National Competency Standard Level -5 in Mechanical Technology

National Vocational and Technical Training Commission (NAVTTC),

Government of Pakistan

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- Dr. Muqeem ul Islam, Director General (Skills,Standards and Curricula) NAVTTC
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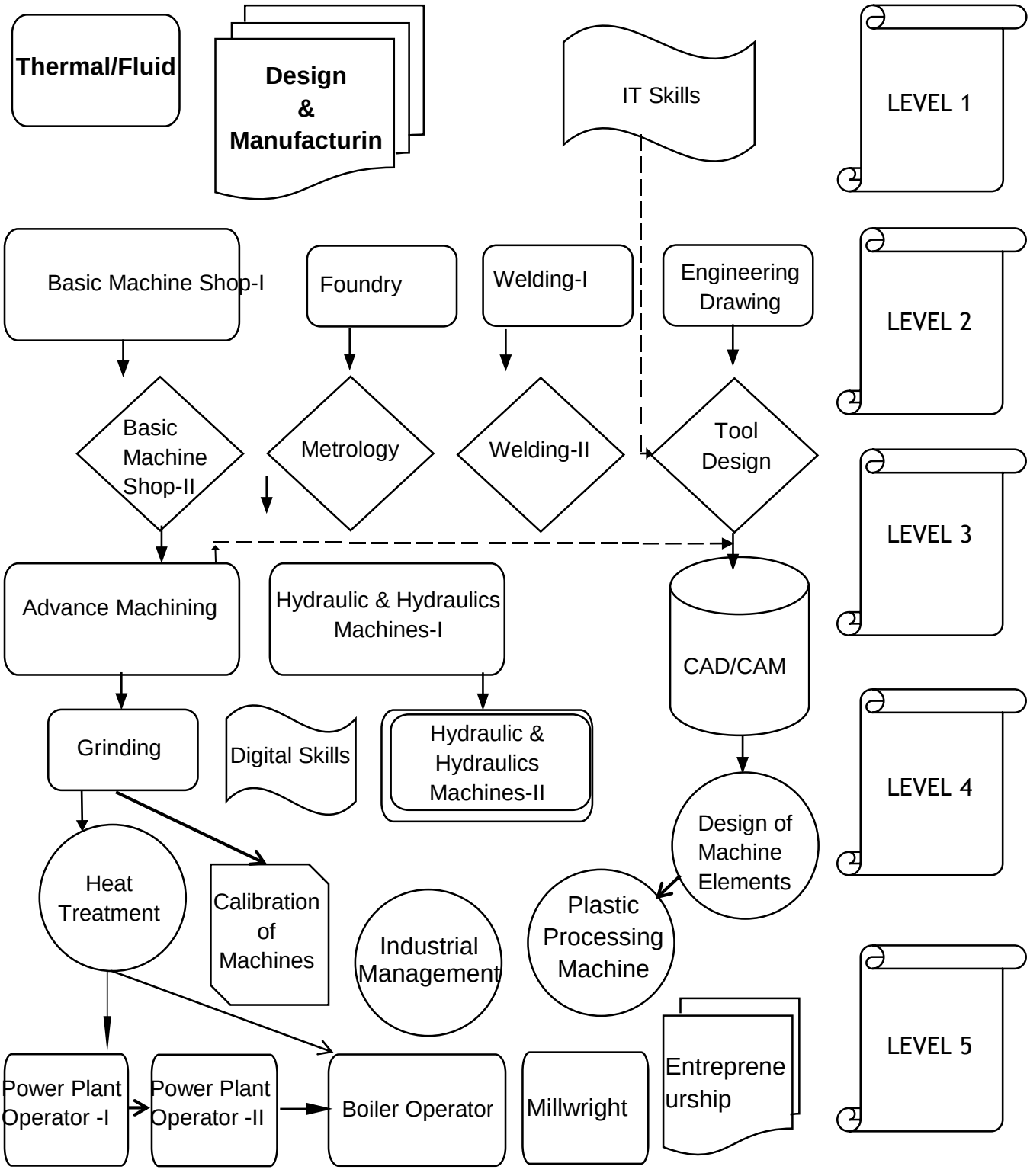
NAVTTC team under the leadership of Dr. Muqeem ul Islam initiated development of CBT & A based qualifications of diploma level-5 as a reform project of TVET sector in November 2018 and completed 27 NVQF diplomas of Level-5 in September, 2019. It seems worth highlighting that during this endeavor apart from developing competency standards/curricula in conventional trades new dimensions containing high-tech trades in TVET sector in the context of generation IR 4.0 trades have also been developed which inter alia includes Robotics, Mechatronics, artificial intelligence, industrial automation, instrumentation and process control. Moreover, trades like entrepreneurship, green/environmental skills and variety of soft/digital skill have also been developed to equip the Pakistani youth with skills set as per requirement of the global trends. These skills have been made integral part of all the 27 diplomas.

Nobody has been more important in the pursuit of this project than Dr. Nasir Khan, Executive Director, NAVTTC, whose patronage and support remain there throughout the development process and lastly to thanks specially to Syed Javed Hassan, Chairman NAVTTC and Raja Saad Khan, Deputy Team Lead TSSP-GIZ who made it happened in this challenging time.

OCCUPATION PROFILE LEVEL PACKAGING CHART



Content

1. Introduction

Mechanical engineering is the discipline that applies engineering, physics, engineering mathematics, and materials science principles to design, analyze, manufacture, and maintain mechanical systems. It is one of the oldest and broadest of the engineering disciplines.

Mechanical Technology Courses, classes and training Programs. Mechanical technology courses are available through undergraduate and advanced degree programs. Curricula typically include courses in mechanical principles, processes and materials, welding, safety and quality control.

Mechanical engineering technicians help mechanical engineers manufacture industrial machinery and other equipment. Most employers prefer to hire candidates with associate's degrees or other postsecondary training in mechanical engineering technology.

The importance of mechanical engineering may be determined according to its usefulness in our daily life. Therefore, industry expectations for skilled workforce are also dynamic which can only be managed through setting relevant competency standards in collaboration with the leading industries. Being conscious of this fact, National Vocational & Technical Training Commission (NAVTTC) developed competency standards for Mechanical Technology 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 Mechanical industries, Engineering Universities and Technical Education of the country.

