



National Competency Standards For “Junior Technician in Metallurgy and Metal casting” Level-2



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



ACKNOWLEDGEMENT

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

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

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

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

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



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1. Introduction

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

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

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

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



2. Purpose of the Qualification

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

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

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



3. Date of Validation

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

4. Date of Review

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

5. Codes of Qualifications

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

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



6. Members of Qualification Development Committee

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

Date: 18 to 22 December 2020

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



7. Members of Qualification Validation Committee

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

Date:

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



8. Entry Requirements

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

9. Regulation of the Qualification and schedule of units

Not applicable

10. Summary of Competency Standards

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



National Competency Standards for "Metallurgy and metal casting"



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



National Competency Standards for "Metallurgy and metal casting"



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



National Competency Standards for "Metallurgy and metal casting"



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



11. Levelling and Packaging of the Qualification

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



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



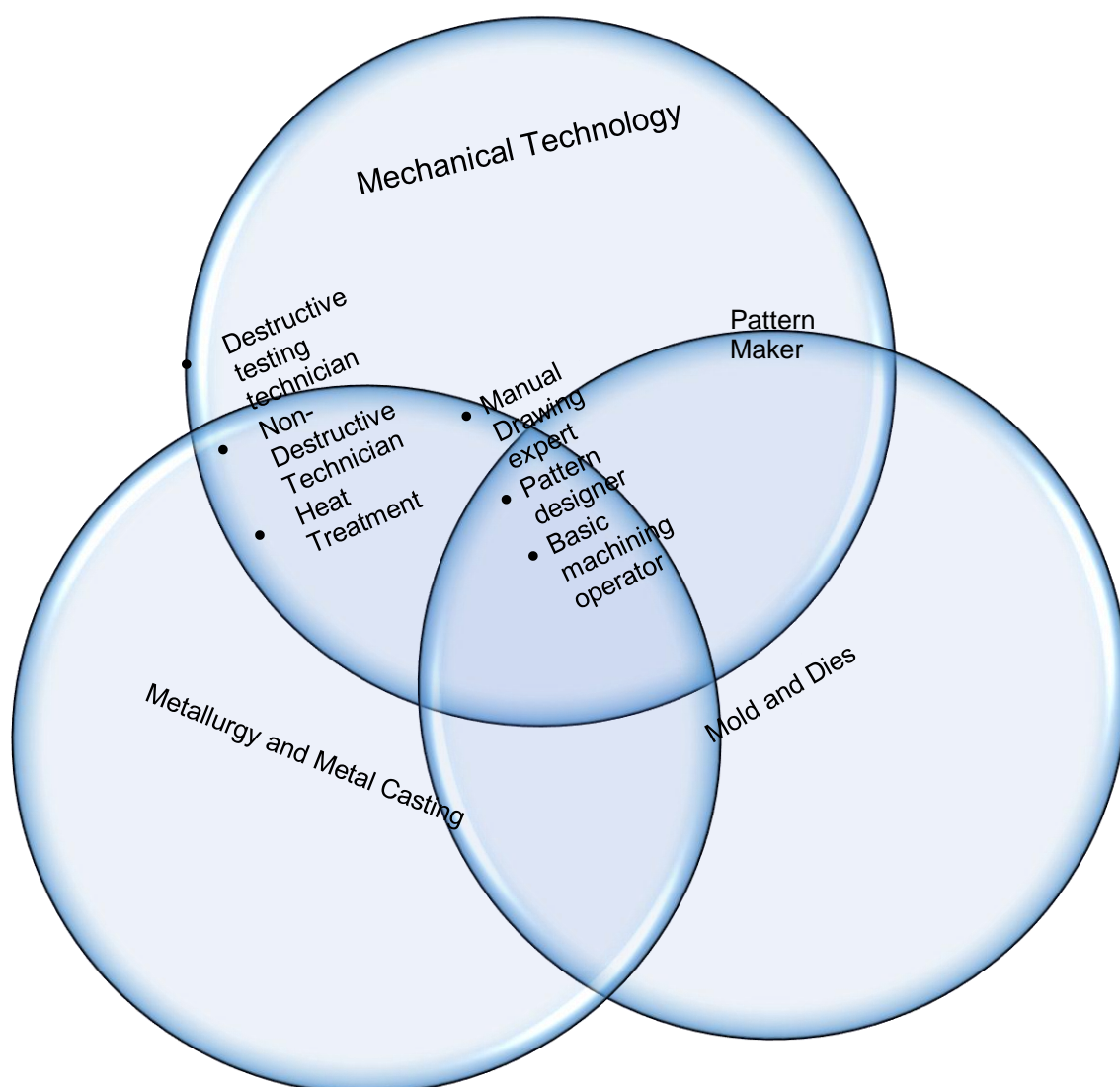
21	Jr.Metallographic technician	65. Perform Sectioning, Cutting and Rough Grinding 66. Perform Mounting Operation 67. Perform Fine Grinding Operation 68. Perform Fine Polishing Operation
22	Jr.Surface coating technician	69. Perform Galvanizing Coating 70. Perform Conversion Coating (Anodizing) 71. Perform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



