standard health and safety 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 types of Pattern,
K2. Define allowance and allowances used for pattern making
K3. Types of woods used for pattern making
K4. Advantages and Disadvantage of metallic pattern.
K5. Describe pattern making machines.
K6. Brief note on wood work lath.
K7. Describe types of chisels and their uses.
K8. Describe CNC machine operations.
K9. Define pattern drafting.

K10. Describe flat pattern techniques.

K11. Tools required for pattern making.

K12. Importance of pattern making.

K13. Different types of pattern

K14. What are the pattern making techniques?

K15. Process of making pattern

K16. Types of wood work saws

K17. Methods of preserving wooden pattern.

Tools & Equipment

- Vernier caliper
- Deodar wood
- Hacksaw
- Tri square
- Steel tape
- Vernier caliper
- Wood work lath
- Chisels
- Wood work files
- CNC router machine
- Paper
- Varnish
- Wood block
- Abrasive paper.
- Paint
- Wood router machine tool
- Pattern material
- Measuring instruments
- Turning tool
- Hammer
- Spanner
- Plane drill
- Wood saw
- CNC router

- Cutting tools
- Wood work files

11. Melter

CS 34 Work Safely with Molten Metal

Overview: This competency standard covers the skills and knowledge required to identify the need for personal protective equipment, Adhere to emergency procedures with molten metal, Identify hazardous conditions at Workplace, Observe good OHS practices.

Competency Units	Performance Criteria
CU1. Identify the need for personal protective equipment(PPE	**P1.** Use appropriate personal protective equipment as specified in standard operating procedures (SOP). **P2.** Interpret regulations & guidelines specific to Melting process. **P3.** Interpret common safety rules and tips. **P4.** Identify employer safety rules and policies.
CU2. Adhere to emergency procedures with molten metal	**P5.** Use emergency equipment located in accordance with workplace policies and procedures. **P6.** Response to emergency procedures as demonstrated in approved safety procedures and instructions.
CU3. Identify hazardous conditions at Workplace	**P7.** Identify hazards and report to maintain a healthy and safe work environment. **P8.** Follow workplace procedures and work instructions for controlled risks accurately.
CU4. Observe good OHS practices	**P9.** Identify hazardous areas and materials associated with molten metal and risks associated. **P10.** Identify safety signs and symbols displayed. **P11.** Use PPE equipment according to the specifications and standard operating procedures. **P12.** Inspect personal protective equipment to maintain in a good order for reuse. **P13.** Identify hazardous items associated with hot material area. **P14.** Perform housekeeping duties according to standard operating procedure to maintain a safe working environment.

Knowledge & Understanding

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

- **K1.** Hazardous materials and hazard control measures associated with molten metal
- **K2.** Procedures relevant to raising OH&S issues
- **K3.** Designated personnel responsible for OH&S
- **K4.** Applicable personal protective equipment
- **K5.** Safety signs, symbols and labels
- **K6.** Procedures for correct inspection and service of equipment including PPEs
- **K7.** Routine maintenance procedures for equipment
- **K8.** Workplace procedures for working in hazardous areas
- **K9.** Consequences of not maintaining a clean and safe working environment
- **K10.** Safe manual handling procedures
- **K11.** Location of emergency equipment including first aid facilities

Critical Evidence(s) Required

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

- 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

- Steel-toed footwear
- Hard hat
- Safety gloves
- Appropriate safety glasses
- Site emergency response plan
- Fire extinguishers
- Fire blankets
- Fire hoses

CS 35 Melt Ferrous Material (Cast Steel) in Induction Furnace

Overview: This competency standard covers the skills and knowledge required to Read and Understand to Identify required specifications for melting, Select materials, Verify metal charges to melting, Charge furnace, Monitor furnace operation, Take sample of molten metal, Perform refractory repair to crucible, Monitor tapping of molten metal, Tap the furnace, Control hazards.

Competency Units	Performance Criteria
CU1. Identify required specifications for melting	**P1.** Identify mould requirements **P2.** Identify any special melting requirements for the job **P3.** Identify safety procedures for the required melting operation **P4.** Follow regulations relevant to foundry and individual melting
CU2. Select materials	**P5.** Raise requisition as required according to standard operating procedures. **P6.** Take charge analysis in accordance with standard operating procedures. **P7.** Convert charge analysis to furnace charge weight using standard operating procedures. **P8.** Weigh the charge according to standard operating procedures.
CU3. Verify metal charges to melting	**P9.** Select required components to give the required metal specification **P10.** Calculate required charge of each component **P11.** Recommend changes/additions to the charge **P12.** Monitor the preparation of the charge including checking for contaminants
CU4. Charge furnace	**P13.** Follow emergency/safety procedures as necessary. **P14.** Pre-Heat materials if required according to standard operating procedures. **P15.** Charge materials into furnace using standard operating procedures. **P16.** Identify suitable areas for emergency unloading of molten metal and kept available.

CU5. Monitor melting process	**P17.** Check furnace is in operational condition **P18.** Maintain furnace at optimum operating condition to standard operating procedures. **P19.** Identify metal/alloy specification for required melting **P20.** Charge batches of scrap periodically to attain required melt quantity **P21.** Monitor melt to ensure the product meets specification
CU6. Take sample of molten metal	**P22.** Take sample for chemical analysis **P23.** Apply remedial action as required to standard operating procedures. **P24.** Hold furnace temperature to standard operating procedures. **P25.** Add alloying elements if required **P26.** Achieve final melt charge as per requirement **P27.** Check temperature of metal and adjustment if necessary.
CU7. Perform refractory repair to crucible	**P28.** Identify specific areas of the refractory if repair is required **P29.** Select appropriate refractory materials to meet specifications. **P30.** Install refractory using appropriate techniques and tools to meet the job specification.
CU8. Monitor tapping of molten metal	**P31.** Check pouring area is secure and that all non-essential personnel are excluded **P32.** Check all members of pouring crew are wearing appropriate and in good condition personal protective equipment **P33.** Ensure escape routes are known in advance by all members of the pouring crew **P34.** Check pouring is undertaken at correct temperature and in efficient order **P35.** Ensure moulds are ready to receive liquid metal **P36.** Ensure proper placing of ladle **P37.** Attach purging pipe to the ladle
CU9. Tap the furnace	**P38.** Identify quantity of the required metal **P39.** Carry out tap rate to standard operating procedures.

	P40. Tap heat safely according to standard operating procedures. **P41.** Perform purging operation **P42.** Remove purging pipe attached to ladle
CU10. Control hazards	**P43.** Identify hazards in the metal melting/pouring process **P44.** Assess the risks arising from those hazards **P45.** Implement procedures to control those hazards in line with procedures and duty of care

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. types of alloy additions and their effects on casting behavior and finished product
K2. induction furnace melting and refractories suitable for steelmaking
K3. Influence of carbon and silicon contents
K4. the grades of steel and their applications including carbon steel and alloy steels
K5. methods of controlling physical properties
K6. advantages/disadvantages of density of each type of ferrous metal
K7. the influence of melting points on production processes
K8. the shrinkage percentage of the types of ferrous metals
K9. how to control metal fluidity
K10. casting temperature
K11. make a selection of ferrous metal based on required properties
K12. conduct metal analysis on ferrous metal
K13. types and pouring characteristics of metals
K14. types and characteristics of ladles
K15. procedures for maintaining condition and integrity of ladle
K16. procedures for safe handling and transference of molten metal
K17. metal treatments, applications and procedures for making additions to melt
K18. slag and dross removing procedures
K19. techniques for sampling and testing molten metal
K20. metal identification and tagging procedures
K21. use and application of personal protective equipment
K22. hazards and control measures associated with pouring molten metal

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

- Induction melting Furnace
- Immersion type Thermo-couple (1300 C° min.)
- Transfer ladle
- Iron rods
- Weighing scale (10, 50, 100, 500, 1000 Kgs capacity)
- Charging hoist (1 ton capacity)
- Charging box (200Kgs capacity)
- Optical Pyro-meter (for ferrous metals)
- Coating for metal
- handling tools
- PPE kit

CS 36 Melt Ferrous Material (Cast Iron) in Cupola Furnace

Overview: This competency standard covers the skills and knowledge required to Read and Understand to Identify casting requirement, Select melting, Melt base iron materials, Perform duplexing with control activities, Perform inoculation procedure, Conduct gray iron casting inspection

Competency Units	Performance Criteria
CU1. Identify casting Requirement	**P1.** Select base metal as per ASTM specifications **P2.** Identify type of cast iron as per requirement **P3.** Determine chemical and physical properties of cast iron from instruction sheet
CU2. Select melting Materials	**P4.** Select high-grade raw material consistent with quality **P5.** Undertake charge analysis and convert to appropriate furnace charge. **P6.** Complete requisitions as required according to standard operating procedures. **P7.** Weigh furnace charge according to standard operating procedures.
CU3. Melt base iron	**P8.** Prepare cupola furnace as per standard operating procedures. **P9.** Charge cupola furnace as per standard operating procedures. **P10.** Monitor cupola melt temperature **P11.** Test chemical composition of melt as per standard operating procedures. **P12.** Adapt corrective measures to attain required chemical composition. **P13.** Conduct wedge chill testing as per standards **P14.** Undertake rectification measures to attain desired results. **P15.** Transfer molten metal to cupola fore-hearth as per standard operating procedures.
CU4. Perform duplexing with control activities	**P16.** Desulfurized metal (0.02% max) if making nodular (Ductile) cast iron **P17.** Transfer molten metal to an induction furnace/duplexing furnace in accordance with standard operating procedures

	P18. Add required alloying elements to the melt as per standard operating procedures. **P19.** Undertake chemical composition analysis **P20.** Adjust composition of melt if required as per standard operating procedures. **P21.** Raise metal temperature to tapping value **P22.** Take wedge chill test as per standard operating procedures. **P23.** Transfer molten metal to pouring ladle for inoculation **P24.** Pour melt as per standard operating procedures.
CU5. Perform inoculation procedure	**P25.** Select appropriate inoculants compatible with casting **P26.** Perform inoculation to improve metal properties in accordance with recommended inoculation procedures **P27.** Take wedge chill value after inoculation as per standard operating procedures. **P28.** Control dead melt time as per standard operating procedures. **P29.** Control pouring time as per standard operating procedures. **P30.** Transport ladle to pouring station to pour metal into molds.
CU6. Conduct gray iron casting inspection	**P31.** Conduct visual inspection using color check **P32.** Perform file test to determine chills on casting edges. **P33.** Lead scrap diagnosis in coordination with process engineering personnel.

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. Foundry melting production process (from material selection to fettling and trimming).
K2. Procedure of quality assurance and control system including inspection and testing.
K3. Crucible conditions, faults and repair limits.
K4. Metallic charge materials, ferro-alloys, additives, ladle additions.
K5. Weighing procedure and scale types.
K6. Thermocouple condition monitoring and adjustment mechanism.
K7. Interpretation of carbon equivalent (thermal analysis) and wedge chill test result.
K8. Coagulant agents, application and removal procedures.
K9. Applicable industry standard, JIS, ASTM, SAE, DIN, BS, AS etc.
K10. Metallic charge materials and its characteristics.

K11. Metal composition and its effects on the mechanical physical properties of the metal.
K12. Pouring temperature and its effect on the casting integrity.
K13. Proper pouring techniques.
K14. Effect of charge material on the mechanical / physical properties of the metal.
K15. Effect of inoculation, ductile treatment, fade time or molten metal.
K16. Use and application of personal protective equipments.
K17. Safe work practice 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 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

- Cupola melting Furnace
- Immersion type Thermo-couple (1300 C° min.)
- Transfer ladle
- Chill mold (wedge)
- Weighing scale (10, 50, 100, 500, 1000 Kgs capacity)
- Charging hoist (1 ton capacity)
- Charging box (200Kgs capacity)
- Degasser
- Modifier
- Grain refiner
- Inoculant (stabilizer)
- Inoculant (graphitizer)
- Optical Pyro-meter (for ferrous metals)
- Coating for metal
- handling tools
- Slag coagulants
- PPE kit

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CS 37 Melt Non-Ferrous Material in Pit Furnace

Overview: This competency standard covers the skills and knowledge required to Read and Understand to Identify job requirement, Perform melting of metal, Perform metal treatment process, Identify casting quality requirement, Identify defects cause by unsound melting, Recycle scraps / turnings.

Competency Units	Performance Criteria
CU1. Identify job requirement	**P1.** Identify alloy melting requirements as per manufacturers/ suppliers instruction sheets. **P2.** Cross check required specifications with corresponding international specification **P3.** Determine casting method with available mold **P4.** Determine metal treatment based on available product bulletin. **P5.** Coat all tools which comes into contact with the melt to avoid melt contamination **P6.** Select appropriate melting furnace as per required metal treatment and type of crucible (stationary/dip-out or tilting).
CU2. Perform melting of metal	**P7.** Feed Metal charges as per standard operating procedures. **P8.** Perform fluxing technique based on composition of metal charges (virgin ingot and recycled scrap). **P9.** Start furnace as per standard operating procedures. **P10.** Weigh specified amounts of scrap metal **P11.** Charge metal into furnace by hand or by directing crane operator **P12.** Regulate the injection of fuel and air into furnace **P13.** Apply appropriate degassing technique as per standard operating procedures. **P14.** Add melt refining agent of the alloy as per standard operating procedures. **P15.** Observe melt temperature with the help of thermocouple **P16.** Take test sample of molten metal from crucible using hand ladle **P17.** Record data from each melt on form

CU3. Perform metal treatment process	**P18.** Apply structured modification of the alloy as per standard operating procedures. **P19.** Monitor speed of melting to avoid oxidation. **P20.** Control pouring temperature corresponding to the alloy **P21.** Apply filtration method and location corresponding to the alloy **P22.** Tap metal from crucible with minimum turbulence to avoid oxide formations. **P23.** Accompany pouring in accordance with OH & S requirements
CU4. Identify casting quality requirement	**P24.** Identify content of contaminants, which will affect integrity of the casting in accordance with procedures. **P25.** Apply structural modification in accordance with procedures **P26.** Carry out chemical analysis results in process control **P27.** Follow written procedures during casting as per quality standards
CU5. Identify defects caused by unsound melting	**P28.** Identify remedial actions in accordance with standard operating procedures. **P29.** Show up defective castings with the respective sections in accordance with company procedures **P30.** Re-orient the correct melting and treatment of given alloy.
CU6. Recycle scraps / turnings	**P31.** Accomplish re-melting in accordance with company standard operating procedures **P32.** Remove dross completely from the melt before pouring into molds. **P33.** Ensure label ingot type as per standard operating procedures **P34.** Enter production reports in performa with recommendation for future production reference.