2. Purpose of the Qualification

The purpose of this qualification is to set high professional standards for Mechanical technology sector. The specific objectives of developing these qualifications are as under:

- Improve the professional competence of the trainees
- Provide opportunities for recognition of skills attained through non-formal or informal pathways
- Improve the quality and effectiveness of training and assessment for Mechanical Technology industry
- Enable the existing workforce to capacitate themselves in new technologies and methods

3. Core competencies of the Qualification

The Mechanical Technology qualifications of level 5 consists 40% Theory and 60% Practical. The Core competencies of the qualification are as follows:

0715. Welding

S#	Competency Standard	Level	Category	Contact Hrs.			Cr. Hr.
				Th	Pr.	Total	
0715.1.1.	Interpret Drawing and Execute to Fabricate Parts	2	Technical	2	6	8	0.8
0715.1.2.	Evaluate the Use of Hand and Power Tools	2	Technical	2	12	14	1.4
0715.1.3.	Perform Pre-Welding Operations	2	Technical	2	18	20	2.0
0715.1.4.	Perform Oxy Acetylene Welding	3	Technical	2	6	8	0.8
0715.1.5.	Cut Metal by Oxy-Acetylene / Oxy-Fuel Flame/Grinding (Manually and Auto Cutting)	3	Technical	2	12	14	1.4
0715.1.6.	Perform Gas Welding On Mild Steel Plates (1F, 2F, 3F)	3	Technical	2	18	20	2.0
0715.1.7.	Gas Metal Arc Welding (GMAW) in Flat (1F, 1G), Horizontal (2F, 2G), Vertical (3F, 3G) and Overhead (4F, 4G) Positions	3	Technical	2	12	14	1.4
0715.1.8.	Shielded Metal Arc Welding (SMAW) in Flat (1F, 1G), Horizontal (2F, 2G), Vertical (3F, 3G) and Overhead (4F, 4G) Positions	4	Technical	2	18	20	2.0
0715.1.9.	Perform Soldering and Brazing Operations	4	Technical	2	6	8	0.8
0715.1.10.	Gas Tungsten Arc Welding (GTAW) in Flat (1F, 1G), Horizontal (2F, 2G), Vertical (3F, 3G) and Overhead (4F, 4G) Positions	5	Technical	2	12	14	1.4
0715.1.11.	Flux Cored Arc Welding (FCAW)	5	Technical	2	6	8	0.8
0715.1.12.	Perform Submerged Arc Welding	5	Technical	2	6	8	0.8
0715.1.13.	Perform Forged Welding	5	Technical	2	6	8	0.8
0715.1.14.	Perform Friction Welding	5	Technical	2	6	8	0.8
0715.1.15.	Non-Destructive Welding Tests	5	Technical	2	12	14	1.4
0715.1.16.	Destructive Welding Tests	5	Technical	2	12	14	1.4
Total				32	168	200	20

9.2. Foundry & Casting

S#	Competency Standard	Level	Category	Contact Hrs.			Cr. Hr.
				Th.	Pr.	Total	
0715.2.1.	Perform Core Making	3	Technical	2	12	14	1.4
0715.2.2.	Perform Molding	3	Technical	2	12	14	1.4
0715.2.3.	Preform Pattern Making	3	Technical	**2**	**12**	**14**	**1.4**
0715.2.4.	Perform Cleaning and Finishing Of Casting	3	Technical	3	9	12	1.2
0715.2.5.	Perform Foundry Work	5	Technical	2	12	14	1.4
0715.2.6.	Perform casting	5	Technical	3	24	27	2.7
0715.2.7.	Perform Sand Testing	5	Technical	3	12	15	1.5
Total				17	93	110	11

9.3. Basic Machining

S#	Competency Standard	Level	Category	Contact hrs.			Cr. Hr.
				Th.	Pr.	Total	
0715.3.1	Perform cutting on Metal Circular/Power Heck Saw	2	Technical	0	6	6	0.6

0715.3.2	Perform Drilling Machine Operations	2	Technical	3	12	15	1.5
0715.3.3	Perform Metal/Bench Work	3	Technical	4	24	28	2.8
0715.3.4	Perform general machining	3	Technical	3	12	15	1.5
0715.3.5	Perform Grinding operation	3	Technical	3	12	15	1.5
0715.3.6	Perform Basic Lathe Machine Operations	3	Technical	4	36	40	4.0
0715.3.7	Perform Shaper, Planar and Slotter Machining Operations	3	Technical	3	21	24	2.4
0715.3.8	Perform Milling Operations	5	Technical	8	36	44	4.4
0715.3.9	Generate Gears on Hobbing Machine	5	Technical	4	18	22	2.2
0715.3.10	Perform broaching operation	5	Technical	2	9	11	1.1
Total				34	186	220	22

9.4. Advance machining/CNC Machinist

S#	Competency Standard	Level	Category	Contact hr.			Cr.
				Th.	Pr.	Total	Cr. Hr.
0715.4.1	Carry Out Computerized Numerical Control (CNC) Machine Operations	5	Technical	6	12	18	1.8
0715.4.1	Perform CNC Lathe Operations	5	Technical	4	12	16	1.6
0715.4.2	Perform CNC Milling Operations	5	Technical	6	24	30	3.0
0715.4.3	Perform CNC EDM Wire-Cut Operations	5	Technical	4	12	16	1.6
0715.4.4	Perform advance mechanical machining processes	5	Technical	4	12	16	1.6
0715.4.5	Perform Laser Beam Machining & electroplating/chemical machining	5	Technical	6	18	24	2.4
Total				30	90	120	12.0

9.5. Grinding operator

S#	Competency Standard	Level	Category	Contact hr.			Cr.
				Th.	Pr.	Total	Cr. Hr.
0715.5.1	Perform off hand grinding	3	Technical	2	6	8	0.8
0715.5.2	Perform Belt and Jig Grinding	3	Technical	4	12	16	1.6
0715.5.3	Perform Surface Grinding	5	Technical	2	6	8	0.8
0715.5.4	Perform Universal cylindrical grinding and centerless grinding	5	Technical	4	12	16	1.6
0715.5.5	Perform Tool & Cutter Grinding	5	Technical	4	12	16	1.6
0715.5.6	Perform Form, High Speed Peel Grinding and Plunge Cut Grinding	5	Technical	4	12	16	1.6
Total				20	60	80	8.0

9.6. Power Plant

S#	Competency Standard	Level	Category	Contact hr.			Cr.
				Th.	Pr.	Total	Cr. Hr.
0715.6.1	Operate valves/Gauges	3	Technical	2	18	20	2.0
0715.6.2	Operate Pumps	3	Technical	6	18	24	2.4
0715.6.3	Operate Compressors	3	Technical	4	12	16	1.6
0715.6.4	Operate Internal Combustion Engine	4	Technical	6	18	24	2.4
0715.6.5	Operate External Combustion Engine	4	Technical	4	12	16	1.6

0715.6.6	Operate Turbine	5	Technical	2	12	16	1.6
0715.6.7	Operate Boilers	5	Technical	6	24	30	3.0
0715.6.8	Operate Thermal Power Plant	5	Technical	6	12	18	1.8
0715.6.9	Demonstrate/ Operate/ Overview of Wind Power Plant	5	Technical	2	6	8	0.8
0715.6.10	Operate Solar Power Plant	5	Technical	2	6	8	0.8
0715.6.11	Design and operation of Hydel Power Plant	5	Technical	2	6	8	0.8
0715.6.12	Operate Biomass Power Plant	5	Technical	2	12	14	1.4
Total				44	156	200	20.0

9.7. Calibration

S#	Competency Standard	Level	Category	Contact hr.			Cr. Hr
				Th.	Pr.	Total	Cr.
0715.7.1	Callibrate Mechanical Standards	4	Technical	4	0	4	0.4
0715.7.2	Callibrate Mechanical Measuring Instruments/tools	4	Technical	3	21	19	1.6
0715.7.3	Callibrate Mechanical Machines	5	Technical	9	45	57	5.8
0715.7.4	Calibrate Mechanical Equipment	5	Technical	3	12	15	1.5
Total				19	81	100	10