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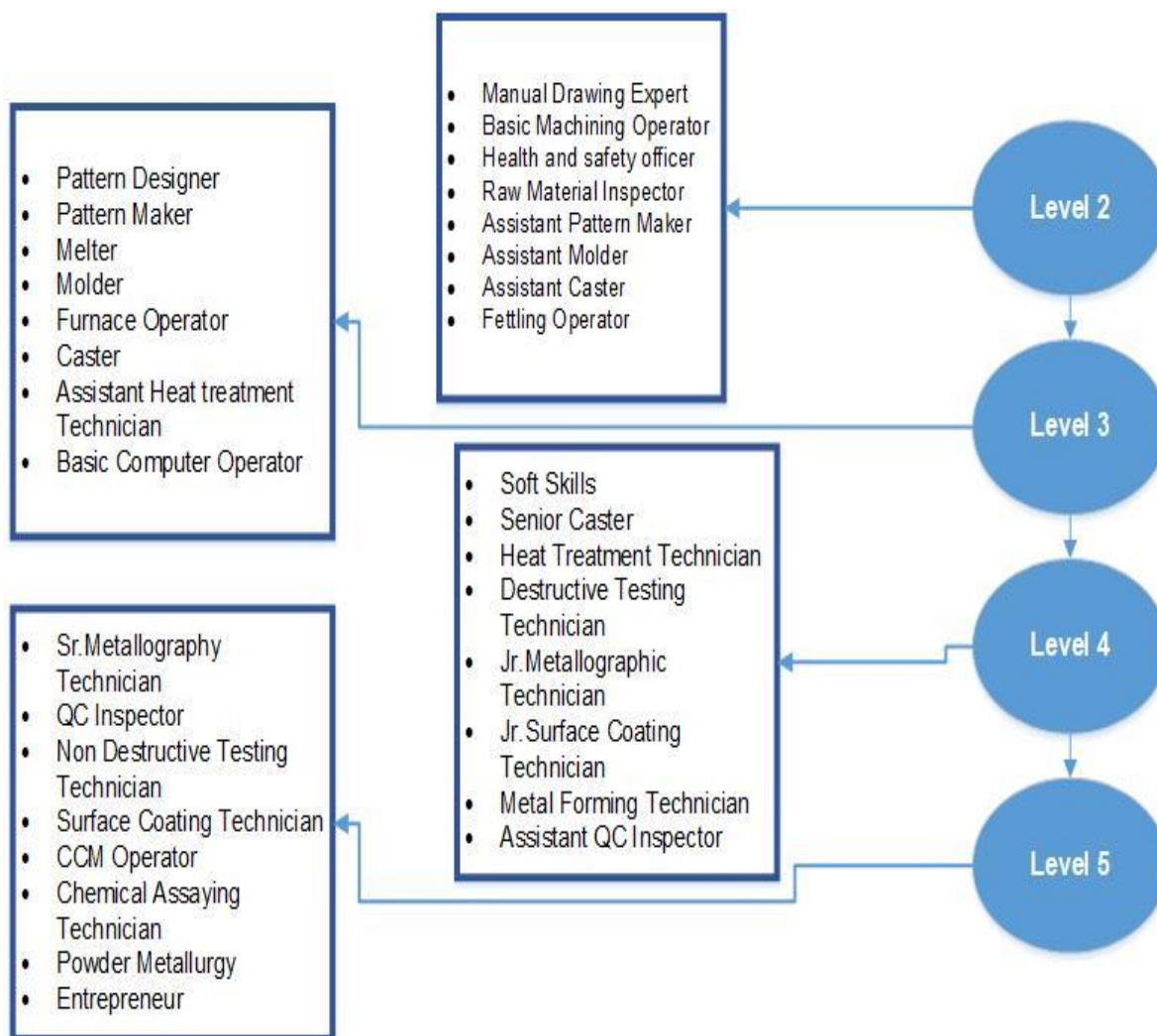


12. Mapping of the Qualification





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



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

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.