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. Effects of chemical composition on integrity of the casting
K2. (strengths, ductility, surface finish)
K3. Charging sequence of metallic charges and melt treatment
K4. Pouring temperature range limits.
K5. Countermeasures to eliminate / minimize casting defects.
K6. Safety test applied to casting.

K7. Operation of emission spectrometer analyzer
K8. Safe work practice and procedures.
K9. Use and application of personal protective equipments.
K10. advantages/disadvantages of density of each type of non-ferrous metal
K11. methods of controlling tensile strength of non-ferrous metals
K12. methods of controlling the hardness of non-ferrous metals
K13. influence of melting points on production processes
K14. shrinkage percentage of the types of non-ferrous metals
K15. how to control metal fluidity
K16. be able to make a refractory selection for non-ferrous alloys
K17. the use of degassing to control gas defects
K18. be able to take action to control grain size
K19. the grades of brass and their applications
K20. the grades of bronze and their applications
K21. the grades of gunmetal and their applications
K22. the grades of other copper based alloys and their applications
K23. the grades of aluminium based alloys and their applications
K24. the grades of lead based alloys and their applications
K25. the grades of zinc based alloys and their applications
K26. the grades of magnesium based alloys and their applications

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

- Pit Furnace
- Burners
- Iron rods
- Molds/dies
- Immersion type Thermo-couple
- Transfer ladle

- Weighing scale Charging hoist (1 ton capacity)
- Charging box (200Kgs capacity)
- Optical Pyro-meter (for ferrous metals)
- Coating for metal
- handling tools
- repair tool kit
- Slag coagulants
- PPEs kit

12. Molder-II

CS 38 Operate molding machine

Overview: This competency standard covers the skills and knowledge required to Basic moulding /moulding machine with two piece pattern in sand molding for metal casting process

Competency Units	Performance Criteria
• **CU1. Operate Muller mixture machine**	**P1.** Add sand in Muller mixture machine as required **P2.** Add water in Muller mixture machine as required **P3.** Add additives (binders) as required **P4.** Operate the machine as per SOP **P5.** Practice standard health and safety procedures **P6.** Unload the materials from machine
• **CU2. Operate Jolt machine**	**P1.** Place the mold box on the surface of machine table **P2.** Place the pattern in mold box on the surface of machine table **P3.** Fill sand in the mold box on the surface of machine table **P4.** Perform jolting operation **P5.** Remove the mold from the machine **P6.** Operate the machine as per SOP **P7.** Practice standard health and safety procedures
• **CU3. Operate squeeze machine**	**P1.** Place the mold box on the surface of machine table **P2.** Place the pattern in mold box on the surface of machine table **P3.** Fill sand in the mold box on the surface of machine table **P4.** Align the plate/rubber frame diaphragm with mold upper surface

	P5. Apply pneumatic pressure on the surface of the loose sand in mold **P6.** Remove the mold from the machine **P7.** Operate the machine as per SOP **P8.** Practice standard health and safety procedures
• **CU4. Operate Jolt Squeeze Machine**	**P1.** Assemble the match plate pattern **P2.** Place the assembled pattern on machine surface **P3.** Place the drag upside **P4.** Fill the drag with sand **P5.** Perform machine as per SOP **P6.** Rollover the assembled mold using hand **P7.** Fill the cope with the sand **P8.** Perform machine as per SOP **P9.** Perform the vibrating operation **P10.** Remove the mold from the machine **P11.** Practice standard health and safety 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. Basic Molding
K2. Molding and its types.
K3. Properties of green sand
K4. Molding accessories.
K5. Repairing mound and its precautions.
K6. Cleaning process
K7. Molding machines
K8. Molding techniques
K9. Gating system

Tools & Equipment

- Shovel
- Riddle
- Lifter
- Trovel
- Gate cutter
- Molding box
- Sprue pin
- Runner
- Sprue pin
- Vent wire
- rammer
- Shovel
- Riddle
- Lifter
- Trovel
- Gate cutter
- Molding box
- Sprue pin
- rammer
- Sodium silicate
- CO2 cylinder
- Silica sand
- Molding tools
- Three piece pattern

CS 39 Operate core making machines

Overview: This competency standard covers the skills and knowledge required to Basic core making / core making machines machine in sand molding for metal casting process

Competency Units	Performance Criteria
• **CU1. Prepare Core sand**	**P1.** Prepare sand for core making **P2.** Add additives (water, Binders) as required **P3.** Mix sand using hand tools/machine
• **CU2. Operate Core Shooter Machine**	**P1.** Fill core pattern with core sand **P2.** Place sand filled core pattern in core shooter machine **P3.** Operate the machine as per SOP **P4.** Apply pressurized air to the core box **P5.** Remove the core box from machine **P6.** Extract core from the box **P7.** Practice standard health and safety procedures
• **CU3. Operate Core Baking Oven**	**P1.** Energize electric/gas fired baking oven **P2.** Place cores batch inside oven **P3.** Operate oven as per SOP **P4.** Remove batch of baked core from oven **P5.** Practice standard health and safety 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. Core
K2. Types of core
K3. Properties of molasses sand
K4. Types of core venting
K5. Steps for core making
K6. Methods of supporting core
K7. Core making accessories
K8. Core baking machine/oven

Tools & Equipment

- Molding tools
- Split box
- core sand
- Molding tools
- Split box
- Left and right hand core box.

13. Furnace Operator

CS 40 Operate Non-Electric Melting Furnace

Overview: This competency standard covers the skills and knowledge required to operate Pit furnace for melting of suitable metallic material and operate the Cupola furnace for the melting of suitable metallic material

Competency Units	Performance Criteria
CU1. Operate Pit furnace for melting of suitable metallic material	**P1.** Inspect the lining of pit. **P2.** Repair the lining of pit, with suitable refractory material, if required. **P3.** Inspect the crucible. **P4.** Replace the crucible, if required. **P5.** Inspect the accessories (valves, flow meter gauges and pipes) of gas supply system. **P6.** Inspect the blower accessories (power supply,RPM and valves) **P7.** Place the empty crucible in the pit furnace on specific position for preheating. **P8.** Open gas valve and ignite gas in the pit furnace. **P9.** Switch off furnace after suitable preheating time. **P10.** Receive the metallic charge and put incrucible. **P11.** Open the gas valve again and ignite gas in the furnace for melting. **P12.** Place the cover on the pit. **P13.** Switch ON the blower to increase the intensity of fire. **P14.** Check the temperature of the charge with temperature gun after specific intervals of time during melting. **P15.** Remove the slag with the help of crucible tongs. **P16.** Switch off the furnace, after proper melting and heating of charge. **P17.** Remove cover for picking out the crucible. **P18.** Transfer molten metal to relevant person for mold filling.

	P19. Repeat the necessary steps for the next heat.
CU2. Operate cupola furnace for the melting of suitable metallic material	**P1.** Inspect the interior lining of the cupola furnace. **P2.** Inspect the condition of slag hole and tap hole. **P3.** Repair damaged areas of furnace with refractory material. **P4.** Close the bottom door of furnace and put prop under it. **P5.** Prepare coke bed on bottom plate of cupola with suitable slope towards tap hole **P6.** Put soft wood pieces on the coke bed. **P7.** Ignite wood pieces with cotton soaked in kerosene oil. **P8.** Toss some coke on burning pieces of wood through charging door. **P9.** Add more coke in cupola when it becomes red hot **P10.** Add metallic charge on the red-hot coke. **P11.** Add coke and metal charge periodically up to charging door. **P12.** Wait for soaking time **P13.** Close tap and slag hole **P14.** Start air blast to increase the melting speed of molten metal. **P15.** Pour out the slag from slag hole and close the slag hole. **P16.** Pour molten metal into the ladle and close tap hole. **P17.** Hand over the molten metal to relevant person for mold filling **P18.** Repeat necessary steps for the next heat.

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:

K17. Define refractory materials.

K18. Describe different types of refractories.

K19. Enlist different types of fuel used in pit furnace.

K20. Discuss advantages and limitations of different types of fuels.

K21. What is difference between coal and coke?

K22. How coke is produced by coal.

K23. Define slag.

K24. Explain different types of slags produced during melting of non-ferrous metals.

K25. Explain different types of slags produced during melting of cast iron and steel.

K26. Describe different possible deterioration ways of furnace lining.

K27. Explain different parts of pit furnace.

K28. Explain different parts of cupola furnace.

K29. Describe charging and taping of a furnace.

K30. Describe melting points and other properties of some common non-ferrous metals.

K31. Explain safety parameters required to operate pit furnace.

K32. Explain safety parameters required to operate cupola furnace.

Critical Evidence(s) Required

Tools and Equipment

- **Pit Furnace**
- **Crucible**
- **Refractory material for lining**
- **Crucible Tongs**
- **Safety Accessories**

CS 41 Operate Electric Melting Furnace

Overview: This competency standard covers the skills and knowledge required to operate induction furnace for melting of given metallic charge, operate direct arc furnace for melting of given metallic charge and operate indirect arc furnace for melting of given metallic charge.

Competency Units/Task	Performance Criteria/Step
CU1. Operate induction furnace for melting of given metallic charge	**P1.** Inspect the lining of the crucible **P2.** Inspect the condition of induction coils **P3.** Fill the crucible of the induction furnace with raw material **P4.** Maintain the pressure of circulating water for cooling of induction coils. **P5.** Switch on the furnace power supply. **P6.** Inspect the movement of trunnion and tilting bail. **P7.** Adjust the frequency of thyristor according to the requirements. **P8.** Reset control panel to delete the previous settings. **P9.** Increase the amperes of the supply to maintain the required temperature. **P10.** Tilt the furnace to pour out the slag as per requirement. **P11.** Tilt the furnace to pour out the molten metal in ladle **P12.** Hand over the molten metal to relevant person for filling of the molds. **P13.** Repeat the necessary steps for the next heat.
CU2. Operate direct arc furnace for melting of given metallic charge	**P1.** Inspect the lining of electric furnace. **P2.** Inspect the condition of tap hole and slag hole of the furnace **P3.** Inspect the condition of electrodes and their movement **P4.** Inspect the oxygen supply accessories **P5.** Inspect the accessories associated with tilting mechanism of furnace **P6.** Allow to enter the charge to be melted into the electric arc furnace from an overhead crane **P7.** Follow the safety precautions of charging **P8.** Place the lid containing the three electrodes into position. **P9.** Adjust the position of electrodes to adjust proper distance between electrodes and charge.

	P10. Allow the electric current to pass through the electrodes to carry out melting process **P11.** Add alloying additions, during melting, if required. **P12.** Allow the oxygen to enter into the melt at suitable time, to oxidize elements, if required. **P13.** Tilt the furnace to one side to allow the slag to pour out. **P14.** Tilt the furnace to other side to allow the molten metal to pour out **P15.** Handed over the molten metal to relevant person for filling of moulds. **P16.** Repeat the necessary steps for the next heat
CU3. Operate Indirect arc furnace for melting of given metallic charge	**P1.** Inspect the lining of indirect arc furnace. **P2.** Inspect the charging door and lining of the door. **P3.** Inspect the condition of tap hole of the furnace. **P4.** Inspect the condition of electrodes. **P5.** Inspect and set the oxygen supply accessories **P6.** Inspect the gas hole and other related accessories. **P7.** Charge the furnace with material to be melted through charging door. **P8.** Follow the safety precautions of charging. **P9.** Allow the electric current to pass through the electrodes to carry out melting process **P10.** Allow the oxygen to enter into the melt at suitable time **P11.** Remove the slag from the surface of molten metal with safety precautions. **P12.** Open the taping hole to pour out the molten metal. **P13.** Handed over the molten metal to relevant person for filling of moulds. **P14.** Repeat the necessary steps for the next heat

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 electric current.

K2. Define electric induction.

K3. Describe types of induction furnaces.

K4. Describe types of refractories used in electric furnaces.

K5. Explain different parts of an induction furnace.

K6. Define electric Arc.

K7. Describe different types of electric arc furnaces.

K8. Explain different components of an electric arc furnace.

K9. Discuss material and dimensions of electrodes of electric arc furnaces.

K10. Describe different safety precaution required to operate induction furnace.

K11. Describe different safety precaution required to operate electric arc furnace.

Critical Evidence(s) Required

Tools and Equipment

- Electric induction furnace
- Electric arc furnace
- Different instruments required to operate electric furnaces
- Safety Accessories

14. Caster-II

CS 42 Operate Pressure Die Casting

Overview: This competency standard covers the skills and knowledge required to conduct pre-operational checks, Operate machine control panel, Monitor melt in furnace, Operate machine to produce castings, perform post casting operation.

Competency Units	Performance Criteria
CU1. Conduct pre-operational checks	**P1.** Start machine according to standard operating procedures. **P2.** Clamp the two halves of the die inside the die casting machine as per SOP **P3.** Inspect the opening and closing function of die as per SOP **P4.** Inspect function of ejector and cooling system of die **P5.** Adjust component gripper if necessary. **P6.** Adjust die spray nozzles as necessary.
CU2. Operate machine control panel	**P1.** Set die opening limit **P2.** Adjust shot size as per requirement **P3.** Make functional check of the picking robot if required **P4.** Adjust operating parameters of machine at given specifications
CU3. Monitor melt in furnace	**P1.** Handle furnace according to standard operating procedures. **P2.** Maintain liquid metal as per die operating condition **P3.** Control furnace temperature at optimum operating condition **P4.** Ensure safe work practices in handling furnace
CU4. Operate machine to produce castings	**P1.** Clean each die half as per requirement **P2.** Lubricate die to facilitate the ejection of part **P3.** Close two halves of the die and clamp mold together **P4.** Apply sufficient force to the die to keep it securely closed **P5.** Transfer molten metal into the chamber as per SOPs **P6.** Inject the molten metal with required pressure into the die/mold **P7.** Fill the entire cavity of die **P8.** Open the die after casting solidification **P9.** Eject the casting out of the die cavity **P10.** Clamp shut the die for the next injection
CU5. Perform Post Casting Operation	**P11.** Trim excess material along with any flash from castings **P12.** Ensure efficient flow of finished product i.e. breaking of runners, stacking baskets, bins, conveyors **P13.** Inspect castings visually for porosity, cracks, tears, splits, sinks, cold shuts, tinning and die surface crazing

	P14. Handle castings to minimise risk of damage to the casting and injury to personnel

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. procedures for pre-start checks
K2. procedures for starting up the die casting machine
K3. adjustments that can be made to ensure correct operation of the machine
K4. procedures for adjusting the shot size
K5. the effects of incorrect shot size on the quality of the die casting
K6. the function of nitrogen and vacuum systems in the die casting process
K7. the procedures for checking/ adjusting nitrogen and/or vacuum systems
K8. the function of a picking robot and the component gripper
K9. procedures for adjusting the picking robot
K10. the effects of adjustments on robot performance
K11. the reasons for spraying the die
K12. procedures for adjusting the die spray nozzles
K13. operations to be performed subsequent to the die casting of the product
K14. methods of transporting/conveying the die cast product
K15. the effect of adjusting each machine control on the quality of the die casting produced
K16. procedures to adjust the operation of the die casting machine
K17. procedures to remove runners from the die casting
K18. procedures to inspect die castings
K19. common faults in die castings and probable causes
K20. damage that can be caused to castings through inappropriate handling and storage
K21. procedures for checking first-off castings for conformance to specification
K22. specifications of the die cast product
K23. safe work practices and procedures
K24. use and application of personal protective equipment

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 unit
- Die assembly unit
- Injection unit
- Transfer Ladles
- Tongs
- crucible
- Dies
- Molds
- Die coats
- Pump
- Metal holding pot
- Furnace
- Shot chamber
- Hydraulic plunger
- Flasks

CS 43 Perform Centrifugal Casting Process

Overview: This competency standard covers the skills and knowledge required to Read and Understand to Prepare mold for casting, Cast the molten metal, carry out cooling process, Remove the castings from mold, Clean the cast metal, Undertake preventive maintenance.