9.8. Hydraulics and Hydraulic Machinery

S#	Competency Standard	Level	Category	Contact hr.			Cr. Hr
				Th.	Pr.	Total	Cr.
0715.8.1	Operate Hydraulic Bench and its Functions	5	Technical	4	12	16	1.6
0715.8.2	Operate Hydraulic Press	5	Technical	2	6	8	0.8
0715.8.3	Actuate Double Acting Hydraulic Cylinder	5	Technical	4	12	16	1.6
0715.8.4	Setup a Pressure Device and Hold Specific Load on a Double Acting Cylinder	5	Technical	2	6	8	0.8
0715.8.5	Construct Circuit of Double Acting Hydraulic Cylinder for Mechanical Interlocking	5	Technical	2	6	8	0.8
0715.8.6	Verify Bernoulli's Equation	5	Technical	2	6	8	0.8
0715.8.7	Operate Pressure Measuring Instruments	5	Technical	2	6	8	0.8
0715.8.8	Calibrate Bourdon Tube and Diaphragm Pressure Gauge	5	Technical	2	6	8	0.8
0715.8.9	Analyse the performance of Turbines	5	Technical	4	12	16	1.6
0715.8.10	Analyse the performance of Pumps	5	Technical	2	6	8	0.8
0715.8.11	Set Speed and Direction of Hydraulic Motor	5	Technical	2	6	8	0.8
0715.8.12	Operate Flow Regulating Devices	5	Technical	2	6	8	0.8
Total				30	90	120	12

9.9. Metrology

S#	Competency Standard	Level	Category	Contact hr.			Cr. Hr
				Th.	Pr.	Total	Cr.
0715.9.1	Take measurements through various gauges	3	Technical	2	12	14	1.4
0715.9.2	Measure dimensions with Vernier tools	3	Technical	2	12	14	1.4
0715.9.3	Perform Levelling	3	Technical	2	12	14	1.4
0715.9.4	Take measurements with graduated tools	3	Technical	2	12	14	1.4
0715.9.5	Take measurements with combination set	4	Technical	4	18	22	2.2
0715.9.6	Perform measurements through Micrometer	4	Technical	2	12	14	1.4
0715.9.7	Measure angles with angle measuring Instruments	4	Technical	2	12	14	1.4

0715.9.8	Perform different measurements	4	Technical	4	18	22	2.2
0715.9.9	Measure Threads and Gears	5	Technical	2	12	14	1.4
0715.9.10	Compare measurement with Comparators	5	Technical	6	12	18	1.8
Total				28	132	160	16

9.10. Mechanical Engineering Drawing

S#	Competency Standard	Level	Category	Contact hr.			Cr. Hr.
				Th.	Pr.	Total	
0715.10.1	Perform Basic Manual Drawing	4	Technical	4	18	22	2.2
0715.10.2	Construct different Engineering Curves	4	Technical	6	30	36	3.6
0715.10.3	Construct multi-view drawings	4	Technical	6	36	42	4.2
0715.10.4	Manage display in AutoCAD software	5	Technical	2	12	14	1.4
0715.10.5	Develop 2D drawings	5	Technical	4	30	34	3.4
0715.10.6	Develop 3D drawing	5	Technical	4	48	52	5.2
Total				26	174	200	20

9.11. Heat Treatment and Material Testing

S#	Competency Standard	Level	Category	Contact hr.			Cr. Hr.
				Th.	Pr.	Total	
0715.11.1	Perform Metallography of Metallic Materials	5	Technical	4	36	40	4.0
0715.11.2	Perform Heat Treatment of Metallic Materials	5	Technical	4	48	52	5.2
0715.11.3	Perform hardness tests for different metallic materials	5	Technical	4	18	22	2.2
0715.11.4	Perform Impact testing of metallic materials	5	Technical	4	12	16	1.6
0715.11.5	Perform Mechanical Testing on Universal Testing Machine	5	Technical	4	24	28	2.8
0715.11.6	Perform Torque and Fatigue test	5	Technical	2	12	14	1.4
0715.11.7	Perform non-destructive test	5	Technical	4	24	28	2.8
Total				26	174	200	20

9.12. Design of Machine Elements

S#	Competency Standard	Level	Category	Contact hr.			Cr.
				Th.	Pr.	Total	Cr.
0715.12.1	Calculate Stresses in Machine Parts	5	Technical	8	18	26	2.6
0715.12.2	Calculator diameter of cylinder for hoop and longitudinal stresses	5	Technical	8	18	26	2.6
0715.12.3	Calculate thickness and diameter of spherical shell for circumferential stresses	5	Technical	8	12	20	2.0
0715.12.4	Design welded joints for transverse and parallel fillet under static and fatigue loading	5	Technical	8	18	26	2.6
0715.12.5	Calculate stresses due to initial tightening and external load on screws	5	Technical	4	12	16	1.6
0715.12.6	Design dimension of square and rectangular keys	5	Technical	4	12	16	1.6
0715.12.7	Design hollow and solid shaft subjected to twisting moment only	5	Technical	6	6	12	1.2
0715.12.8	Design flange coupling for specific torque	5	Technical	4	6	10	1.0
0715.12.9	Design the dimensions of helical spring	5	Technical	4	6	10	1.0
0715.12.10	Design bearings, speed, lubrication, pressure, viscosity and coefficient of friction	5	Technical	6	6	12	1.2
0715.12.11	Design and draw the CAM profile	5	Technical	8	18	26	2.6
Total				68	132	200	20

9.13. Industrial Management

S#	Competency Standard	Level	Category	Contact hr.			Cr.
				Th.	Pr.	Total	Cr.
0715.13.1	Perform Store Operation in Industry	4	Functional	4	6	10	1.0
0715.13.2	Perform Maintenance Activities	4	Functional	4	6	10	1.0
0715.13.3	Paraphrase Industrial Planning	5	Functional	2	0	2	0.2
0715.13.4	Carry out Site Selection for an Industry	5	Functional	2	6	8	0.8
0715.13.5	Develop Plant Layout	5	Functional	2	12	14	1.4
0715.13.6	Demonstrate Production Method	5	Functional	6	0	6	0.6
0715.13.7	Carry out Job Analysis	5	Functional	6	6	12	1.2
0715.13.8	Carryout Production Planning and Control	5	Functional	6	0	6	0.6
0715.13.9	Perform Quality control and Quality Assurance	5	Functional	6	0	6	0.6
0715.13.10	Carry out Cost Determination and Control	5	Functional	6	0	6	0.6
Total				44	36	80	8.0

9.14. CAD CAM

S#	Competency Standard	Level	Category	Contact hr.			Cr.
				Th.	Pr.	Total	Cr.
0715.14.1	Draw A Simple Drawing of Die for Given Objects	5	Technical	2	24	26	2.6
0715.14.2	Perform Part Modelling	5	Technical	4	48	52	5.2
0715.14.3	Carry Out Assembly Modelling	5	Technical	4	36	40	4.0
0715.14.4	Perform CAM Operations	5	Technical	8	54	62	6.2
Total				18	162	180	18

9.15. Boiler Operator

S#	Competency Standard	Level	Category	Contact hr.	Cr.