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



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

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



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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 1 st 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



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



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



<p>CU3. Prepare Bottle Opener</p>	<p>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</p>
<p>CU4. Cut Threads on Work Piece with tap and die</p>	<p>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</p>
<p>CU5. Cut Pipe Threads</p>	<p>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</p>
<p>CU6. Prepare spanner (small size)</p>	<p>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</p>



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.
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Knowledge & Understanding

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

- K1.** Define 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



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



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



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

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	<p>P1. Observe personal and work place safety.</p> <p>P2. Set up drilling machine for producing holes according to job requirement.</p> <p>P3. Manipulate the machine tool controls safely and correctly in line with operational procedures.</p> <p>P4. Produce components to the required quality and within the specified dimensional accuracy.</p> <p>P5. Carry out quality sampling checks at suitable intervals.</p> <p>P6. Shut down the equipment to a safe condition on conclusion of the machining activities.</p>
CU2. Perform counter boring and counter sinking	<p>P1. Select relevant tools according to the information given in engineering drawings and job specifications.</p> <p>P2. Ensure tooling is correct in terms of size, shape, type, and grade for the work.</p> <p>P3. Position the work-piece in the drill in such a way that it is aligned, secured and stable during drilling.</p> <p>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.</p>
CU3. Perform machine Reaming	<p>P1. Observe personal and workplace safety.</p> <p>P2. Clamp work-piece in the vice properly.</p> <p>P3. Select reamer according to hole size and drawing requirements</p> <p>P4. Set reamer in the drill chuck according to procedure.</p> <p>P5. Use lubricants during reaming for smooth cutting.</p>



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



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



CU6. Machining internal Keyways	<p>P1. Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident.</p> <p>P2. Dial the machine vice according to job requirement.</p> <p>P3. Select point cutting tool and set machine according to job requirements.</p> <p>P4. Mount cutting tool and work piece in the machine.</p> <p>P5. Check quality of the component at suitable intervals.</p> <p>P6. Shut down the machine in safe position after finishing the work</p>
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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	<p>P1. Identify safety hazards related with milling operations and take appropriate steps to avoid any injury or accident.</p> <p>P2. Dial the machine vice according to job requirement.</p> <p>P3. Select cutters and set machine as per requirements.</p> <p>P4. Mount cutters and work piece in the machine.</p> <p>P5. Produce a part matching the process plan and the part print specifications.</p> <p>P6. Check quality of the component at suitable intervals.</p> <p>P7. Shut down the machine at safe position after finishing the work.</p>
Cu2. Perform slotting or grooving on work piece	<p>P1. Identify safety hazards related with milling operations and take appropriate steps to avoid any injury or accident.</p> <p>P2. Set the work piece in machine vice according to procedure.</p> <p>P3. Select the appropriate cutter as per specifications.</p> <p>P4. Adjust the milling cutter for slotting and grooving.</p> <p>P5. Determine the touching point of the work piece.</p> <p>P6. Produce slotting or grooving on the workpiece to the required quality.</p> <p>P7. Check quality of the component at suitable intervals.</p> <p>P8. Shut down the machine at safe position after finishing the work.</p> <p>P9. Observe personal and workplace safety at all time.</p>



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



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



	<p>P5. Store raw material in correct location using appropriate materials handling techniques</p> <p>P6. Prepare report for record keeping and circulate to concerned department</p>
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Knowledge & Understanding

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

K1. Define 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



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



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



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

Knowledge & Understanding

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

This includes the knowledge of:

K1. 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



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- 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



National Competency Standards for “Metallurgy and metal casting”



- 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



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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



National Competency Standards for “Metallurgy and metal casting”