Competency Units	Performance Criteria
CU1. Prepare mold for casting	**P1.** Apply refractory ceramic coating to cylindrical mold walls **P2.** Perform rotation of mold to spread coating properly **P3.** Perform drying of ceramic coat as per standard operating procedures **P4.** Rotate mold about its axis at high speeds typically at 1000 RPM on casting machine rollers
CU2. Cast the molten metal	**P5.** Pour molten metal into the pouring tub with transfer ladle **P6.** Transfer molten metal into the rotating mold at required temperature **P7.** Avoid spillage of molten metal while pouring
CU3. Carry out cooling process	**P1.** Perform continuous rotation of mold with the molten metal **P2.** Allow melt to spread inside mold walls to let it cool **P3.** Stop the mold rotation after the casting has cooled
CU4. Remove the Castings from mold	**P1.** Perform solidification of melt to room temperature **P2.** Shake out the solidified casting from mold as per SOPs
CU5. Clean the cast metal	**P1.** Remove less dense impurities at the inner surface of the casting as per SOP **P2.** Remove dross by machining/grinding operation **P3.** Perform shot blasting to smooth the inner diameter of the part.
CU6. Undertake preventive maintenance	**P1.** Ensure general maintenance of the machine **P2.** Ensure no shut down of machines due to improper maintenance **P3.** Perform regular cleaning process as prescribed by manufacturer

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 centrifugal casting process
K2. types of centrifugal casting process
K3. Identify various centrifugal casting process
K4. Knowledge of true centrifugal casting
K5. Knowledge of semi centrifugal casting
K6. Knowledge of centrifuge centrifugal casting

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

- Die assembly unit
- Pouring basin
- Transfer Ladles
- Top rollers
- Guide rollers
- Pouring basin
- fastners
- Tongs
- Thermal insulation
- crucible
- Dies
- Molds
- Die coats
- Pump
- Metal holding pot
- Furnace
- PPEs

15. Heat Treatment-I

CS 44 Perform quenching, annealing and normalizing process

Overview: This competency standard covers the skills and knowledge required to perform Quenching, Annealing and Normalizing treatment.

Competency Units	Performance Criteria
CU1. Perform quenching process	Handle the job as per SOP Place the job in the heating furnace **Control** the temperature of the furnace as per given job Set standard soaking time of the heat treatment cycle as per given job **T**urn off the furnace, once the required temperature and soaking time is achieved. Remove the job from the furnace and quench into the quenching media. Clean the job and refer it to the next section.
CU2. Perform annealing treatment on steel	Handle the job as per SOP Place the job in the heating furnace **Control** the temperature of the furnace as per given job Set standard soaking time of the heat treatment cycle as per given job **T**urn off the furnace, once the required temperature and soaking time is achieved. **P5**. Let the workpiece to cool in the furnace. **P6**. Remove the workpiece from the furnace, once the temperature drops to room temperature. **P7**. Clean the workpiece and prepare observation data sheet
CU3. Perform normalizing process	**P1**. Handle the job as per SOP **P2**. Place the job in the furnace **Control** the temperature of the furnace as per given job Set standard soaking time of the heat treatment cycle as per given job **T**urn off the furnace, once the required temperature and soaking time is achieved.

	P5. Remove the job from furnace and let it cool in the air. **P6**. Clean the job and prepare observation data sheet.

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 45 Perform Heat Treatment of Non-Ferrous Materials

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

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

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:

K18. Differentiate between ferrous and non-ferrous materials

K19. Properties of Aluminum metal and its alloys

K20. Properties of Copper metal and its alloys

K21. Describe Soaking time

K22. Purposes of heat treatment of non-ferrous alloys

K23. Describe heat treatment furnace

K24. Describe quenching media used for non-ferrous materials

K25. Describe Aging.

16. Basic Computer Operator

CS 46 Install/Use system software

Overview: After this competency standard candidate will be able to install and configure system software / operating systems (windows/Linux) and resolve installation errors on computers.

Competency Unit	Performance Criteria
CU1. Install system software	**P1.** Prepare drive/partitions before OS installation. **P2.** Format mass storage on a PC/computer **P3.** Ensure that after formatting the mass storage device memory is empty when open. **P4.** Perform Partitioning of hard drive **P5.** Install operating system in the PC/computers by following instructional manual. **P6.** Trouble Shoot installation errors
CU2. Update /upgrade sytem software	**P1.** Schedule operating system update **P2.** Run operating system update using internet **P3.** Download and run windows/application patches
CU3. Perform tasks using operating system	**P1.** Create folders/directories **P2.** Open folders/directories and view files in desired format **P3.** Copy files, folder/ directories to different location (Hard drive, external storage, cloud) **P4.** Move files, folder/ directories to different location (Hard drive, external storage, cloud) **P5.** Rename files and directories/folder **P6.** Search files / folder/directories against various search criterion (File name, date, text etc) **P7.** Explore task Manager to view running process/tasks **P8.** Configure desktop settings

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:

- Define different types of operating system
- Describe the OS Installation process
- Demonstrate how to apply Operating system updates/patches

Tools and Equipment

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

S. No.	Items
1.	Computer System
2.	Internet Connection
3.	Web Browser
4.	Search Engines
5.	Internet or Intranet Connectivity
6.	UPS
7.	Operating System (Windows,Linux)

Critical Evidence(s) Required

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

- Install operating system
- Resolve Installation errors.

CS 47 Install / Use Application Software

Overview: After this competency standard candidate will be able to install, configure and upgrade application software on computers.

Competency Unit	Performance Criteria
CU1. Install application Software	**P1.** Install application software in the PC/computers by following instructional manual. **P2.** Trouble Shoot installation errors
CU2. Update /upgrade application Software	**P1.** Check for the update **P2.** Update/upgrade application software
CU3. Install and upgrade antivirus software	**P1.** Select appropriate antivirus software **P2.** Install antivirus software **P3.** Update antivirus database/repository **P4.** Update/upgrade antivirus software. **P5.** Schedule antivirus software update **P6.** Make sure that antivirus software is up-to-date
CU4. Perform virus scan	**P1.** Perform complete virus scan on any infected system. **P2.** Detect the viruses available on the hard disk. **P3.** Delete / quarantine all the viruses successfully which are detected as a result of scan.
CU5. Un-install application softwares	**P1.** Uninstall the application softwares **P2.** Make sure that the action is done from control panel.

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:

- Differentiate between system software and application software.

- Describe Installation process of application software
- Define the benefits of software upgradation

Tools and Equipment

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

S. No.	Items
1	Computer System
2	Internet Connection
3	Web Browser
4	Search Engines
5	Professional Office Suite (MS Office)/ Compatible office suite as per Operating System
6	Application Software
7	Antivirus software

Critical Evidence(s) Required

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

- Install application software
- Install and run antivirus software
- Uninstall application software

CS 48 Draft office documents

Overview: After this competency standard candidate will be able to prepare office documents, take offline and online backups, perform files conversions efficiently.

Competency Unit	Performance Criteria
CU1. Prepare document on word	**P1.** Explore and select appropriate word processing application **P2.** Create new document / open already existing word document **P3.** Set page Layout **P4.** Perform basic Formatting (text, paragraph, page) **P5.** Perform insert operation (picture, shapes, charts, tables, smart art, clip art, hyperlinks, page numbers, header/footers, bullets/numbering, columns) in the word document **P6.** Check the spellings in the word file through available dictionary **P7.** Save document **P8.** Print document
CU2. Prepare spreadsheet	**P1.** Explore and select appropriate spreadsheet application **P2.** Create / open Spread Sheet **P3.** Set page Layout **P4.** Perform basic Formatting **P5.** Perform insert operation (picture, charts, smart art, clip art, hyperlinks, page numbers, header/footers, bullets / numbering) in the spread sheet **P6.** Insert / use arithmetic functions/formulas **P7.** Save Spreadsheet **P8.** Print Spreadsheet
CU3. Prepare presentation	**P1.** Explore and Select appropriate presentation tool. **P2.** Create / open presentation **P3.** Set page Layout **P4.** Perform basic Formatting

	P5. Perform insert operation (slides, picture, shapes, charts, tables, smart art, clip art, hyperlinks, page numbers, bullets/numbering) in the presentation. **P6.** Select various template designs **P7.** Apply animation to slides **P8.** Check the spellings in the presentation through available dictionary **P9.** Run power point presentation **P10.** Save power point presentation **P11.** Print power point presentation
CU4. Prepare in-page files	**P1.** Set Keyboard preferences **P2.** Set page Layout **P3.** Perform basic Formatting in Inpage File **P4.** Toggle between languages **P5.** Perform insert operation (picture etc.) in the Inpage file **P6.** Insert Columns **P7.** Save Inpage File **P8.** Print Inpage File
CU5. Create backup of office record by maintaining integrity of files	**P1.** Manage electronic record's backup **P2.** Create backup on cloud based storage. **P3.** Verify the integrity of backup by restoring backup
CU6. Convert files into different formats	**P1.** Identify file conversion software **P2.** Convert files into different formats **P3.** Use online convertor to give a practical demonstration

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:

- Demonstrate proficiency in creating a Word Document.
- Describe spread sheets, use formulas and apply necessary formats
- Explain qualities of a robust presentation.

- Write a note on Urdu Word Processing.
- Understand types of files and their conversions to various file types

Tools and Equipment

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

S. No.	Items
	Computer System
	Internet Connection
	Search Engines
	Internet or LAN Connectivity
	UPS
	DVD or BLU-RAY writer
	Professional Office Suite (MS Office))/ Compatible office suite as per Operating System
	Inpage Software
	Application Softwares

Critical Evidence(s) Required

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

- Create, open, save and print files
- Perform necessary formatting according to provided document format.
- Designs CVs
- Create result Sheet
- Make presentation
- Convert file to different formats

CS 49 Perform web browsing and manage emails

Overview: After this competency standard candidate will be able perform searching on web using various search engines. The candidate shall be able to manage email accounts efficiently and use cloud services i.e Google drive, one drive, drop box etc.

Competency Unit	Performance Criteria
CU1. Perform browsing using different browsers	**P1.** Perform the components of browsing as per given instructions. **P2.** Surfing through different browsers to search required data.
CU2. Download / upload data from the internet	**P1.** Explore different downloading tools **P2.** Search and download required information. **P3.** Upload required information on cloud.
CU3. Create email account	**P1.** Create email accounts on various platforms. **P2.** Identify and remove Errors while Email configuration **P3.** Configure email account on outlook.
CU4. Sort emails	**P1.** Demonstrate sorting of emails on the PC **P2.** Perform successfully sorting of emails as per instructions
CU5. Manage address book	**P1.** Open address book. **P2.** Demonstrate the method of managing the address book by adding some contacts, removing contacts, importing, exporting, sorting and updating etc
CU6. Archive emails	**P1.** Perform the procedure of Archiving Emails **P2.** Demonstrate practically the procedure of archiving emails, as per requirements
CU7. Send and receive emails	**P1.** Compose emails using attachments **P2.** Demonstrate the procedure to send an email. **P3.** Demonstrate the procedure to receive an Email. **P4.** Print emails.

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:

- How to use various browsers
- Describe types of search engines
- Describe management of emails on various platforms.
- How to configure email accounts on outlook Differentiate between downloading and uploading data

Tools and Equipment

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

S. No.	Items
1.	Computer System
2.	Internet Connection
3.	Web Browser
4.	Search Engines
5.	Internet or LAN Connectivity
6.	Operating System (Windows, Linux)

Critical Evidence(s) Required

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

- Use search engines efficiently
- Configure email account on outlook.
- Create and send emails

Level 4

17. Soft Skills

CS 50 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	**P1.** Develop an agenda in line with the stated meeting purpose **P2.** Ensure the style and structure of the meeting are appropriate to its purpose **P3.** Identify meeting participants and notify them in accordance with organizational procedures **P4.** Confirm meeting arrangements in accordance with the requirements of meeting **P5.** Dispatch meeting working papers to participants within designated timelines
2. Conduct meetings	**P1.** Conduct meetings in accordance with organizational requirements, agreed conventions for type of meeting and legal and ethical requirements **P2.** Conduct meetings to ensure they are focused, time efficient and achieve the required outcomes **P3.** Ensure meeting facilitation enables participation, discussion, problem-solving and resolution of issues **P4:** Record minutes of meeting in accordance with organizational requirements**.** **P4.**Brief other minute-taker on method for recording meeting minutes in accordance with organizational requirements and conventions for type of meeting
3. Follow up meetings	**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 **P2.** Distribute and store minutes and other follow-up documentation within designated timelines, and according to organizational requirements **P3.**Report outcomes of meetings as required, within designated timelines

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 51 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 52 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

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:

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

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 54 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 55 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 56 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

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

18. Senior Caster

CS 57 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

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

CS 58 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	**P1.** Arrange wax patterns as per requirement **P2.** Use cores to form any internal features on the pattern if required **P3.** Attach patterns to a central wax gating system (sprue, runners, and risers) to form a tree-like assembly
CU2. Create mold for casting	**P1.** Place wax tree-like assembly into mold flask **P2.** Prepare slurry by mixing ceramic powder with water and stir it homogenously **P3.** Perform degassing of slurry in vacuum chamber **P4.** Pour slurry into the flask to coat the wax pattern tree **P5.** Bake the shell as per standard to form a ceramic shell around the patterns and gating system **P6.** Remove the wax leaving a hollow ceramic shell that acts as a one-piece mold
CU3. Cast molten metal in mold	**P1.** Pre-heat mold in a furnace as per SOP **P2.** Apply protective coating to mold as per standard **P3.** Pour molten metal from a ladle into the gating system of the mold **P4.** Carry out complete filling of the mold cavity with liquid melt as per standard operating procedure
CU4. Perform post-casting operations	**P5.** Allow for adequate solidification time into the shape of the final casting **P6.** Break the ceramic mold and remove the casting as per SOP **P7.** Separate the parts from the gating system by either sawing or cold breaking (using liquid nitrogen) **P8.** Perform finishing operations such as grinding or sandblasting to smooth the part at the gates

	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

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

19. Heat Treatment-II

CS 59 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	**P1**. Handle the job as per SOP **P2**. Place the job in the furnace **Control** the temperature of the furnace as per given job Set standard soaking time of the heat treatment cycle as per given job **T**urn off the furnace, once the required temperature and soaking time is achieved. **P5**. Remove the job from the furnace and cool in the air. **P6**. Clean the job and prepare observation data sheet.
CU5. Perform Austempering treatment on steel	**P1**. Handle the job as per SOP **P2**. Place the workpiece in the furnace **P3**. Adjust the temperature in the austenitic range and soaking time of the furnace according to steel grade and size. **P4**. Turn of the furnace once the required temperature and soaking time is achieved. **P5**. Let the workpiece to quench in a salt bath maintained at a temperature above the martensitic start (MS) range. **P6**. Hold the workpiece in a salt bath till the complete transformation of bainite. **P7.** Remove the workpiece from the salt bath and cool in the air. **P7**. Clean the workpiece and referred it to the next section.
CU6. Perform Martempring treatment of steel	**P1**. Handle the workpiece with appropriate care **P2**. Place the workpiece in the furnace **P3**. Adjust the temperature above the upper critical range and soaking time of the furnace according to steel grade and size. **P4**. Turn off the furnace, once the required temperature and soaking time is achieved.