				Th.	Pr.	Total	Hr.
0715.15.1	Maintain Boiler house Record	4	Technical	2	6	8	0.8
0715.15.2	Set and adjust burners	4	Technical	2	12	14	1.4
0715.15.3	Perform Boiler Operations	5	Technical	6	24	30	3.0
0715.15.4	Operate boiler auxiliaries	5	Technical	6	12	18	1.8
0715.15.5	Perform Maintenance of Boiler	5	Technical	4	6	10	1.0
Total				20	60	80	8

9.16. Plastic Processing Machine operator

S#	Competency Standard	Level	Category	Contact hr.			Cr. Hr.
				Th.	Pr.	Total	
0715.16.1	Operate Injection Moulding Machine	4	Technical	4	18	22	2.2
0715.16.2	Operate Blow Molding Machine	4	Technical	4	18	22	2.2
0715.16.3	Operate Foam Processing Machines	4	Technical	2	6	8	0.8
0715.16.4	Operate Multi-Color Printing Machines (Rotogravure)	4	Technical	2	12	14	1.4
0715.16.5	Operate Multi-Color Printing Machine (Flexographic)	4	Technical	2	12	14	1.4
0715.16.6	Operate Plastic Film Extrusion machines (Blown/Cast)	5	Technical	4	12	16	1.6
0715.16.7	Operate Pipe & Profile Extrusion Machines	5	Technical	2	12	14	1.4
0715.16.8	Operate Rotational Molding Machines	5	Technical	4	12	16	1.6
0715.16.9	Operate Compression/Transfer Molding Machines	5	Technical	2	12	14	1.4
Total				26	114	140	14

9.17. HVAC

S#	Competency Standard	Level	Category	Contact hr.			Cr. Hr.
				Th.	Pr.	Total	
0715.17.1	Install Residential Air Conditioner	4	Technical	2	18	20	2.0
0715.17.2	Repair/Service Residential Air-Conditioner	4	Technical	2	24	26	2.6
0715.17.3	Repair / Service Residential Refrigeration Units	4	Technical	2	18	20	2.0
0715.17.4	Carry out Calculations and Prepare Estimates	5	Technical	6	0	6	0.6
0715.17.5	Install Commercial Refrigeration Units	5	Technical	4	24	28	2.8
	Repair/Service Commercial Refrigeration Units	5	Technical	4	24	28	2.8
0715.17.6	Carry out Fabrication for HVAC Work	5	Technical	2	18	20	2.0
0715.17.7	Install Central Air Conditioning Systems	5	Technical	4	36	40	4.0
0715.17.8	Repair/Service Central Air Conditioning System	5	Technical	4	12	16	1.6
0715.17.9	Perform Preventive Maintenance	5	Technical	4	12	16	1.6
Total				34	186	220	22

9.18. Millwright

S#	Competency Standard	Level	Category	Contact hr.			Cr. Hr.
				Th.	Pr.	Total	
0715.18.1	Perform Routine Trade Activity	4	Technical	6	12	18	1.8
0715.18.2	Apply basic Occupational Health & Safety Functions	4	Technical	2	0	2	0.2
0715.18.3	Perform general health, safety and environment practices	4	Technical	2	6	8	0.8
0715.18.4	Perform Measuring and Layout of Workpiece	4	Technical	4	12	16	1.6
0715.18.5	Perform Cutting And Welding Operation	5	Technical	6	18	24	2.4
0715.18.6	Perform Rigging,Hoisting/Lifting & Moving	5	Technical	8	24	32	3.2
0715.18.7	Service general mechanical equipment	5	Technical	12	48	60	6.0
Total				40	120	160	16

9.19. Tool design and tool making

S#	Competency Standard	Level	Category	Contact hr.			Cr. Hr.
				Th	Pr.	Total	
0715.19.1	Draw standard parts of jigs & fixtures (manual drawing)	3	Technical	6	18	24	2.4
0715.19.2	Draw different types of clamps	3	Technical	2	12	14	1.4
0715.19.3	Draw locators (Manual)	3	Technical	2	12	14	1.4
0715.19.4	Draw template jig and plate type drill Jig	3	Technical	2	12	14	1.4
0715.19.5	Draw swinging leaf jig	3	Technical	2	6	8	0.8
0715.19.6	Draw an indexing jig	3	Technical	2	6	8	0.8
0715.19.7	Design and draw the CAM profile with knife edge follower for uniform velocity	5	Technical	6	12	18	1.8
0715.19.8	Draw an angle milling fixture	5	Technical	2	6	8	0.8
0715.19.9	Draw lathe fixture for turning and boring operation	5	Technical	2	12	14	1.4
0715.19.10	Draw simple blanking die for making a blank dia 40 mm	5	Technical	2	6	8	0.8
0715.19.11	Draw a progressive die for making a washer of inner diameter 20 and outer 40 mm	5	Technical	4	12	16	1.6
0715.19.12	Draw a simple drawing die for a cup for inner dia 40 mm, depth 30 mm and sheet thickness 1mm	5	Technical	2	12	14	1.4
Total				34	126	160	16

9.20. Entrepreneurship Skills

S#	Competency Standard	Level	Category	Contact hr.			Cr. Hr.
				Th.	Pr.	Total	
0715.20.1	Develop Basic Enterpreneurial Skills	4	Generic	1	6	7	0.7
0715.20.2	Develop a Sales Plan	4	Generic	2	6	8	0.8
0715.20.3	Manage a Small Team	5	Generic	1	6	7	0.7
0715.20.4	Plan Small Scale Bussiness Activities	5	Generic	1	9	10	1.0
0715.20.5	Address Basic Customer Needs	5	Generic	2	9	11	1.1
0715.20.6	Manager Human Resources	5	Generic	2	6	8	0.8
0715.20.7	Execute Bussines to Bussines activities	5	Generic	2	9	11	1.1
0715.20.8	Manage Personal Finance	5	Generic	1	6	7	0.7
0715.20.9	Develop a Small Team	5	Generic	1	9	10	1.0
0715.20.10	Manage Human Resources	5	Generic	1	6	7	0.7
0715.20.11	Solve Problems Pertaining to Health & Safety	5	Generic	2	6	8	0.8
0715.20.12	Develop Bussines Plan	5	Generic	1	6	7	0.7
0715.20.13	Apply Information & Communication Skills	5	Generic	2	6	8	0.8
0715.20.14	Coordinate with a team	5	Generic	1	6	7	0.7
0715.20.15	Maintain Bussiness Resources	5	Generic	1	9	10	1.0
0715.20.16	Develop human Resources for a project	5	Generic	1	6	7	0.7
0715.20.17	Solve Problems at a workplace	5	Generic	2	9	11	1.1
Total				24	120	144	14.4

9.21. IT Skills

S#	Competency Standard	Level	Category	Contact hr.			Cr. Hr.
				Th.	Pr.	Total	
0715.21.1	Operate Basic Computer Functions	1	Generic	1	12	13	1.4
0715.21.2	Perform Basic Computer Applications	2	Generic	3	15	18	1.8
0715.21.3	Develop Computer Applications Skills	3	Generic	2	15	17	1.7
0715.21.4	Develop Advance Computer Application Skills	4	Generic	3	18	21	2.1
0715.21.5	Explore Computer Applications Skills for Careers	5	Generic	3	18	21	2.1
Total				12	78	90	9.0