- 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
<ul style="list-style-type: none">CU1. Prepare sand for molding	<p>P1. Prepare green sand by using sieve sand with riddle</p> <p>P2. Add additives as per requirements (Binders, Bentonite, Coal dust)</p> <p>P3. Sprinkle Water as required</p> <p>P4. Perform mixing of sand with hand tools or in Muller mixer machine</p>
<ul style="list-style-type: none">CU2. Produce mold by hand using two piece/split pattern	<p>1. Place pattern on molding platform</p> <p>P2. Place drag part of the mold and ram molding sand by rammer.</p> <p>P3. Roll over the drag part and strike off extra green sand.</p> <p>P4. Place other half of the pattern (with dowel) and match it</p> <p>P5. Place pouring basin at appropriate place</p> <p>P6. Place runner at appropriate place.</p> <p>P7. Place gate at appropriate place</p> <p>P8. Create a parting line by pouring parting sand on drag part.</p> <p>P9. Place cope part and sprue pin on runner.</p> <p>P10. Add riddled molding sand and ram using rammer.</p> <p>P11. Remove extra sand using strike off bar</p> <p>P12. Make vents for gas escaping with vent wire at appropriate place.</p> <p>P13. Remove cope part and make pouring gate with gate cutter.</p> <p>P14. Make cavity by drawing out pattern halves politely.</p> <p>P15. Repair mold as required</p> <p>P16. Place cope with locating plug</p>



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

- K1. Basic Molding
- K2. Molding and its types.
- K3. Properties of green sand
- K4. Molding accessories.
- K5. Repairing mould 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



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



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

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

- K1.** 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	<p>P1. Mix die coat in correct proportion.</p> <p>P2. Maintain die temperatures at the correct level.</p> <p>P3. Use appropriate safety clothing and apparatus</p> <p>P4. Apply die coat in correct sequence according to standard operating procedures.</p> <p>P5. Place die correctly on machine</p> <p>P6. Handle closing of die correctly.</p> <p>P7. Attach clamps as per requirement</p> <p>P8. Attach air-cooling to the die as specified if required.</p>
CU2. Carry out manual pouring	<p>P9. Select appropriate pouring tool</p> <p>P10. Take melt from furnace</p> <p>P11. Pour melt in die while ensuring the minimal porosity and lamination.</p> <p>P12. Make allowance for adequate cooling time</p> <p>P13. Pour at a continuous and appropriate rate during filling.</p> <p>P14. Monitor die coating condition</p> <p>P15. Re-spray die coat as required</p>
CU3. Remove extra materials	<p>P16. Remove cast parts from the die</p> <p>P17. Store parts in a manner that minimises damage</p> <p>P18. Remove flash from the die surface.</p>
CU4. Clean die after casting	<p>P19. Operate shot blaster in a safe manner according to standard</p> <p>P20. Apply remedial action as required to standard operating procedures.</p> <p>P21. Dross / De-gas furnace to standard operating procedures.</p>



	P22. Clean work area of coating P23. Clean shot residue to appropriate standard.
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Knowledge & Understanding

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

- K1.** 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.



	<p>P4. Verify the required specification after fettling process of excess metal</p> <p>P5. Record and report the casting defects as per standard operating procedures.</p>
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Knowledge & Understanding

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

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)



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

Knowledge & Understanding

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

- K1.** 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	<p>P1. Mark the job according to given drawing</p> <p>P2. Select appropriate blade according to job requirement</p> <p>P3. Set blade in frame of hacksaw as per procedure</p> <p>P4. Ensure the work piece is clamped firmly and properly</p> <p>P5. Adopt methods and techniques for sawing that is appropriate to job requirement by using Hand Hacksaw</p> <p>P6. Adopt methods and techniques for sawing that is appropriate to job requirement by using Power Hacksaw</p> <p>P7. Follow marked line during sawing to ensure accuracy.</p>
CU2. Perform off-hand grinding	<p>P1. Select the proper size and shape of grinding wheel.</p> <p>P2. Hold the work piece firmly against the rotating wheel by placing it on the tool rest.</p> <p>P3. Use coolant at intervals to avoid over heating of the job.</p> <p>P4. Adopt technique and methods which are safe.</p> <p>P5. Produce component according to work operations.</p> <p>P6. Observe personal and workplace safety.</p>
CU3. Perform swing grinder operation	<p>P1. Select the suitable size and type of grinding wheel.</p> <p>P2. Mount the work piece over the holding devices to ensure proper clamping.</p> <p>P3. Dress the wheel as per requirement.</p> <p>P4. Identify reference points on work piece before grinding.</p> <p>P5. Adjust depth of cut according to speed of machine table.</p> <p>P6. Use coolant continuously to avoid over heating of the job.</p> <p>P7. Observe personal and workplace safety.</p>
	<p>P1.</p>

Knowledge & Understanding

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



- K1. 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



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



	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