	P5. Remove the workpiece from furnace and quenched in a salt bath, kept at a temperature of 150-300ºC. **P6**. Hold the workpiece in bath, until the temperature becomes uniform throughout the cross section of workpiece. **P7**. Remove the workpiece from salt bath and cooled in air to room temperature. **P8**. Clean the workpiece and referred it to the next section.

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

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

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
- ❖ Oxyaccetylene torch
- ❖ Gas cylinders
- ❖ Quenching bath
- ❖ Salt bath
- ❖ Long tong

20. Non Destructive Testing technician

CS 61 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	**P20.** Prepare the surface of standard specimen as per requirement. **P21.** Inspect the working mode of the Brinell Hardness Testing Machine. **P22.** Select the indenter and Load as per standard. **P23.** Place the specimen on anvil with safety precautions. **P24.** Apply load on the specimen for standard time period. **P25.** Calculate the Brinell Hardness number with formula or directly note from the gauge according to design of the machine.
CU2. Measure hardness of the specimen by using Rockwell Hardness Test	**P19.** Prepare the surface of standard specimen as per requirement. **P20.** Inspect the working mode of the Rockwell Hardness Testing Machine. **P21.** Select the Scale of the machine (A, B or C) depending upon the material. **P22.** Place the specimen on anvil with safety precautions and apply minor load. **P23.** Apply major load on the specimen according to the scale of the machine. **P24.** Note the Rockwell Hardness number from gauge.
CU3. Measure hardness of the specimen by using Vickers Hardness Test	**P8.** Prepare the surface of standard specimen as per requirement. **P9.** Inspect the working mode of the Vickers Hardness Testing Machine.

	P10.	Select the Load as per standard depending upon the material.
	P11.	Place the specimen on anvil with safety precautions.
	P12.	Apply load on the specimen for standard time period.
	P13.	Note the Vickers Hardness number from the gauge.

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:

K33. Define mechanical properties.
K34. Define destructive test.
K35. Define Hardness.
K36. Describe Brinell hardness test procedure
K37. Enlist different limitations of Brinell hardness test.
K38. What is the formula of Brinell hardness number?
K39. What is the standard method of writing Brinell hardness number?
K40. Enlist different advantages of Rockwell hardness test over Brinell hardness test.
K41. Describe Rockwell hardness test procedure
K42. What is the standard method of writing Rockwell hardness number?
K43. Compare A, B and C Scales of Rockwell hardness test.
K44. Describe Vickers hardness test procedure.
K45. 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 62 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	**P14.** Check the dimensions of Izod specimen with the help of measuring instrument as per ASTM standard. **P15.** Inspect the working mode of the izod impact testing machine. **P16.** Adjust the initial position of the hammer. **P17.** Calculate the initial potential energy of the hammer. **P18.** Clamp the standard specimen in the anvil by keeping standard length out of the anvil. **P19.** Drop the hammer to strike it with standard specimen. **P20.** Calculate the final potential energy of the hammer. **P21.** Calculate the toughness of the specimen material by calculating difference of initial and final energy of the hammer.
CU2. Measure Toughness of the specimen by using Charpy Impact Test	**P17.** Check the dimensions of Charpy specimen, received from workshop, with Vernier calliper as per ASTM standard. **P18.** Inspect the working mode of the charpy impact testing machine. **P19.** Adjust the initial position of the hammer. **P20.** Calculate the initial potential energy of the hammer. **P21.** Clamp the standard specimen in the anvil by keeping standard length out of the anvil. **P22.** Drop the hammer to strike it with standard specimen. **P23.** Calculate the final potential energy of the hammer. **P24.** Calculate the toughness of the specimen material by calculating difference of initial and final energy of the hammer.

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

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

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

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

21. Metallography Technician-I

CS 65 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	**P26.** Label the identification number to recognize specimen identity. **P27.** Perform proper documentation with date & time in log book. **P28.** Record the initial conditions of Specimen. **P29.** Use the measuring tool for marking. **P30.** Mark the cutting area with permanent marker, to be sectioned or cut.
Perform Sectioning & Cutting Operation	**P1.** Adopt standard safety practice and procedure for handling sectioning operation. **P2.** Gripe the specimen area of interest, which will be easier in handling during grinding and polishing. **P3.** Select of the abrasive blade depend upon material type. **P4.** Identify proper cutting requirement and the correct selection of abrasive type, bonding, and size; as well as proper cutting speed, load and coolant. **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).
Perform Rough Grinding Operation	**P1.** Adopt standard safety practice and procedure for handling rough grinding operation. **P2.** Select of the abrasive blade depend upon material type. **P3.** Gripe the specimen in hands then place on abrasive wheel.

	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:

K46. Define purpose of labeling and documentation.
K47. Describe safety symbols for acid chemical.
K48. Explain sectioning techniques
K49. Define General marking.
K50. Define fine rough grinding.
K51. 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 66 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	**P1.** Identify the mounting method as per requirement of metallographic standards. • Cold Mounting. • Hot Mounting. **P2.** Adopt standard safety practice and procedure for handling
CU2. Perform Cold Mounting Operation	**P25.** Select the specimen side or face, which will be study. **P26.** Place that side toward bottom of the mounting cup. **P27.** Prepare the castable mounting material by mixing material A and B. **P28.** Make past of mounting material by proper mixing. **P29.** Lubricating the mounting cup by oil. **P30.** Pour the mixture in mounting cup and leave it for settling. **P31.** Remove the mounted specimen and ready for next step of metallography.
CU3. Perform Hot Mounting Operation	**P1.** Switch on the hot mounting machine. **P2.** Select the area or side of specimen to be mounted. **P3.** Place that side toward bottom of the mounting die. **P4.** Measure the mounting material according to standard requirement. **P5.** Transfer the mounting material into the mounting die. **P6.** Select the mounting load according to standard and apply. **P7.** Adjust the mounting temperature as per standard. **P8.** Select the time for mounting. Remove the specimen from die and ready for next step.

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 67 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	**P14.** Adopt standard safety practice and procedure for handling. **P15.** Select the set of emery or abrasive paper according to their grit size. **P16.** Start grinding on paper from 60 to 1200 grit size. **P17.** Use water during grinding operation. **P18.** Rotate the specimen at 90 degree after short intervals in manual operation and continuously ground until the scratches from previous grinding direction are removed. **P19.** Replace paper on requirement.
CU3. Perform Grinding on semi/ fully automatic machine	**P1.** Identify grinding material specifications (Grit number) according to metallographic standard and type of specimen. **P2.** Adopt standard safety practice and procedure for handling. **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). **P4.** Open tape water to lubricating the grinding operation. **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. **P6.** Thoroughly clean the specimen between each abrasive grit size in automated operation. **P7.** Change the abrasive paper if necessary.

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 68 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	**P1.** Identify polishing material specifications (micron number) according to metallographic standard and type of specimen. **P2.** Adopt standard safety practice and procedure for handling. **P3.** Attach napped polishing cloth on wheel of machine. **P4.** Polishing is accomplished by decreasing down the abrasive micron number (09 to 01). **P5.** Lubricating the grinding operation with special oil. **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.
CU4. Perform Polishing Operation Automatically	**P1.** Identify polishing material specifications (micron number) according to metallographic standard and type of specimen. **P2.** Adopt standard safety practice and procedure for handling. **P3.** Attach napped polishing cloth on wheel of machine. **P4.** Polishing is accomplished by decreasing down the abrasive micron number (09 to 01). **P5.** Lubricating the grinding operation with special oil. **P6.** Thoroughly clean the specimen between each abrasive grit size in automated operation. **P7.** Change the abrasive cloth if required.

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.

22. Surface Coating technician-I

CS 69 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	**P31.** Perform documentation of the initial conditions of Specimen and recognize its identity. **P32.** Adopt standard safety practice and procedure for handling. **P33.** Prepare job layout according to process requirements
CU2. Perform Cleaning Operation	**P1.** Carry out cleaning process as per standard requirement. **P2.** Adopt standard safety practice and procedure for chemical handling. **P3.** Select the specimen side/face for coating **P4.** Prepare caustic cleaning solution for treatment with a hot alkali solution to remove dirt and oil. **P5.** Place specimen in the solution for standard time then remove and rinsing with water. **P6.** Prepare pickling cleaning solution where the surface rust and scales are removed by using a hydrochloric acid solution. **P7.** Place specimen in the solution for specific time then remove and rinsing with water. **P8.** Prepare flux solution where the surface oxides are removed and protected from further oxidation risks. **P9.** Place specimen in the solution for specific time. **P10.** Remove the specimen from bath and ready for next step.
CU3. Perform Drying Operation	**P20.** Place the specimen on the drying holders or fixtures. **P21.** Arrange specimen in sequence with all safety factors **P22.** Use hot air blower for drying the specimen.
CU4. Perform Galvanize coating Operation	**P7.** Identify galvanizing material specifications (Zn or Al %) according to standard and type of galvanizing coating on specimen.

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

Knowledge & Understanding

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

K52. Define purpose of galvanizing.
K53. Describe safety symbols for acid chemical.
K54. Explain drying and quenching techniques
K55. Define General coating thickness ranges
K56. Define cleaning types.
K57. Define galvanizing materials.
K58. Explain galvanizing time and temperatures.
K59. Define galvanizing of metals specimen.
K60. 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 70 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	**P1.** Perform documentation of the initial conditions of Specimen and recognize its identity. **P2.** Adopt standard safety practice and procedure for handling. **P3.** Prepare job layout according to process requirements
CU2. Perform Cleaning Operation	**P1.** Identify the cleaning process as per requirement of standards. **P2.** Adopt standard safety practice and procedure for chemical handling. **P3.** Select the specimen side or face, which will be coating. **P4.** Prepare degreasing cleaning solution where steel is treated with spirit solution which removes common dirt and oils. **P5.** Place specimen in the solution for specific time then remove and rinsing with water. **P6.** Prepare chemical cleaning solution where the surface rust and scales are removed by using alkaline solution. **P7.** Place specimen in the solution for specific time then remove and rinsing with water. **P8.** Prepare nitric acid solution where the surface oxides are removed. **P9.** Place specimen in the solution for specific time. **P10.** Remove the specimen from bath and ready for next step.
CU3. Perform Solution Preparation	**P1.** Take glass beaker or polythene tank. **P2.** Adopt standard safety practice and procedure for handling chemical process. **P3.** Filled half with distil or deionized water. **P4.** Add acid solution slowly and stir it.
CU3. Set up Coating bath	**P1.** Add prepared solution in the bath. **P2.** Adopt standard safety practice and procedure for handling process. **P3.**

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

Knowledge & Understanding

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

K61. Define purpose of anodizing.
K62. Describe safety symbols for acid chemical.
K63. Explain drying techniques
K64. Define General coating thickness ranges
K65. Define cleaning types.
K66. Define anodizing materials.
K67. Explain anodizing time and temperatures.
K68. 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 71 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	**P4.** Perform proper documentation of the initial conditions of Specimen and recognize its identity. **P5.** Adopt standard safety practice and procedure for handling. **P6.** Prepare job layout according to process requirements
CU. Perform Polishing	**P1.** Adopt standard safety practice and procedure for handling. **P2.** Select of the abrasive blade depend upon material type. **P3.** Gripe the specimen in hands then place on abrasive wheel. **P4.** Remove the sharp edges and corner of specimen. **P5.** Select the set of emery or abrasive paper according to their grit size. **P6.** Start grinding on paper from 60 to 1200 grit size. **P7.** Use water during grinding operation. **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. **P9.** Replace paper on requirement.
CU2. Perform Cleaning Operation	**P11.** Identify the Cleaning process as per requirement of standards. **P12.** Adopt standard safety practice and procedure for chemical handling. **P13.** Select the specimen side or face, which will be coating. **P14.** Prepare degreasing cleaning solution where steel is treated with solution which removes common dirt and oils. **P15.** Place specimen in the solution for specific time then remove and rinsing with water. **P16.** Prepare pickling solution where the surface rust and scales are removed by using alkaline or acidic solution. **P17.** Place specimen in the solution for specific time then remove and rinsing with water.

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

Knowledge & Understanding

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

K69. Define purpose of Electroplating.
K70. Describe safety symbols for acid chemical.
K71. Explain drying techniques
K72. Define General coating thickness ranges
K73. Define cleaning types.
K74. Define electrolyte materials.
K75. Explain electroplating time and temperatures.
K76. 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 72 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	**P1.** Perform proper documentation of the initial conditions of Specimen and recognize its identity. **P2.** Adopt standard safety practice and procedure for handling. **P3.** Prepare job layout according to process requirements
CU. Perform Polishing	**P1.** Adopt standard safety practice and procedure for handling. **P2.** Select of the abrasive blade depend upon material type. **P3.** Gripe the specimen in hands then place on abrasive wheel. **P4.** Remove the sharp edges and corner of specimen. **P5.** Select the set of emery or abrasive paper according to their grit size. **P6.** Start grinding on paper from 60 to 1200 grit size. **P7.** Use water during grinding operation. **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. **P9.** Replace paper on requirement.
CU2. Perform Cleaning Operation	**P1.** Identify the Cleaning process as per requirement of standards. **P2.** Adopt standard safety practice and procedure for chemical handling. **P3.** Select the specimen side or face, which will be coating.