9.22. Communication Skills

S#	Competency Standard	Level	Category	Contact hr.			Cr. Hr.
				Th.	Pr.	Total	
0715.22.1	Follow basic communication skills	1	Generic	3	12	15	1.5
0715.22.2	Perform basic communication	2	Generic	3	12	15	1.5
0715.22.3	Communicate at workplace	3	Generic	3	12	15	1.5
0715.22.4	Perform Advanced Communication	4	Generic	3	12	15	1.5
0715.22.5	Perform Managerial Communication Skills	5	Generic	3	12	15	1.5
Total				15	60	75	7.5

4. Date of Validation

The level 5 of National DAE qualification on Mechanical Technology has been validated by the Qualifications Validation Committee (QVC) members on 20-22 May, 2019 and will remain in currency until 19 May, 2029

*Shall be reviewed after 3 years

5. Codes of Qualifications

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

ISCED Classification for DAE Mechanical Technology level-5	
Code	**Description**
0715-M&MT	1st Level National Certificate of level-5, in " Mechanical Technology"
0715-M&MT	2nd Level National Certificate of level-5, in "Mechanical Technology"
0715-M&MT	3rd Level National Certificate of level-5, in "Mechanical Technology"
0715-M&MT	4th Level National Certificate of level-5, in "Mechanical Technology"
0715-M&MT	5th Level National Certificate of level-5, in "Mechanical Technology"

6. Members of Qualifications Development Committee

The following members participated in the qualifications development and validation of these qualifications:

S#	Name	Designation	Organization
1	Rizwan Zafar	Assistant Professor	University Of Lahore
2	Ali Raza	Principal	Quaid-e-Azam College of Engineering & Technology Okara
3	Muhammad Azhar	Senior Instructor Mech.	Descon Training Institute Lahore
4	Saba Sadiq	Lecturer	University Of Lahore
5	Faizan	Installation Engineer	Buhler Pakistan pvt Ltd
6	Eng Farooq Iftikhar	Metallurgy engineer	PCSIR Lahore

7	Engr Haris Iqram	Foundry Engineer	PCSIR Lahore
8	zain-ul-abideen	Instructor(Machinist)	GTTI , Mughal Pura Lahore
9	Shakeel Ahmed	Master Trainer,	Govt Staff Training College Lahore,
10	Waqas Iqbal	Instructor(Machinist)	GTTI, Mughal Poora Lahore
11	Khawar Abbas	Machinist(Mechanical)	GSTC Gujrat
12	Muhammad Arsalan Khan	Lecturer	University Of Lahore
13	Engr. Inayat Ur Rehman	DACUM Facilitator,	Ex. KPK TVETA
14	Muhammad Yasir Khan	Asstt. Director	NAVTTC Islamabad

7. Qualifications Validation Committee

S#	Name	Designation	Organization
1	Engr.Jamal Akbar	Associate Professor	GPI,Peshawer KP
2	Engr.Muahmmad Akram Sarfraz	Instructor(Mechanical)	GCT Railway Road,Lahore
3	Engr. M Shahzad Javed	Research Officer(Technical)	PBTE ,Lahore
4	Engr. Farooq Iftikhar	Metallurgy Engineer	PCSIR Lahore
5	Muhammad Arsalan Khan	Lecturer	University Of Lahore
6	Ali Raza	HOD Mechanical	Quaid E Azam College Sahiwal
7	Saba Sadiq	DACUM CO-Facilitator, Lecturer	University Of Lahore
8	Engr. Inayat Ur Rehman	DACUM Facilitator,	Ex. KPK TEVTA
9	Muhammad Yasir Khan	Asstt. Director	NAVTTC Islamabad

8. Entry Requirements

The entry for D.A. E National Certificate level 5, in Mechanical Technology are

1. A person having National Vocational Certificate level 4, in Mechanical Technology.
2. A person having Matric certificate with Science subjects

9. Categorization and Levelling of the Competency Standards

MECHANICAL TECHNOLOGY (0715)

MECHANICAL TECHNOLOGY (0715)

COMPETENCY STANDARDS/LEVELS AND CONTACT HOURS

DETAIL OF QUALIFICATIONS WISE TRADES

0715-1	Welding						

S#	Competency Standard	Level	Category	Contact Hrs.			Cr. Hr.
S#	Competency Standard	Level	Category	Th	Pr.	Total	Cr. Hr.
0715-1.1	Interpret Drawing and Execute to Fabricate Parts	2	Technical	2	6	8	0.8
0715-1.2	Evaluate the Use of Hand and Power Tools	2	Technical	2	12	14	1.4
0715-1.3	Perform Pre-Welding Operations	2	Technical	2	18	20	2
0715-1.4	Perform Oxy Acetylene Welding	3	Technical	2	6	8	0.8
0715-1.5	Cut Metal by Oxy-Acetylene / Oxy-Fuel Flame/Grinding (Manually and Auto Cutting)	3	Technical	2	12	14	1.4
0715-1.6	Perform Gas Welding On Mild Steel Plates (1F, 2F, 3F)	3	Technical	2	18	20	2
0715-1.7	Gas Metal Arc Welding (GMAW) in Flat (1F, 1G), Horizontal (2F, 2G), Vertical (3F, 3G) and Overhead (4F, 4G) Positions	3	Technical	2	12	14	1.4
0715-1.8	Shielded Metal Arc Welding (SMAW) in Flat (1F, 1G), Horizontal (2F, 2G), Vertical (3F, 3G) and Overhead (4F, 4G) Positions	4	Technical	2	18	20	2
0715-1.9	Perform Soldering and Brazing Operations	4	Technical	2	6	8	0.8
0715-1.10	Gas Tungsten Arc Welding (GTAW) in Flat (1F, 1G), Horizontal (2F, 2G), Vertical (3F, 3G) and Overhead (4F, 4G) Positions	5	Technical	2	12	14	1.4
0715-1.11	Flux Cored Arc Welding (FCAW)	5	Technical	2	6	8	0.8

0715-1.12	Perform Submerged Arc Welding	5	Technical	2	6	8	0.8
0715-1.13	Perform Forged Welding	5	Technical	2	6	8	0.8
0715-1.14	Perform Friction Welding	5	Technical	2	6	8	0.8
0715-1.15	Non-Destructive Welding Tests	5	Technical	2	12	14	1.4
0715-1.16	Destructive Welding Tests	5	Technical	2	12	14	1.4
Total				**32**	**168**	**200**	**20**

0715-2	Foundry & Casting						
S#	**Competency Standard**	**Level**	**Category**	**Contact Hrs.**			**Cr. Hr.**
S#	**Competency Standard**	**Level**	**Category**	**Th.**	**Pr.**	**Total**	**Cr. Hr.**
0715-2.1	Perform Core Making	3	Technical	2	12	14	1.4
0715-2.2	Perform Molding	3	Technical	2	12	14	1.4
0715-2.3	Preform Pattern Making	3	Technical	2	12	14	1.4
0715-2.4	Perform Cleaning and Finishing Of Casting	3	Technical	3	9	12	1.2
0715-2.5	Perform Foundry Work	5	Technical	2	12	14	1.4
0715-2.6	Perform casting	5	Technical	3	24	27	2.7
0715-2.7	Perform Sand Testing	5	Technical	3	12	15	1.5
Total				**17**	**93**	**110**	**11**

0715-3	Basic Machining						

S#	Competency Standard	Level	Category	Contact hrs.			
S#	**Competency Standard**	**Level**	**Category**	**Th.**	**Pr.**	**Total**	**Cr. Hr.**
0715-3.1	Perform cutting on Metal Circular/Power Heck Saw	2	Technical	0	6	6	0.6
0715-3.2	Perform Drilling Machine Operations	2	Technical	3	12	15	1.5
0715-3.3	Perform Metal/Bench Work	3	Technical	4	24	28	2.8
0715-3.4	Perform general machining	3	Technical	3	12	15	1.5
0715-3.5	Perform Grinding operation	3	Technical	3	12	15	1.5
0715-3.6	Perform Basic Lathe Machine Operations	3	Technical	4	36	40	4
0715-3.7	Perform Shaper, Planar and Slotter Machining Operations	3	Technical	3	21	24	2.4
0715-3.8	Perform Milling Operations	5	Technical	8	36	44	4.4
0715-3.9	Generate Gears on Hobbing Machine	5	Technical	4	18	22	2.2
0715-3.10	Perform broaching operation	5	Technical	2	9	11	1.1
Total				**34**	**186**	**220**	**22**
0715-4	Advance machining/CNC Machinist						
S#	**Competency Standard**	**Level**	**Category**	**Contact hr.**			**Cr. Hr.**
S#	**Competency Standard**	**Level**	**Category**	**Th.**	**Pr.**	**Total**	**Cr. Hr.**
0715-4.1	Carry Out Computerized Numerical Control (CNC) Machine Operations	5	Technical	6	12	18	1.8
0715-4.2	Perform CNC Lathe Operations	5	Technical	4	12	16	1.6
0715-4.3	Perform CNC Milling Operations	5	Technical	6	24	30	3

0715-4.4	Perform CNC EDM Wire-Cut Operations	5	Technical	4	12	16	1.6
0715-4.5	Perform advance mechanical machining processes	5	Technical	4	12	16	1.6
0715-4.6	Perform Laser Beam Machining & electroplating/chemical machining	5	Technical	6	18	24	2.4
Total				**30**	**90**	**120**	**12**
0715-5	Grinding operator						
S#	**Competency Standard**	**Level**	**Category**	**Contact hr.**			**Cr. Hr.**
S#	**Competency Standard**	**Level**	**Category**	**Th.**	**Pr.**	**Total**	**Cr. Hr.**
0715-5.1	Perform off hand grinding	3	Technical	2	6	8	0.8
0715-5.2	Perform Belt and Jig Grinding	3	Technical	4	12	16	1.6
0715-5.3	Perform Surface Grinding	5	Technical	2	6	8	0.8
0715-5.4	Perform Universal cylindrical grinding and centerless grinding	5	Technical	4	12	16	1.6
0715-5.5	Perform Tool & Cutter Grinding	5	Technical	4	12	16	1.6
0715-5.6	Perform Form, High Speed Peel Grinding and Plunge Cut Grinding	5	Technical	4	12	16	1.6
Total				**20**	**60**	**80**	**8**
0715-6	Power Plant						
S#	**Competency Standard**	**Level**	**Category**	**Contact hr.**			**Cr. Hr.**
S#	**Competency Standard**	**Level**	**Category**	**Th.**	**Pr.**	**Total**	**Cr. Hr.**
0715-6.1	Operate valves/Gauges	3	Technical	2	18	20	2
0715-6.2	Operate Pumps	3	Technical	6	18	24	2.4

0715-6.3	Operate Compressors	3	Technical	4	12	16	1.6
0715-6.4	Operate Internal Combustion Engine	4	Technical	6	18	24	2.4
0715-6.5	Operate External Combustion Engine	4	Technical	4	12	16	1.6
0715-6.6	Operate Turbine	5	Technical	2	12	16	1.6
0715-6.7	Operate Boilers	5	Technical	6	24	30	3
0715-6.8	Operate Thermal Power Plant	5	Technical	6	12	18	1.8
0715-6.9	Demonstrate/ Operate/ Overview of Wind Power Plant	5	Technical	2	6	8	0.8
0715-6.10	Operate Solar Power Plant	5	Technical	2	6	8	0.8
0715-6.11	Design and operation of Hydel Power Plant	5	Technical	2	6	8	0.8
0715-6.12	Operate Biomass Power Plant	5	Technical	2	12	14	1.4
Total				**44**	**156**	**200**	**20**

0715-7	Calibration						
S#	**Competency Standard**	**Level**	**Category**	**Contact hr.**			**Cr. Hr.**
S#	**Competency Standard**	**Level**	**Category**	**Th.**	**Pr.**	**Total**	**Cr. Hr.**
0715-7.1	Callibrate Mechanical Standards	4	Technical	4	0	4	0.4
0715-7.2	Callibrate Mechanical Measuring Instruments/tools	4	Technical	3	21	19	1.6
0715-7.3	Callibrate Mechanical Machines	5	Technical	9	45	57	5.8
0715-7.4	Calibrate Mechanical Equipment	5	Technical	3	12	15	1.5
Total				**19**	**81**	**100**	**10**

0715-8	Hydraulics and Hydraulic Machinery						
S#	**Competency Standard**	**Level**	**Category**	**Contact hr.**			
S#	**Competency Standard**	**Level**	**Category**	**Th.**	**Pr.**	**Total**	**Cr. Hr.**
0715-8.1	Operate Hydraulic Bench and Its Functions	5	Technical	4	12	16	1.6
0715-8.2	Operate Hydraulic Press	5	Technical	2	6	8	0.8
0715-8.3	Actuate Double Acting Hydraulic Cylinder	5	Technical	4	12	16	1.6
0715-8.4	Setup a Pressure Device and Hold Specific Load on a Double Acting Cylinder	5	Technical	2	6	8	0.8
0715-8.5	Construct Circuit of Double Acting Hydraulic Cylinder for Mechanical Interlocking	5	Technical	2	6	8	0.8
0715-8.6	Verify Bernoulli's Equation	5	Technical	2	6	8	0.8
0715-8.7	Operate Pressure Measuring Instruments	5	Technical	2	6	8	0.8
0715-8.8	Calibrate Bourdon Tube and Diaphragm Pressure Gauge	5	Technical	2	6	8	0.8
0715-8.9	Analyse the performance of Turbines	5	Technical	4	12	16	1.6
0715-8.10	Analyse the performance of Pumps	5	Technical	2	6	8	0.8
0715-8.11	Set Speed and Direction of Hydraulic Motor	5	Technical	2	6	8	0.8
0715-8.12	Operate Flow Regulating Devices	5	Technical	2	6	8	0.8
Total				**30**	**90**	**120**	**12**
0715-9	Metrology						
S#	**Competency Standard**	**Level**	**Category**	**Contact hr.**			
S#	**Competency Standard**	**Level**	**Category**	**Th.**	**Pr.**	**Total**	**Cr. Hr.**