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

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:

K77. Define purpose of Electrolysis electroplating.
K78. Describe safety symbols for acid chemical.
K79. Explain drying techniques
K80. Define General coating thickness ranges
K81. Define cleaning types.
K82. Define electrolyte materials.
K83. Explain Electrolysis electroplating time and temperatures.
K84. 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

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

23. Metal forming technician

CS 73 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	**P34.** Ensure occupation health safety and environment standards as per requirement **P35.** Check the Property of Materials **P36.** Measure the strip dimensions. **P37.** Set parameters (pressure, current, speed, time temperature cycle, concentration, tension) according to coil specifications **P38.** Handle command for carrying out the operation **P39.** Perform Rolling operation with Two-High Rolling Mills **P40.** Perform Rolling operation with Three-High Rolling Mills **P41.** Perform Rolling Operation with Four High Rolling Mills **P42.** Perform Rolling Operation with Shape rolling **P43.** Monitor the process parameters during operation e.g. RPM, temperature, line tension, pressure, concentration, line speed, coating thickness, etc. **P44.** Unload the strip and measure the dimensions and properties of Materials.
CU2. Perform Hot rolling process as per given requirement	**P32.** Ensure occupation health safety and environment standards as per requirement **P33.** Check the Property of Materials **P34.** Measured the strip dimensions. **P35.** Preheat the strip for Hot rolling. **P36.** Set parameters (pressure, time) according to coil specifications **P37.** Handle command for carrying out the operation **P38.** Perform Rolling operation with Two-High Rolling Mills **P39.** Perform Rolling operation with Three-High Rolling Mills

	P40. Monitor the process parameters during operation e.g. RPM, temperature, line tension, pressure, concentration, line speed, coating thickness, etc. **P41.** Unload the strip and measure the dimensions and properties of Materials.

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:

K85. Define metal forming process
K86. Describe types of metal forming processes (bulk deformation and sheet metalworking)
K87. Explain types of sheet metalworking (bending, deep or cup drawing, shearing processes and miscellaneous processes)
K88. Explain types of rolling process
K89. Describe material behavior in metal forming processes
K90. Explain temperature in metal forming
K91. Explain strain rate sensitivity
K92. Explain friction and lubrication in metal forming
K93. 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 74 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)	**P1.** Ensure occupation health safety and environment standards as per requirement **P2.** Prepare the metal stock. **P3.** Check the Property of stock. **P4.** Check the Property of Materials **P5.** Measure the stock dimensions. **P6.** Select the Open dies according to requirement. **P7.** Preheat the stock for hot forging operation. **P8.** Apply the forced multiple times to get desired shape **P9.** Perform Finishing operations.
Cu2. Perform closed/impression die Forging(Cold, Hot)	**P1.** Ensure occupation health safety and environment standards as per requirement **P2.** Check the Property of Materials **P3.** Measured the stock dimensions. **P4.** Select the open and closed dies according to Shape requirement. **P5.** Preheat the stock for hot forging operation. **P6.** Apply force through moveable die to get desired shape **P7.** Perform Finishing operations

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:

K9. Define metal forming process
K10. Hot Forging and Cold Forging
K11. 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 75 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	**P1.** Ensure occupation health safety and environment standards as per requirement **P2.** Prepare the metal blanks. **P3.** Check the property of Blank. **P4.** Select the suitable die according to your Requirements. **P5.** Select the suitable Punch according to your Requirement. **P6.** Perform forward extrusion **P7.** Perform backword extrusion **P8.** Perform hydrostatic extrusion. **P9.** Compare The output with your Requirements. **P10.** Perform Finishing operation
Cu2. Perform Hot Extrusion	**P1.** Ensure occupation health safety and environment standards as per requirement **P2.** Prepare the metal blanks. **P3.** Check the Property of Blank. **P4.** Preheat the stock for hot forging operation. **P5.** Select the suitable die according to your Requirements. **P6.** Select the suitable Punch according to your Requirement. **P7.** Perform forward extrusion **P8.** Perform backword extrusion **P9.** Perform hydrostatic extrusion **P10.** Compare the output with your Requirements. **P11.** Perform Finishing operation

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 76 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	**P1.** Ensure occupation health safety and environment standards as per requirement **P2.** Prepare the metal blanks. **P3.** Check the Property of Blank. **P4.** Set No of Dies according to requirement. **P5.** Perform wire drawing operation. **P6.** Measure the dimeter of wire and match it with requirements.
CU2. Perform Deep Drawing operation	**P1.** Ensure occupation health safety and environment standards as per requirement **P2.** Prepare the metal blanks. **P3.** Check the Property of Blank. **P4.** Chose the die according to your requirement. **P5.** Set the Blank Holder **P6.** Select the punch and set the punch Travel distance. **P7.** Apply the require force through punch and get the final output. **P8.** Perform Measuring and finishing operation.

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

24. QC Inspector-I

CS 77 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	**P1. Test casting defects for conformance to specifications in accordance with standard operating procedures.** **P2. Test forging defects for conformance to specifications in accordance with standard operating procedures.** **P3. Test molding process for conformance to specifications in accordance with standard operating procedures.** **P4. Test Heat treatment process for conformance to specifications in accordance with standard operating procedures.**
CU2. Keep records	**P1. Ensure identification of conforming products** **P2. Ensure identification of non-conforming products** **P3. Ensure identification of conforming process** **P4. Ensure identification of non-conforming process** **P5. Maintain records accurately using standard operating procedures**
CU3. Provide feedback	**P1. Test products after rework or repair** **P2. Inspect products after rework or repair** **P3. Measure products after rework or repair** **P4. Report Deficiencies or deviations according to 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. 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 78 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:

- Identify and implement various method of inspection

Tools and Equipment:

- ❖ Inspection instruments

CS 79 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

LEVEL 5

25. Metallography Technician-II

CS 80 Perform Etching Operation

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

Competency Units/Task	Performance Criteria/Step
Perform Etching Operation	**P1.** Identify the etching method as per requirement of metallographic standards. • Chemical etching. • Electrolytic etching. **P2.** Adopt standard safety practice and procedure for handling
CU5. Perform Chemical Etching Operation	**P1.** Identify etching solution specifications according to metallographic standard and type of specimen. **P2.** Adopt standard safety practice and procedure for handling acid chemicals. **P3.** Make etching solution in china dish as per requirement. **P4.** Dip the specimen into solution with the help of tong for several time until its shine become dim. **P5.** Wash with distil water then clean with alcohol. **P6.** Dry the specimen with air dryer.
CU5. Perform Electrolytic Etching Operation	**P1.** Identify electrolyte solution specifications according to metallographic standard and type of specimen. **P2.** Adopt standard safety practice and procedure for handling acid chemicals. **P3.** Make etching solution in beaker as per requirement. **P4.** Transfer solution in machine bath. **P5.** Dip the specimen in bath. **P6.** Connect the specimen with positive pole.

	P7. Select the current and time for etching. **P8.** Wash with distil water then clean with alcohol. **P9.** Dry the specimen with air dryer.

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 etching in Metallography.
K2. Describe safety symbols for acid chemical.
K3. Explain etching techniques
K4. Define General chemical use in etching.
K5. Define fine polishing and polishing cloths.
K6. Define etching glass ware.
K7. Explain etching time and temperatures.

Critical Evidence(s) Required

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

- Identify etching requirements according international standards given in the ASTM.
- Identify material specifications for etching according to metallographic standard requirements
- Identify etching chemicals and glass ware according to metallographic standard
- Interpret etching according to metallographic standard for different metals.
- Assemble electrolytic etching machine connections according to metallographic standard

Tools and Equipment

- Mounting tools & equipment
- Etching chemicals
- Glass wares

CS 81 Perform Microscopic Examination Operation

Overview: This competency standard covers the skills and knowledge required to Perform Fine microscopic examination operations of Metallic materials. Also determine Microscopic Examination Operation requirements, Check the operations of equipment.

Competency Units/Task	Performance Criteria/Step
Perform Leveling Operation	**P1.** Levelling the specimen by using on-toxic, non-staining, reusable modeling compound. **P2.** Put compound at bottom of specimen. **P3.** Cover the both ends of specimen with tissue to avoid stain on surface. **P4.** Apply small load with press.
Perform Microscopic Examination Operation	**P1.** Place the specimen onto the stage of Metallurgical microscope. **P2.** Power on source light and adjust its intensity. **P3.** Select the magnification power by adjusting eye piece number (50 to 1000X) **P4.** Adjusting the stage with the help of nobs to make clear microstructure of specimen. **P5.** Capture the picture of microstructure with the help of camera. **P6.** Save the image in computer for further study.

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:

K8. Define purpose of Metallography.
K9. Describe safety symbols.
K10. Explain metallographic technique
K11. Explain microscopic examination.
K12. Explain microstructure of steel, cast iron and Al, cu.

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 according international standards given in the ASTM.
- Identify material specifications for rough and fine polishing according to metallographic standard requirements
- Interpret microscopic examination according to metallographic standard
- Assemble leveling press machine according to metallographic standard

Tools and Equipment

- ❖ Measuring devices
- ❖ Hand held calculator
- ❖ Metallurgical Microscope

26. QC Inspector-II

CS 82 Conduct process and product capability analysis

Overview: This competency standard covers the skills and knowledge required to Read and understand Process capability analysis, control limits and sampling plans

Competency Units/Task	Performance Criteria/Step
CU1. Conduct process capability studies	**P1. Determine procedure for conducting capability study** **P2. Prepare instructions for personnel conducting trial run** **P3. Analyse data from trial run** **P4. Calculate process capability** **P5. Estimate possible number of product defects from a particular process** **P6. Determine optimum target mean to suit process capability data** **P7. Prepare reports listing various options from process capability studies** **P8. Design specifications based on an analysis of data are recommended.**
CU2. Set control limits	**P1. Calculate control limits for sample/subgroup average, range and standard deviation.** **P2. Calculate warning limits for subgroup average, range and standard deviation** **P3. Determine course of action resulting from out of control situation** **P4. Document course of action to standard operating procedure**
CU3. Select sampling plans	**P1. Select appropriate sampling plan to suit production schedule** **P2. Determine acceptable quality limits taking into account specified producer and consumer risks.** **P3. Document Sampling plan** **P4. Document implementation strategy**

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 the process
K2. Explain the procedures for conducting process capability studies
K3. Define the data used to calculate the process capability
K4. Define the procedures for estimating the possible number of product defects
K5. Describe options for improving the process
K6. Explain the procedures for determining the optimum target mean
K7. Define the procedures for setting control limits
K8. Describe numerical operations and calculations/formulae for process capability, control limits and other outcomes within the scope of this unit
K9. Describe the procedures for setting warning limits
K10. Define the concept of 'out of control' situations
K11. Define the action to be taken when an 'out of control' situation is detected
K12. Describe the procedures for documenting 'out of control' situations
K13. Define the acceptable level of quality
K14. Define a variety of sampling plans and their application
K15. Describe the sampling plan to be applied to a given situation
K16. Explain the reasons for selecting the chosen plan
K17. Describe the acceptable quality limits
K18. Define the risks associated with identifying acceptable quality limits for the producer and customer
K19. Explain the procedures for documenting and implementing sampling plans
K20. Define hazards and control measures
K21. Explain use and application of personal protective equipment
K22. Define 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:

- Select a process for improvement
- Perform process capability analysis of required process
- Calculation of control limits
- Calculation of warning limits

Tools and Equipment:

- Desktop Computer/laptop

CS 83 Perform advanced statistical quality control

Overview: This competency standard covers the skills and knowledge required to Read and understand the implementation of 6 quality tools and construction of control charts.

Competency Units/Task	Performance Criteria/Step
CU1. Understand sampling and sample size	**P1. Differentiate continuous and variable data** **P2. Identify population** **P3. Determine confidence level** **P4. Understand various sampling techniques** **P5. Understand sample size**
CU2. Implement six Quality tools	**P1. Understand cause and effect diagram** **P2. Understand check sheet template** **P3. Understand control charts** **P4. Understand histogram** **P5. Understand pareto chart** **P6. Understand scattered diagram** **P7. Implement required tool on given data**
CU3. Construct control charts	**P1. Identify the key product parameters to be controlled.** **P2. Understand the types of control charts** **P3. Construction of control charts including upper control limits and lower control limits from sample data as per requirement** **P4. Identify special and common causes of quality variation** **P5. Calculate sigma level 1,2 & 3.**

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 process parameters
K2. Explain the procedures for constructing control charts and determining control limits from sample data
K3. Define sampling
K4. Define sample size
K5. Explain 6 Quality tools
K6. Describe population dispersion in terms of 1, 2 and 3 sigma limits
K7. 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 process parameters
- Calculate variance
- Measure sigma values

Tools and Equipment:

- ❖ Desktop Computer/laptop

27. Non-destructive testing technician

CS 84 Perform dye penetrant, magnetic and ultrasonic test

Overview: This competency standard covers the skills and knowledge required to Determine the flaws in specimen using dye penetrant technique, Determine the flaws of specimen metallic specimen and Determine the flaws of given specimen using magnetic particle testing equipment

Competency Units	Performance Criteria
CU1. Determine the surface defects of specimen using dye penetrant technique	**P1.** Perform pre-cleaning of samples. **P2.** Apply dye penetrant. **P3.** Remove the excess dye penetrant. **P4.** Apply the developer. **P5.** Inspect the specimen for defects. **P6.** Interpret the results.
CU2. Determine the defects of specimen by using ultrasonic technique	**P1.** Perform pre-cleaning of samples. **P2.** Inspect the working mode of the equipment **P3.** Switch ON the ultrasonic testing equipment **P4.** Calibrate the ultrasonic equipment with respect to calibration block **P5.** Select the probe according to the specimen **P6.** Apply couplant gel on the given specimen **P7.** Test the given specimen **P8.** Observe the peaks. **P9.** Interpret the peaks and record the results
CU3. Determine the defects of given ferromagnetic specimen using magnetic	**P1.** Perform pre-cleaning of samples. **P2.** Inspect the working mode of the equipment **P3.** Apply magnetic field to the specimen **P4.** Apply ferromagnetic medium with respect to type of test (Dry or Wet) **P5.** Remove the excess ferromagnetic medium.

particle testing technique	**P6.** Interpret the indications. **P7.** Evaluated the results.
CU4. Determine the defects of given metallic specimen by using eddy current testing technique	**P1.** Perform pre-cleaning of samples. **P2.** Inspect the working mode of the equipment **P3.** Place the specimen on insulator table **P4.** Test the specimen **P5.** Note the values of resultant current of the coil **P6.** Interpret and record the results
CU5. Determine the defects of given specimen by radiography technique	**P1.** Perform pre-cleaning of samples. **P2.** Inspect the working mode of the radiographic equipment **P3.** Inspect all safety facilities as per standard **P4.** Set the position of photographic film **P5.** Place the specimen at specific position in front of photographic film **P6.** Pass the rays through the specimen **P7.** Develop the photographic film **P8.** Observe the image of specimen **P9.** Record the results

Knowledge & Understanding

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

K13. Describe test procedure of radiography.