0715-9.1	Take measurements through various gauges	3	Technical	2	12	14	1.4
0715-9.2	Measure dimensions with Vernier tools	3	Technical	2	12	14	1.4
0715-9.3	Perform Levelling	3	Technical	2	12	14	1.4
0715-9.4	Take measurements with graduated tools	3	Technical	2	12	14	1.4
0715-9.5	Take measurements with combination set	4	Technical	4	18	22	2.2
0715-9.6	Perform measurements through Micrometer	4	Technical	2	12	14	1.4
0715-9.7	Measure angles with angle measuring Instruments	4	Technical	2	12	14	1.4
0715-9.8	Perform different measurements	4	Technical	4	18	22	2.2
0715-9.9	Measure Threads and Gears	5	Technical	2	12	14	1.4
0715-9.10	Compare measurement with Comparators	5	Technical	6	12	18	1.8
Total				**28**	**132**	**160**	**16**
0715-10	Mechanical Engineering Drawing						
S#	**Competency Standard**	**Level**	**Category**	**Contact hr.**			**Cr. Hr.**
S#	**Competency Standard**	**Level**	**Category**	**Th.**	**Pr.**	**Total**	**Cr. Hr.**
0715-10.1	Perform Basic Manual Drawing	4	Technical	4	18	22	2.2
0715-10.2	Construct different Engineering Curves	4	Technical	6	30	36	3.6
0715-10.3	Construct multi-view drawings	4	Technical	6	36	42	4.2
0715-10.4	Manage display in AutoCAD software	5	Technical	2	12	14	1.4
0715-10.5	Develop 2D drawings	5	Technical	4	30	34	3.4

0715-10.6	Develop 3D drawing	5	Technical	4	48	52	5.2
Total				**26**	**174**	**200**	**20**

0715-11	Heat Treatment and Material Testing						
S#	**Competency Standard**	**Level**	**Category**	**Contact hr.**			**Cr. Hr.**
S#	**Competency Standard**	**Level**	**Category**	**Th.**	**Pr.**	**Total**	**Cr. Hr.**
0715-11.1	Perform Metallography of Metallic Materials	5	Technical	4	36	40	4
0715-11.2	Perform Heat Treatment of Metallic Materials	5	Technical	4	48	52	5.2
0715-11.3	Perform hardness tests for different metallic materials	5	Technical	4	18	22	2.2
0715-11.4	Perform Impact testing of metallic materials	5	Technical	4	12	16	1.6
0715-11.5	Perform Mechanical Testing on Universal Testing Machine	5	Technical	4	24	28	2.8
0715-11.6	Perform Torque and Fatigue test	5	Technical	2	12	14	1.4
0715-11.7	Perform non-destructive test	5	Technical	4	24	28	2.8
Total				**26**	**174**	**200**	**20**

0715-12	Design of Machine Elements						
S#	**Competency Standard**	**Level**	**Category**	**Contact hr.**			**Cr. Hr.**
S#	**Competency Standard**	**Level**	**Category**	**Th.**	**Pr.**	**Total**	**Cr. Hr.**
0715-12.1	Calculate Stresses in Machine Parts	5	Technical	8	18	26	2.6
0715-12.2	Calculator diameter of cylinder for hoop and longitudinal stresses	5	Technical	8	18	26	2.6
0715-12.3	Calculate thickness and diameter of spherical shell for circumferential stresses	5	Technical	8	12	20	2

0715-12.4	Design welded joints for transverse and parallel fillet under static and fatigue loading	5	Technical	8	18	26	2.6
0715-12.5	Calculate stresses due to initial tightening and external load on screws	5	Technical	4	12	16	1.6
0715-12.6	Design dimension of square and rectangular keys	5	Technical	4	12	16	1.6
0715-12.7	Design hollow and solid shaft subjected to twisting moment only	5	Technical	6	6	12	1.2
0715-12.8	Design flange coupling for specific torque	5	Technical	4	6	10	1
0715-12.9	Design the dimensions of helical spring	5	Technical	4	6	10	1
0715-12.10	Design bearings, speed, lubrication, pressure, viscosity and coefficient of friction	5	Technical	6	6	12	1.2
0715-12.11	Design and draw the CAM profile	5	Technical	8	18	26	2.6
Total				**68**	**132**	**200**	**20**

0715-13	Industrial Management						
S#	**Competency Standard**	**Level**	**Category**	**Contact hr.**			**Cr. Hr.**
S#	**Competency Standard**	**Level**	**Category**	**Th.**	**Pr.**	**Total**	**Cr. Hr.**
0715-13.1	Perform Store Operation in Industry	4	Functional	4	6	10	1
0715-13.2	Perform Maintenance Activities	4	Functional	4	6	10	1
0715-13.3	Paraphrase Industrial Planning	5	Functional	2	0	2	0.2
0715-13.4	Carry out Site Selection for an Industry	5	Functional	2	6	8	0.8
0715-13.5	Develop Plant Layout	5	Functional	2	12	14	1.4
0715-13.6	Demonstrate Production Method	5	Functional	6	0	6	0.6
0715-13.7	Carry out Job Analysis	5	Functional	6	6	12	1.2

0715-13.8	Carryout Production Planning and Control	5	Functional	6	0	6	0.6
0715-13.9	Perform Quality control and Quality Assurance	5	Functional	6	0	6	0.6
0715-13.10	Carry out Cost Determination and Control	5	Functional	6	0	6	0.6
Total				**44**	**36**	**80**	**8**
0715-14	CAD CAM						
S#	**Competency Standard**	**Level**	**Category**	**Contact hr.**			**Cr. Hr.**
S#	**Competency Standard**	**Level**	**Category**	**Th.**	**Pr.**	**Total**	**Cr. Hr.**
0715-14.1	Draw A Simple Drawing of Die for Given Objects	5	Technical	2	24	26	2.6
0715-14.2	Perform Part Modelling	5	Technical	4	48	52	5.2
0715-14.3	Carry Out Assembly Modelling	5	Technical	4	36	40	4
0715-14.4	Perform CAM Operations	5	Technical	8	54	62	6.2
Total				**18**	**162**	**180**	**18**
0715-15	Boiler Operator						
S#	**Competency Standard**	**Level**	**Category**	**Contact hr.**			**Cr. Hr.**
S#	**Competency Standard**	**Level**	**Category**	**Th**	**Pr.**	**Total**	**Cr. Hr.**
0715-15.1	Maintain Boiler house Record	4	Technical	2	6	8	0.8
0715-15.2	Set and adjust burners	4	Technical	2	12	14	1.4
0715-15.3	Perform Boiler Operations	5	Technical	6	24	30	3
0715-15.4	Operate boiler auxiliaries	5	Technical	6	12	18	1.8

0715-15.5	Perform Maintenance of Boiler	5	Technical	4	6	10	1
Total				**20**	**60**	**80**	**8**

0715-16	Plastic Processing Machine operator						
S#	**Competency Standard**	**Level**	**Category**	**Contact hr.**			**Cr. Hr.**
S#	**Competency Standard**	**Level**	**Category**	**Th**	**Pr.**	**Total**	**Cr. Hr.**
0715-16.1	Operate Injection Moulding Machine	4	Technical	4	18	22	2.2
0715-16.2	Operate Blow Molding Machine	4	Technical	4	18	22	2.2
0715-16.3	Operate Foam Processing Machines	4	Technical	2	6	8	0.8
0715-16.4	Operate Multi-Color Printing Machines (Rotogravure)	4	Technical	2	12	14	1.4
0715-16.5	Operate Multi-Color Printing Machine (Flexographic)	4	Technical	2	12	14	1.4
0715-16.6	Operate Plastic Film Extrusion machines (Blown/Cast)	5	Technical	4	12	16	1.6
0715-16.7	Operate Pipe & Profile Extrusion Machines	5	Technical	2	12	14	1.4
0715-16.8	Operate Rotational Molding Machines	5	Technical	4	12	16	1.6
0715-16.9	Operate Compression/Transfer Molding Machines	5	Technical	2	12	14	1.4
Total				**26**	**114**	**140**	**14**