K14. Describe applications of radiography.

Tool and Equipment

- Relevant Testing Apparatus
- Relevant safety tools
- Relevant instruments

CS 85 Perform radiography and eddy current test

Overview: This competency standard covers the skills and knowledge required to Determine the flaws in specimen using dye penetrant technique, Determine the flaws of specimen metallic specimen and Determine the flaws of given specimen using magnetic particle testing equipment

Competency Units	Performance Criteria
CU1. Determine the defects of given metallic specimen by using eddy current testing technique	**P7.** Perform pre-cleaning of samples. **P8.** Inspect the working mode of the equipment **P9.** Place the specimen on insulator table **P10.** Test the specimen **P11.** Note the values of resultant current of the coil **P12.** Interpret and record the results
CU2. Determine the defects of given specimen by radiography technique	**P10.** Perform pre-cleaning of samples. **P11.** Inspect the working mode of the radiographic equipment **P12.** Inspect all safety facilities as per standard **P13.** Set the position of photographic film **P14.** Place the specimen at specific position in front of photographic film **P15.** Pass the rays through the specimen **P16.** Develop the photographic film **P17.** Observe the image of specimen **P18.** Record the results

Knowledge & Understanding

K15. Define Non-destructive test.
K16. Describe different types of defects of engineering materials.
K17. Describe procedure of dye penetrant technique.
K18. Describe limitations of dye penetrant test.
K19. Enlist applications of dye penetrant test.
K20. Describe the test procedure of ultrasonic testing.
K21. Enlist applications of ultrasonic testing.
K22. Describe test procedure of magnetic particle test.
K23. Enlist applications of magnetic particle test.
K24. Enlist limitations of magnetic particle test.
K25. Describe test procedure of eddy current inspection.
K26. Describe applications of eddy current inspection.
K27. Describe test procedure of radiography.
K28. Describe applications of radiography.

Tool and Equipment

- Relevant Testing Apparatus
- Relevant safety tools
- Relevant instruments

28. Surface Coating technician-II

CS 86 Perform Vapor Deposition Coatings (PVD)

Overview: This competency standard covers the skills and knowledge required to perform Vapor Deposition coating (PVD) of steel materials and observing operational sequence and parameters.

Competency Units/Task	Performance Criteria/Step
CU1. Perform cataloging	**P1.** Perform proper documentation of the initial conditions of Specimen and recognize its identity. **P2.** Adopt standard safety practice and procedure for handling. **P3.** Prepare job layout according to process requirements

CU2. Perform Cleaning Operation	**P1.** Identify the Cleaning process as per requirement of standards. **P2.** Adopt standard safety practice and procedure for chemical handling. **P3.** Prepare degreasing cleaning solution where steel is treated with CCL4 solution which removes common dirt and oils. **P4.** Place specimen in the solution for specific time in ultrasonic bath then remove and rinsing with water. **P5.** Prepare chemical cleaning solution where the surface rust and scales are removed by using acetone solution. **P6.** Place specimen in the solution for specific time in ultrasonic bath then remove and rinsing with water. **P7.** Prepare cleaning solution where the surface oxides are removed by using cleano gel. **P8.** Place specimen in the solution for specific time in ultrasonic bath with agitation then rising with water. **P9.** Remove the specimen from bath and ready for next step.
CU5. Perform Drying Operation	**P1.** Place specimen in the tray. **P2.** Switch on hot air dryer use for drying . **P3.** Remove specimen after specific time for drying.
CU3. Set up Jigs & Fixture	**P10.** Adjust C plate length according to specimen height. **P11.** Adopt standard safety practice and procedure for handling process. **P12.** Use standard holder or fixture for specimen. **P13.** Hang the specimen in holders with S.S wires. **P14.** Clean the Carosole with cold compress air. **P15.** Clamping and tightening the holders in Carosole. **P16.** Lift the Carosole with lifter and place in chamber.
CU4. Perform Coating	**P1.** Pre heat the chamber with open door at 120C for 30-60 min.

Operation	**P2.** Clean the door, chamber and Carosole with vacuum cleaner. **P3.** Clean the door sealing with alcohol then apply vacuum sealing gel. **P4.** Close the door of machine. **P5.** Select the required recipe or parameters. **P6.** Start the coating machine, coating time depends upon type and thickness of coating. **P7.** After coating finished wait for cooling down of chamber. **P8.** Open door and take out Carosole with lifter. **P9.** Clean the specimen with cold compress air.

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:

K94. Define purpose of PVD coating.
K95. Describe safety symbols for acid chemical.
K96. Explain PVD coating techniques
K97. Define General coating thickness ranges
K98. Define cleaning types.
K99. Define PVD coating materials.
K100. Explain Coatingtime and temperatures.
K101. 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 PVD coating 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 PVD coating according to standard.

Tools and Equipment

- Drying tools & equipment
- PVD coating tools & equipment
- Cleaning tools & equipment
- Carosole & equipment
- Measuring devices
- Hand held calculator
- Chemical & Glass wares

CS 87 Perform Vapor Deposition Coatings (CVD)

Overview: This competency standard covers the skills and knowledge required to perform Vapor Deposition coating (CVD) of steel materials and observing operational sequence and parameters.

Competency Units/Task	Performance Criteria/Step
CU1. Perform cataloging	**P1.** Perform proper documentation of the initial conditions of Specimen and recognize its identity. **P2.** Adopt standard safety practice and procedure for handling. **P3.** Prepare job layout according to process requirements
CU2. Perform Cleaning Operation	**P1.** Identify the Cleaning process as per requirement of standards. **P2.** Adopt standard safety practice and procedure for chemical handling. **P3.** Prepare degreasing cleaning solution where steel is treated with CCL4 solution which removes common dirt and oils. **P4.** Place specimen in the solution for specific time in ultrasonic bath then remove and rinsing with water.

	P5. Prepare chemical cleaning solution where the surface rust and scales are removed by using acetone solution. **P6.** Place specimen in the solution for specific time in ultrasonic bath then remove and rinsing with water. **P7.** Prepare cleaning solution where the surface oxides are removed by using cleano gel. **P8.** Place specimen in the solution for specific time in ultrasonic bath with agitation then rising with water. **P9.** Remove the specimen from bath and ready for next step.
CU5. Perform Drying Operation	**P1.** Place specimen in the tray. **P2.** Switch on hot air dryer use for drying. **P3.** Remove specimen after specific time for drying.
CU3. Set up Jigs & Fixture	**P1.** Adjust fixtures according to specimen height. **P2.** Adopt standard safety practice and procedure for handling process. **P3.** Use standard holder or fixture for specimen. **P4.** Hang the specimen in holders with S.S wires. **P5.** Clean the Fixtures with cold compress air. **P6.** Clamping and tightening the holders in fixtures. **P7.** Lift the Carosole with lifter and place in chamber.
CU4. Perform Coating Operation	**P1.** Pre heat the chamber with open door at 120C for 30-60 min. **P2.** Clean the door, chamber and Carosole with vacuum cleaner. **P3.** Clean the door sealing with alcohol then apply vacuum sealing gel. **P4.** Close the door of machine. **P5.** Select the required recipe or parameters. **P6.** Start the coating machine, coating time depends upon type and thickness of coating. **P7.** After coating finished wait for cooling down of chamber. **P8.** Open door and take out fixture with lifter. **P9.** Clean the specimen with cold compress air.

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:

K102. Define purpose of CVD coating.

K103. Describe safety symbols for acid chemical.

K104. Explain CVD coating techniques

K105. Define General coating thickness ranges

K106. Define cleaning types.

K107. Define CVD coating materials.

K108. Explain Coating time and temperatures.

K109. 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 CVD coating 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 CVD coating according to standard.

Tools and Equipment

- Drying tools & equipment
- CVD coating tools & equipment
- Cleaning tools & equipment
- Carosole & equipment
- Measuring devices
- Hand held calculator
- Chemical & Glass wares

CS 88 Perform Thermal Spray Coatings (Plasma)

Overview: This competency standard covers the skills and knowledge required to perform Thermal Spray Coatings (Plasma) of steel materials and observing operational sequence and parameters.

Competency Units/Task	Performance Criteria/Step
CU1. Perform cataloging	**P1.** Perform proper documentation of the initial conditions of Specimen and recognize its identity. **P2.** Adopt standard safety practice and procedure for handling. **P3.** Prepare job layout according to process requirements
CU2. Perform ultrasonic Cleaning Operation	**P1.** Identify the Cleaning process as per requirement of standards. **P2.** Adopt standard safety practice and procedure for chemical handling. **P3.** Prepare degreasing cleaning solution where steel is treated with CCL4 solution which removes common dirt and oils. **P4.** Place specimen in the solution for specific time in ultrasonic bath then remove and rinsing with water. **P5.** Prepare chemical cleaning solution where the surface rust and scales are removed by using acetone solution. **P6.** Place specimen in the solution for specific time in ultrasonic bath then remove and rinsing with water. **P7.** Prepare cleaning solution where the surface oxides are removed by using cleano gel. **P8.** Place specimen in the solution for specific time in ultrasonic bath with agitation then rising with water. **P9.** Remove the specimen from bath and ready for next step.
CU. Perform Grit Blasting Operation	**P1.** Add grit of required mesh size in the blasting machine. **P2.** Adopt standard safety practice and procedure for handling. **P3.** Place the sample in chamber. **P4.** Set angle 90 or 45 degree for blasting depends upon type of materials. **P5.** Blast according to standard time. **P6.** Remove specimen from chamber. **P7.** Clean the specimen with compress air. **P8.** Also use alcohol for cleaning.

CU. Perform Masking Operation	**P1.** Place specimen in the tray. **P2.** Apply masking solution with help of brush on the safe from coating. **P3.** Let it dry or use compress air for drying. **P4.** Masking may also be use. **P5.** Remove specimen after specific time for drying.
CU. Set up Jigs & Fixture	**P1.** Adjust holder according to specimen height, width. **P2.** Adopt standard safety practice and procedure for handling process. **P3.** Use standard holder or fixture for specimen. **P4.** Grip the specimen in holders. **P5.** Clean the Fixtures with cold compress air. **P6.** Clamping and tightening the holders.
CU. Set up Plasma coating system	**P1.** Connect primary (Ar) and secondary (H2) gases and set required pressure. **P2.** Set the temperature max 18C of chiller and connect hoses to gun and system. **P3.** Set air pressure of compressor and connect to gun and system. **P4.** Pre heat coating powder in oven then mix in mixing machine. **P5.** Put powder in system hopper and set it flow rate. **P6.** Set coating current from 500-700 amps.
CU. Perform Coating Operation	**P1.** Perform ignition test to check parameters of plasma system. **P2.** Switch on holding machine to rotate the specimen. **P3.** Fix in holder and Set distance from specimen of plasma coating gun. **P4.** Open primary gas and adjust current as per coating standards. **P5.** Pre heat the specimen around 120C. **P6.** Open secondary gas to achieve required temperature. **P7.** Switch on powder feeder for coating. **P8.** Remove specimen from holder and cool with compress air.

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:

K110. Define purpose of Plasma coating.

K111. Describe safety symbols for acid chemical.

K112. Explain Plasma coating techniques

K113. Define General coating thickness ranges

K114. Define cleaning types.

K115. Define Plasma coating materials.

K116. Explain Coating time and temperatures.

K117. 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 Plasma coating requirements according international standards given in the ASTM.
- Identify cleaning specifications for plasma according to standard requirements
- Identify raw materials according to standard.
- Interpret coating examination according to standard.
- Assemble cleaning and Plasma coating according to standard.

Tools and Equipment

- Drying tools & equipment
- Plasma coating tools & equipment
- Cleaning tools & equipment
- Carosole & equipment
- Measuring devices
- Hand held calculator
- Chemical & Glass wares

CS 89 Perform Thermal Spray Coatings (Electric Arc Value)

Overview: This competency standard covers the skills and knowledge required to perform Thermal Spray Coatings (Electric Arc Value) of steel materials and observing operational sequence and parameters.

Competency Units/Task	Performance Criteria/Step
CU1. Perform cataloging	**P4.** Perform proper documentation of the initial conditions of Specimen and recognize its identity. **P5.** Adopt standard safety practice and procedure for handling. **P6.** Prepare job layout according to process requirements
CU2. Perform ultrasonic Cleaning Operation	**P10.** Identify the Cleaning process as per requirement of standards. **P11.** Adopt standard safety practice and procedure for chemical handling. **P12.** Prepare degreasing cleaning solution where steel is treated with CCL4 solution which removes common dirt and oils. **P13.** Place specimen in the solution for specific time in ultrasonic bath then remove and rinsing with water. **P14.** Prepare chemical cleaning solution where the surface rust and scales are removed by using acetone solution. **P15.** Place specimen in the solution for specific time in ultrasonic bath then remove and rinsing with water. **P16.** Prepare cleaning solution where the surface oxides are removed by using cleano gel. **P17.** Place specimen in the solution for specific time in ultrasonic bath with agitation then rising with water. **P18.** Remove the specimen from bath and ready for next step.
CU. Perform Grit Blasting Operation	**P9.** Add grit of required mesh size in the blasting machine. **P10.** Adopt standard safety practice and procedure for handling. **P11.** Place the sample in chamber. **P12.** Set angle 90 or 45 degree for blasting depends upon type of materials. **P13.** Blast according to standard time. **P14.** Remove specimen from chamber. **P15.** Clean the specimen with compress air.

	P16. Also use alcohol for cleaning.
CU. Perform Masking Operation	**P6.** Place specimen in the tray. **P7.** Apply masking solution with help of brush on the safe from coating. **P8.** Let it dry or use compress air for drying. **P9.** Masking may also be use. **P10.** Remove specimen after specific time for drying.
CU. Set up Jigs & Fixture	**P7.** Adjust holder according to specimen height, width. **P8.** Adopt standard safety practice and procedure for handling process. **P9.** Use standard holder or fixture for specimen. **P10.** Grip the specimen in holders. **P11.** Clean the Fixtures with cold compress air. **P12.** Clamping and tightening the holders.
CU. Set up Plasma coating system	**P7.** Set air pressure of compressor and connect to gun and system. **P8.** Adjust gear box, voltage, current and speed of coating wire parameters of system. **P9.** Adjust the gun distance from specimen. **P10.** Assemble the coating wire spools.
CU. Perform Coating Operation	**P9.** Perform ignition test to check parameters of arc value system. **P10.** Switch on holding machine to rotate the specimen. **P11.** Fix in holder and Set distance from specimen of plasma coating gun. **P12.** Switch on arc system then adjust voltage and current as per coating standards. **P13.** Pre heat the specimen around 120C. **P14.** Switch on wire feeder for coating. **P15.** Remove specimen from holder and cool with compress air.

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:

K118. Define purpose of electric Arc coating.

K119. Describe safety symbols for acid chemical.

K120. Explain electric Arc coating techniques

K121. Define General coating thickness ranges

K122. Define cleaning types.

K123. Define Plasma coating materials.

K124. Explain Coating time and temperatures.

K125. 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 electric Arc coating requirements according international standards given in the ASTM.
- Identify cleaning specifications for electric Arc coating according to standard requirements
- Identify raw materials according to standard.
- Interpret coating examination according to standard.
- Assemble cleaning and electric Arc coating according to standard.

Tools and Equipment

- Drying tools & equipment
- electric Arc coating tools & equipment
- Cleaning tools & equipment
- holder & equipment
- Measuring devices
- Hand held calculator
- Chemical & Glass wares

CS 90 Perform Thermal Spray Coatings (LVOF)

Overview: This competency standard covers the skills and knowledge required to perform Thermal Spray Coatings (LVOF) of steel materials and observing operational sequence and parameters.

Competency Units/Task	Performance Criteria/Step
CU1. Perform cataloging	**P7.** Perform proper documentation of the initial conditions of Specimen and recognize its identity. **P8.** Adopt standard safety practice and procedure for handling. **P9.** Prepare job layout according to process requirements
CU2. Perform ultrasonic Cleaning Operation	**P19.** Identify the Cleaning process as per requirement of standards. **P20.** Adopt standard safety practice and procedure for chemical handling. **P21.** Prepare degreasing cleaning solution where steel is treated with CCL4 solution which removes common dirt and oils. **P22.** Place specimen in the solution for specific time in ultrasonic bath then remove and rinsing with water. **P23.** Prepare chemical cleaning solution where the surface rust and scales are removed by using acetone solution. **P24.** Place specimen in the solution for specific time in ultrasonic bath then remove and rinsing with water. **P25.** Prepare cleaning solution where the surface oxides are removed by using cleano gel. **P26.** Place specimen in the solution for specific time in ultrasonic bath with agitation then rising with water. **P27.** Remove the specimen from bath and ready for next step.
CU. Perform Grit Blasting Operation	**P17.** Add grit of required mesh size in the blasting machine. **P18.** Adopt standard safety practice and procedure for handling. **P19.** Place the sample in chamber. **P20.** Set angle 90 or 45 degree for blasting depends upon type of materials. **P21.** Blast according to standard time. **P22.** Remove specimen from chamber. **P23.** Clean the specimen with compress air. **P24.** Also use alcohol for cleaning.

CU. Perform Masking Operation	**P11.** Place specimen in the tray. **P12.** Apply masking solution with help of brush on the safe from coating. **P13.** Let it dry or use compress air for drying. **P14.** Masking may also be use. **P15.** Remove specimen after specific time for drying.
CU. Set up Jigs & Fixture	**P13.** Adjust holder according to specimen height, width. **P14.** Adopt standard safety practice and procedure for handling process. **P15.** Use standard holder or fixture for specimen. **P16.** Grip the specimen in holders. **P17.** Clean the Fixtures with cold compress air. **P18.** Clamping and tightening the holders.
CU. Set up Plasma coating system	**P11.** Connect primary (Ar and O2) and secondary (CH/H2) gases and set required flow rate. **P12.** Connect gas and air hoses to gun and system. **P13.** Set air pressure of compressor and connect to gun and system. **P14.** Pre heat coating powder in oven then mix in mixing machine. **P15.** Put powder in system hopper and set it flow rate.
CU. Perform Coating Operation	**P16.** Perform ignition test to check parameters of LVOF system. **P17.** Switch on holding machine to rotate the specimen. **P18.** Fix in holder and Set distance from specimen of LVOF coating gun. **P19.** Open primary gas to adjust ignition. **P20.** Pre heat the specimen around 120C. **P21.** Open secondary gas to achieve required temperature. **P22.** Switch on powder feeder for coating. **P23.** Remove specimen from holder and cool with compress air.

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:

K126. Define purpose of LVOF coating.

K127. Describe safety symbols for acid chemical.

K128. Explain LVOF coating techniques

K129. Define General coating thickness ranges

K130. Define cleaning types.

K131. Define LVOF coating materials.

K132. Explain Coating time and temperatures.

K133. 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 LVOF coating requirements according international standards given in the ASTM.
- Identify cleaning specifications for LVOF according to standard requirements
- Identify raw materials according to standard.
- Interpret coating examination according to standard.
- Assemble cleaning and LVOF coating according to standard.

Tools and Equipment

- Drying tools & equipment
- LVOF coating tools & equipment
- Cleaning tools & equipment
- Carosole & equipment
- Measuring devices
- Hand held calculator
- Chemical & Glass wares

29. Powder Metallurgy

CS 91 Handle Powder for required process

Overview: This competency standard covers the skills and knowledge required to identify the size, morphology and required weight of powder.

Competency Units/Task	Performance Criteria/Step
• **CU1.** Identify the particle size and morphology of powder.	**P45.** Ensure appropriate PPE to control chemical hazards. **P46.** Select the required particle size from the powder material supplier catalogue. **P47.** Select the powder morphology from the powder material supplier catalogue.
• **CU2.** Identify the required weight of powder and binder.	**P42.** Identify the density of actual metal **P43.** Identify the volume of the required part **P44.** Apply formula of density to calculate the required mass of powder. **P45.** Calculate the percentage of binder **P46.** Make use of weighing scale to weight the right amount of powder and binder. **P47.** Check the balance of scale and tare the reading to zero.

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:

K134. Describe different shapes and size of powder particles.

K135. Describe the density of metals.

K136. Describe the bulk density and apparent density of powders.

K137. Describe the percentage i-e 5% of 20, 20% of 5 etc .

Critical Evidence(s) Required

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

- Identify the size and morphology of powder particles.
- Identify material specifications according to supplier catalogue.
- Analyze the relationship between volume of part and weight of powder.

Tools and Equipment

- ❖ Measuring devices
- ❖ Hand held calculator
- ❖ Safety mask, goggles and gloves

CS 92 Perform Consolidation Operation

Overview: This competency standard covers the skills and knowledge required for Mixing and Blending of powder with binder, and operation of Hydraulic Press.

Competency Units/Task	Performance Criteria/Step
CU1. Mix and Blend powder with binder	**P1.** Make use of mixer machine for proper mixing and blending of powder and binder. **P2.** Set the time of mixer, **P3.** Add powder with binder and start the mixer. **P4.** Fill the die with blended powder and close the die.
CU2. Operate Hydraulic Press	**P1.** Raise the front safety guard of press **P1.** Place the die filled with powder on the lower pressing face. **P2.** Lower the front safety guard. **P3.** Lower the pressing face by turning the screw handle clockwise. **P4.** Pull and push the pump handle to smoothly build up required pressure and hold the applied tonnage as long as required. **P5.** Release the pressure load. **P6.** Turn the screw handle anticlockwise to raise the pressing face. **P7.** Open the front safety guard and remove the die from hydraulic press. **P8.** Remove the green compact part from the die. **P9.** Analyze the density of green compact.

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 packing of particle in pressed form
K2. Explain the effect of particles size distribution in pressing
K3. Describe the effect of binder amount
K4. Explain the operating principle of hydraulic press
K5. Explain the relative density

Critical Evidence(s) Required

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

- Identify the percentage of binder and particles size distribution in pressed form
- Interpret the required pressure for pressing
- Identify all the safety and maintenance (oil leak, over heating and loss of pressure) of hydraulic press
- Identify the relative density of green compact to the apparent density of powder.

Tools and Equipment

- Layout tools
- Mixer Machine
- Hydraulic press

CS 93 Perform Sintering Operation

Overview: This competency standard covers the skills and knowledge required to set the furnace temperature and environmental conditions during sintering.

Competency Units/Task	Performance Criteria/Step
▪ **CU1.** Set the furnace temperature and time	**P1.** Identify the right furnace for sintering **P2.** Identify the controls of the furnace i-e water flow, heating chamber, heating coils, thermocouple and exhaust system **P3.** Set the furnace to desired temperature

	P4. Set the heating rate of the furnace **P5.** Set the holding time of the furnace
▪ **CU2.** Set the furnace environmental conditions.	**P1.** Identify the required inert gas for environmental conditions **P2.** Connect the gas cylinder with furnace **P3.** Set the proper pressure of gas **P4.** Connect the vacuum pump to the furnace heating chamber if vacuum is required
▪ **CU3.** Place the green compact in furnace	**P1.** Set the furnace to required environmental conditions **P2.** Place the green compact in the heating chamber of furnace **P3.** Close the door of heating chamber **P4.** Set ON the furnace power supply. **P5.** Note the time of start. **P6.** Take out the sintered par from the furnace after process completion.

Knowledge & Understanding

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

K1. Explain the effect of sintering

K2. Describe sintering furnaces

K3. Describe environmental conditions of furnace

K4. Define vacuum

K5. Define inert gases

Critical Evidence(s) Required

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

- Identify the furnace controls for sintering
- Identify the readings of pressure on pressure gauge
- Identify the reading of vacuum on gauge
- Identify the gas in a gas cylinder

Tools and Equipment

- ❖ Gas cylinder
- ❖ Vacuum Pump

- Sintering Furnace

CS 94 Perform Finishing Operations

Overview: This competency standard covers the skills and knowledge required to identify the size tolerance and carry out machining of sintered components.

Competency Units/Task	Performance Criteria/Step
• **CU1.** Identify the size tolerance after sintering	**P1.** Inspect the component visually for any defects **P2.** Inspect the dimensions of the component by using measuring scale or devices **P3.** Separate the defected and non defected components.
• **CU2.** Carry out machining of sintered components	**P1.** Make use of grinder to refine tolerance **P2.** Make use of buffing operation to improve surface finish

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 size tolerance.

K2. Explain finishing operations

Critical Evidence(s) Required

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

- Identify the shrinkage before and after sintering.
- Identify the required surface finish.

Tools and Equipment

- Measuring devices
- Hand held calculator
- Grinders
- Buffer / polisher

30. Entrepreneur

CS 95 Develop Project Proposal

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

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

Knowledge & Understanding

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

7Ps of marketing including product, price, placement, promotion, people, packaging and positioning

7Cs of business communication

Different modes of communication and their application in the industry

Specific business terms used in the industry

Available funding sources

Low interest loans to start a new business

Market survey and its tools e.g. : questionnaire, interview, observation etc,.

Market trends for specific product offering

State the main elements of business plan

Business plan format

Critical Evidence(s) Required

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

List 7Ps of marketing

List 7Cs of business communication

CS 96 Apply management and communication techniques

Overview: This unit describes the skills and knowledge required to provide a critical link between people, ideas and information at all stages in the project life cycle. It involves assisting the project team to plan communications, communicating information related to the project, and reviewing Communications. It applies to individuals who are project practitioners working in a project support role.

Competency Unit	Performance Criteria
Contribute to communications planning	P1. Identify, source and contribute relevant information requirements to initial project documentation P2. Contribute to developing and implementing the project communications plan and communications networks
Conduct information-management activities	P1. Act on and process project information according to agreed procedures as directed, to aid decision-making processes throughout project life cycle P2. Maintain information to ensure data is secure and auditable
Communicate project information	P1. Communicate with clients and other stakeholders during project using agreed networks, processes and procedures to ensure flow of necessary information P2. Ensure reports are prepared and released according to authorization, or produced for release by others P3.Seek information and advice from appropriate project authorities as required
Contribute to assessing effectiveness of communication	P1. Assist in ongoing review of project outcomes to determine effectiveness of communications-management activities P2. Report communications-management issues and responses to higher project authorities for application of lessons learned to future projects

Knowledge & Understanding

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

Summarize models and methods of communications management in context of project life cycle and other project management functions

Importance of managing risk by treating information securely

Methods of reviewing outcomes

Organizational policies and procedures relevant to this role in a specific context.

Critical Evidence(s) Required

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

Demonstrate managerial and communications plan for IoT product

Elaborate decision-making processes throughout project life cycle

CS 97 Create human resource management plan

Overview: This unit describes the skills and knowledge required to assist with aspects of human resources management of a project. It involves establishing human resource requirements, identifying the learning and development needs of people working on the project, facilitating these needs being met, and resolving conflict in the team. It applies to individuals who are project practitioners working in a project support role.

Competency Unit	Performance Criteria
Assist in determining human resource requirements	P1. Analyze work breakdown structure to determine human resource requirements P2. Prepare a skills analysis of project personnel against project task requirements P3. Assist in assigning responsibilities for achieving project deliverables
Contribute to establishing and maintaining productive team relationships	P1. Actively seek views and opinions of team members during task planning and implementation P2. Promote cooperation and effective activities, goals and relationships within team P3. Communicate with others using styles and methods appropriate to organizational standards, group expectations and desired outcomes P4. Communicate information and ideas to others in a logical, concise and understandable manner P5. Regularly seek feedback on nature and quality of work relationships, and use feedback as basis for own improvement and development
Assist with human resource monitoring	P1. Monitor work of project personnel against assigned roles and responsibilities within delegated authority levels P2. Monitor and control actual effort against project plan P3 Review skill levels against allocated tasks and recommend solutions, where required, to others

	P4. Advise others within delegated authority when assigned responsibilities are not met by project personnel P5. Undertake work in a multi-disciplinary environment according to established human resource management practices, plans, guidelines and procedures P6. Resolve conflict within delegated authority according to agreed dispute-resolution processes P7. Assist in offering human resource development opportunities to individuals with skill gaps
Contribute to evaluating human resource practices	P1. Contribute to assessing effectiveness of project human resources management P2. Document lessons learned to support continuous improvement processes

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:

Alternative project personnel engagement options

Job design principles and work breakdown structures

Learning and development approaches that can be incorporated into project life cycle

Methods for skills analysis

Project roles, responsibilities and reporting requirements for human resources.

Critical Evidence(s) Required

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

Produce the assigned roles and responsibilities of your team within delegated authority levels

Provide dispute-resolution procedures for an organizations

CS 98 Develop project management plan

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

Competency Unit	Performance Criteria
Prepare project management plan	P1. Evaluate and assess project brief and related documents P2. Produce document on project tasks and associated timelines, including installation processes and test requirements P3. Assess and produce document on resource requirements to assist allocation of appropriate resources P4. Produce training plan assessing training needs and associated timelines for efficient project implementation P5. Determine and document budgetary requirements P6. Discuss roles of all identified parties associated with project to ensure their involvement P7. Produce project verification document, including monitoring and control processes, and review processes such as quality audits P8. Consult with all relevant parties prior to finalizing draft plan and make changes as appropriate
Develop and evaluate management plan	P1. Produce preliminary plan for consultation, including identified factors that may impact on realization of project and observance of relevant legislation, codes, regulation and standards P2. Consult with client and clarify any amendments P3. Develop final plan with recommendations
Communicate project information	P1. Produce and document final plan to include implementation details and training needs P2. Present plan to client and obtain sign off

Contribute to assessing effectiveness of communication	P1. Assist in ongoing review of project outcomes to determine effectiveness of communications-management activities P2. Report communications-management issues and responses to higher project authorities for application of lessons learned to future projects

Knowledge & Understanding

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

Key attributes of common telecommunications applications and related equipment

Evaluate the connections to carrier infrastructure or equipment

Current legislation relating to the design of installation of telecommunications equipment and connection to carrier services

Advantages of leasing and purchase options to assist in delivering cost effective solutions

Evaluate network and transmission equipment

Network topologies, and interface and interconnect solutions

Workplace health and safety (WHS) issues that need to be built into a plan, with consideration of:

electrical safety

materials handling

physical hazards

confined spaces

heights

lifting

Evaluate the power requirements and electrical safety aspects of the installation plan

Performance parameters and typical faults that may be encountered in client equipment and related connection and transmission media

Various test equipment types suitable for tests to be made

Warranty information for equipment supplies and contractor work guarantees.

Critical Evidence(s) Required

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

Produce training plan assessing training needs and associated timelines for efficient project implementation

Determine and document budgetary requirements

Produce project verification document, including monitoring and control processes, and review processes such as quality audits

Produce and document final plan to include implementation details and training needs

Present plan to client and obtain sign off

CS 99 Develop sales plan

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

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

Identify support requirements	P1. Identify and acquire staff resources to implement sales plan P2. Develop an appropriate selling approach P3. Train staff in the selling approach selected P4. Develop and assess staff knowledge of product to be sold
Monitor and review sales plan	P1. Monitor implementation of the sales plan P2. Record data measuring performance versus sales targets P3. Make adjustments to sales plan as required to ensure required results are obtained

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out tasks covered in this competency standard. This includes:
Outline principles and techniques for selling
Outline methods for monitoring sales outcomes
Statistical techniques for analyzing sales and market trends
Internal and external sources of information that are relevant to identifying organizational strategic direction and developing a product sales plan.
Competitors intelligence

Critical Evidence(s) Required

The candidate needs to produce following Critical Evidence(s) in order to be competent in this competency standard:
Identify the risks of the product i.e., sale/deployments
Produce a sales plan for the product
Demonstrate marketing and selling approach
Demonstrate advertising and promotional strategy for product

CS 100 Conduct research for customer needs and satisfaction

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

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

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

Knowledge & Understanding

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

Organizational procedures and standards for establishing and maintaining customer service relationships

Consumer rights and responsibilities

Ways to establish effective regular communication with customers
Outline details of products or services including with reference to:
possible alternative products and services
Variations within a limited product and service range

Critical Evidence(s) Required

The candidate needs to produce following Critical Evidence(s) in order to be competent in this competency standard:
Gather customer needs and requirements
Analyse customer needs and requirements
Enlist communication rights and responsibilities of customers
Handle customer relationship management (CRM) model to identify suitable products/services to meet customer needs

Manage finances

Overview: This unit of competency describes the outcomes required to develop, implement and monitor a personal budget in order to plan regular savings and manage debt effectively.

Competency Unit	Performance Criteria
1. Develop a personal budget	P1. Calculate current living expenses using available information to prepare a personal budget. P2. Keep a record of all income and expenses for a short period of time to help estimate ongoing expenses. P3. Subtract total expenses from total income to determine a surplus or deficit budget for the specified period. P4. Find reasons for a deficit budget and ways to reduce expenditure identified. P5. Identify ways to increase income, if possible
2. Develop longer term personal budget	P1. Analyze income and expenditure and set longer term personal, work and financial goals. P2. Develop a longer-term budget based on the outcomes of short-term budgeting, and adjust to meet living, work and future career requirements. P3. Identify obstacles that might affect finances such as job loss, sickness or unexpected expenses contingency savings P4. Formulate a regular savings plan based on budget, using secure savings products and services. P5. Monitor expenditure against budget and identify areas of possible expenditure saving
3. Identify ways to maximize future finances	P1. Determine sources and ways to maximize personal income, including from work, investments or available government payments/allowances. P2. Get further education or training to maintain or improve future income. P3. Identify the need for debt to finance living and other expenses, and determine the appropriate levels of debt and repayment.

	P4. Consolidate existing debt, where possible, to minimize interest costs and fees. P5.Seek professional money management services, where available, to ensure financial plans are effective and achievable

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:
Abilities to plan and organize to keep records and monitor a personal budget
Abilities to set and review goals
Basic financial management and record keeping to enable development and management of a personal budget
Benefits of financial goal setting and personal budgeting to enable effective management of personal finances
Numeracy skills to compare income and expenditure

Critical Evidence(s) Required

The candidate needs to produce following Critical Evidence(s) in order to be competent in this competency standard:
Produce a longer-term budget based on the outcomes of short-term budgeting
Develop and report the need for debt to finance living and other expenses,
Determine the appropriate levels of debt and repayment
Demonstrate the ways to increase finances and income

CS 101 Identify and resolve problems

Overview: This unit is focus on negotiation in critical incidents and the development of strategic responses designed to resolve threatening incidents.

Competency Unit	Performance Criteria
1. Identify a problem	P1. Form a problem statement and analyze root cause. P2. Take initiative in tackling problems rather than relying solely on directives P3. Follow logic steps in understanding root cause and analyzing potential solutions.
2. Determine strategies for a required solution	P1. Analyze all aspects of the incident for degree of hazard, priorities, optional outcomes and appropriate strategies P2. Analyze and determine strategies and priorities on the incident sought from a range of sources P3. Assess long term objectives against resources and priorities P4. Apply a range of communication techniques to make and maintain contact with the key people P5. Provide clear and factual information to enable an honest and realistic assessment of the interests of the key people and their positions P6. Resolve the conflict and express their likely consequences clearly and do an analysis of the benefits P7. Reassess points of disagreements for common positive Positions
3. Coordinate support Services	P1. Assess the need for support services in terms of the determined strategies and priorities P2. Negotiate the resources of support services according to established procedures and availability P3. Provide information on strategies to support services and maintain the communication P4 .Delegate roles and responsibilities according to expertise and resources

4. Restore order	P1 Assess the incidents for degree of risk and take appropriate action to reduce and remove the impact of the incident and restore order P2 Take action designed to minimize risk and the preserve the safety and security of all involved P3 Take action to prevent the escalation of the incident appropriate to the circumstances and agreed procedures. P4 Carry out the use of force for the restoration of control and the maintenance of security in the least restrictive manner. P5 Complete reports accurately and clearly provided to the appropriate authority promptly P6 Review, evaluate and analyze the incident and the organizational response to it and report it promptly and accurately.
5. Provide leadership. direction and guidance to the work group	P1. Link between the function of the group and the goals of the organization P2 .Participate in decision making routinely to develop, implement and review work of the group and to allocate responsibilities where appropriate P3 .Give opportunities and encouragement to others to develop new and innovative work practices and strategies P4. Identify conflict and resolve with minimum disruption to work group function P5.Provide staff with the support and supervision necessary to perform work safely and without risk to health P6 .Allocate tasks within the competence of staff and support with appropriate authority, autonomy and training P7 .Supervise appropriately the changing priorities and situations and takes into account the different needs of individuals and the requirements of the task

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:

Organization's policies, guidelines and procedures related to control and surveillance, safety and preventing and responding to incidents and breaches of orders covered in the range of variables.

Organization's management and accountability systems

Teamwork principles and strategies

Principles of effective communication

Guidelines for use of equipment and technology

Code of conduct

Critical Evidence(s) Required

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

Identify problem statement

Build team

Identify your target community for the proposed product/solution

Analyze product sale and marketing plan

Provide your strategy to execute entrepreneurial plan

Provide three solutions (A, B, C) of your business plan

Present complete portfolio of entrepreneurial plan as an evidence

Provide clear and factual information to enable an honest and realistic assessment of the interests of the key people and their positions

Provide information on strategies to support after sale services

Provide a complete entrepreneurial plan

CS 102 Create/Manage profile on Non-traditional Freelancing Platform

Overview: This competency standard covers the skills and knowledge required to create/manage profile on a non-traditional freelance platform.

Competency Unit	Performance Criteria
Recognize Gig Economy	Enlist at least 03 strong reasons to work as a freelancer Identify the terminologies related to the freelancing platform like (Gig, profiles, rating, review, revision and a bid etc.) Identity the most in demand freelance skills on non-traditional platform
Setup Profile	Set Up a Seller Profile Add personal and professional information on your profile

	Link up social media and other professional accounts to seller profile
Create the Gigs	Find your ideal category and services Check out the competition Create an appealing title for the gig Choose subcategory and tags Create and price gig packages Win buyers with gig description Boost gig success with visuals Choose a suitable gig package among Basic, Standard and Premium options.
Provide High Quality Services as a seller	Present a professional profile Get and maintain high rating Be responsive and polite to customer
Develop/Increase Business	Deliver the work on agreed deadline Ask for feedback form the client Keep in touch with Buyers/Customers Use the contacts page to maintain close coordination with the potential buyers/customers Request customer to recommend you to other clients and work circles Abide by the rules and regulations of freelance platform in order completion and cancelation

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:

Describe what is gig economy.

Differentiate between a seller and a buyer in non-traditional freelancing.

Write down the characteristics of a powerful gig.

List down the qualities of a top-level seller.

Prepare a business development strategy for a seller.

Tools and Equipment

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

Items
Computer System
Internet Connection
Email Account
Bank account
Microsoft Office (Word, Excel, PowerPoint)
Seller Profile on Non-traditional Freelance Platform (Fiverr)

Critical Evidence(s) Required

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

Setup a seller account/profile.

Create a gig for SEO based Content Writing.

CS 103 Create/Manage profile on a Traditional Freelance Platform

Overview: This competency standard covers the skills and knowledge required to create/manage profile on a traditional freelance platform.

Competency Unit	Performance Criteria
Explore Traditional Freelance Marketplace	Identify characteristics of traditional freelancing Compare strengths and features of different traditional freelancing platforms/websites Select an appropriate freelance platform best suited to your niche
Get started with freelance platform	Join a freelance market place by creating an account Add personal information Add professional information Highlight your strengths and skills

	Build a great profile by adding portfolio
Find work/Submit proposals	Find the right project according to your niche Choose b/w hourly vs. fixed price projects Understand the requirements by reading the project description and demands with great attention/ get clear understanding of the project Write a comprehensive, solution oriented bid proposal for the project Ask questions to clarify the ambiguities. Offer a mockup Setup a competitive fee for the project Review your bid proposal to remove any spelling or grammatical mistakes Submit the bid proposal
Complete projects & Get paid	Setup a personal deadline to finish the project Make close consultation with your client during the development of the project Communicate with the client by using the freelance platform messaging service only Fulfill all project requirements Use payment protection methods to get your reward secure
Manage your reputation as a professional	Ask for the feedback Give priority to the returning customer Create a longstanding bond with customers by providing them great value for their money Promote your profile/business by asking clients to recommend you to others Practice fairness and honesty in your dealings

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:

Write down the names of popular traditional freelance platforms.

Differentiate between hourly and fixed-price projects.

Define mockup.

Perform bidding on the projects.

Describe best practices to win a customer's trust.

Tools and Equipment

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

Items
Computer System
Internet Connection
Email Account
Bank account
Microsoft Office (Word, Excel, PowerPoint)
Seller Profile on a Traditional Freelance Platform (Upwork, Guru, freelance.com etc)

Critical Evidence(s) Required

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

Create and maintain a profile on a popular freelance platform.

Write a bid for a sample project.

Prepare mockup for a fashion blogpost.

CS 104 Write professional proposals for freelance projects

Overview: This competency standard covers the skills and knowledge required to write professional proposals for freelance projects.

Competency Unit	Performance Criteria
Write a winning proposal	Start proposal with the lines which show your interest and care in the project Write ideas and suggestions in original sentences (Don't Copy & Paste)

	Present yourself as a problem solver in proposal, suggest one or two workable ideas for the project. Mention expertise to tell the buyer why you are the best person for the specific project Ask for the resources (Website link etc.) to get more familiar about the business/buyer Ask for the reply from the client in response to suggestions
Adopt best practices of proposal writing	Analyze the project details beforehand Avoid scripted bid proposals Don't sound impersonal Avoid being too hasty in committing your time Do not underbid fellow freelancers Check buyer's history Use phrases that sell in the market Check competitor's reputation Proofread the bid

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:
Write the features of a good bid proposal.
Write a sample bid proposal for an essay writing job, highlight your skills/strengths for the job.

Tools and Equipment

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

Items
Computer System
Internet Connection
Email Account

Bank account
Microsoft Office (Word, Excel, PowerPoint)
Seller Profile on a Freelance Platform (Upwork, Guru, freelancer.com etc.)

Critical Evidence(s) Required

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

Prepare a bid proposal for a research based article-writing project.

CS 105 Develop communication skills

Overview: This competency standard covers the skills and knowledge required to develop good communication skills.

Competency Unit	Performance Criteria
Win a client through good communication skills	Pay attention to Client's Requirements Reply Honestly to Client Keep the Client Informed Give good gestures while waiting for Response Win a Client through Best of Behavior Maintain the relationship even after the completion of the project
Work on improving communication skills	Reproduce any articles you like in your own words Share your knowledge with others Watch successful people's interviews to grab work life realities of your field Learn to improve your focus Spend time with learned individuals Make self-analysis

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:

Write down a note on importance of good communication skills to become a successful freelancer.

Tools and Equipment

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

Items
Computer System
Internet Connection
Browser
Email Account

Books, Newspapers etc.
Microsoft Office (Word, Excel, PowerPoint)
Seller Profile on a Freelance Platform (Upwork, Guru, freelancer.com etc.)

Critical Evidence(s) Required

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

Demonstrate written communication skills in convincing a client for a particular project.