0715-17	HVAC						
S#	**Competency Standard**	**Level**	**Category**	**Contact hr.**			**Cr. Hr.**
S#	**Competency Standard**	**Level**	**Category**	**Th**	**Pr.**	**Total**	**Cr. Hr.**

0715-17.1	Install Residential Air Conditioner	4	Technical	2	18	20	2
0715-17.2	Repair/Service Residential Air-Conditioner	4	Technical	2	24	26	2.6
0715-17.3	Repair / Service Residential Refrigeration Units	4	Technical	2	18	20	2
0715-17.4	Carry out Calculations and Prepare Estimates	5	Technical	6	0	6	0.6
0715-17.5	Install Commercial Refrigeration Units	5	Technical	4	24	28	2.8
0715-17.6	Repair/Service Commercial Refrigeration Units	5	Technical	4	24	28	2.8
0715-17.7	Carry out Fabrication for HVAC Work	5	Technical	2	18	20	2
0715-17.8	Install Central Air Conditioning Systems	5	Technical	4	36	40	4
0715-17.9	Repair/Service Central Air Conditioning System	5	Technical	4	12	16	1.6
0715-17.10	Perform Preventive Maintenance	5	Technical	4	12	16	1.6
Total				**34**	**186**	**220**	**22**

0715-18	Millwright						
S#	**Competency Standard**	**Level**	**Category**	**Contact hr.**			**Cr. Hr.**
S#	**Competency Standard**	**Level**	**Category**	**Th**	**Pr.**	**Total**	**Cr. Hr.**
0715-18.1	Perform Routine Trade Activity	4	Technical	6	12	18	1.8
0715-18.2	Apply basic Occupational Health & Safety Functions	4	Technical	2	0	2	0.2
0715-18.3	Perform general health, safety and environment practices	4	Technical	2	6	8	0.8
0715-18.4	Perform Measuring and Layout of Workpiece	4	Technical	4	12	16	1.6
0715-18.5	Perform Cutting And Welding Operation	5	Technical	6	18	24	2.4

0715-18.6	Perform Rigging,Hoisting/Lifting & Moving	5	Technical	8	24	32	3.2
0715-18.7	Service general mechanical equipment	5	Technical	12	48	60	6
Total				**40**	**120**	**160**	**16**

0715-19	Tool design and tool making						
S#	**Competency Standard**	**Level**	**Category**	**Contact hr.**			**Cr. Hr.**
S#	**Competency Standard**	**Level**	**Category**	**Th**	**Pr.**	**Total**	**Cr. Hr.**
0715-19.1	Draw standard parts of jigs & fixtures (manual drawing)	3	Technical	6	18	24	2.4
0715-19.2	Draw different types of clamps	3	Technical	2	12	14	1.4
0715-19.3	Draw locators (Manual)	3	Technical	2	12	14	1.4
0715-19.4	Draw template jig and plate type drill Jig	3	Technical	2	12	14	1.4
0715-19.5	Draw swinging leaf jig	3	Technical	2	6	8	0.8
0715-19.6	Draw an indexing jig	3	Technical	2	6	8	0.8
0715-19.7	Design and draw the CAM profile with knife edge follower for uniform velocity	5	Technical	6	12	18	1.8
0715-19.8	Draw an angle milling fixture	5	Technical	2	6	8	0.8
0715-19.9	Draw lathe fixture for turning and boring operation	5	Technical	2	12	14	1.4
0715-19.10	Draw simple blanking die for making a blank dia 40 mm	5	Technical	2	6	8	0.8
0715-19.11	Draw a progressive die for making a washer of inner diameter 20 and outer 40 mm	5	Technical	4	12	16	1.6
0715-19.12	Draw a simple drawing die for a cup for inner dia 40 mm, depth 30 mm and sheet thickness 1mm	5	Technical	2	12	14	1.4
Total				**34**	**126**	**160**	**16**

0715-20	Entrepreneurship Skills						
S#	**Competency Standard**	**Level**	**Category**	**Contact hr.**			**Cr. Hr.**
S#	**Competency Standard**	**Level**	**Category**	**Th.**	**Pr.**	**Total**	**Cr. Hr.**
0715-20.1	Develop Basic Enterpreneurial Skills	4	Generic	1	6	7	0.7
0715-20.2	Develop a Sales Plan	4	Generic	2	6	8	0.8
0715-20.3	Manage a Small Team	5	Generic	1	6	7	0.7
0715-20.4	Plan Small Scale Bussiness Activities	5	Generic	1	9	10	1
0715-20.5	Address Basic Customer Needs	5	Generic	2	9	11	1.1
0715-20.6	Manager Human Resources	5	Generic	2	6	8	0.8
0715-20.7	Execute Bussines to Bussines activities	5	Generic	2	9	11	1.1
0715-20.8	Manage Personal Finance	5	Generic	1	6	7	0.7
0715-20.9	Develop a Small Team	5	Generic	1	9	10	1
0715-20.10	Manage Human Resources	5	Generic	1	6	7	0.7
0715-20.11	Solve Problems Pertaining to Health & Safety	5	Generic	2	6	8	0.8
0715-20.12	Develop Bussines Plan	5	Generic	1	6	7	0.7
0715-20.13	Apply Information & Communication Skills	5	Generic	2	6	8	0.8
0715-20.14	Coordinate with a team	5	Generic	1	6	7	0.7
0715-20.15	Maintain Bussiness Resources	5	Generic	1	9	10	1
0715-20.16	Develop human Resources for a project	5	Generic	1	6	7	0.7

0715-20.17	Solve Problems at a workplace	5	Generic	2	9	11	1.1
Total				**24**	**120**	**144**	**14.4**
0715-21	IT Skills						
S#	**Competency Standard**	**Level**	**Category**	**Contact hr.**			**Cr. Hr.**
S#	**Competency Standard**	**Level**	**Category**	**Th.**	**Pr.**	**Total**	**Cr. Hr.**
0715-21.1	Operate Basic Computer Functions	1	Generic	1	12	13	1.4
0715-21.2	Perform Basic Computer Applications	2	Generic	3	15	18	1.8
0715-21.3	Develop Computer Applications Skills	3	Generic	2	15	17	1.7
0715-21.4	Develop Advance Computer Application Skills	4	Generic	3	18	21	2.1
0715-21.5	Explore Computer Applications Skills for Careers	5	Generic	3	18	21	2.1
Total				**12**	**78**	**90**	**9**
0715-22	Communication Skills						
S#	**Competency Standard**	**Level**	**Category**	**Contact hr.**			**Cr. Hr.**
S#	**Competency Standard**	**Level**	**Category**	**Th.**	**Pr.**	**Total**	**Cr. Hr.**
0715-22.1	Follow basic communication skills	1	Generic	3	12	15	1.5
0715-22.2	Perform basic communication	2	Generic	3	12	15	1.5
0715-22.3	Communicate at workplace	3	Generic	3	12	15	1.5
0715-22.4	Perform Advanced Communication	4	Generic	3	12	15	1.5
0715-22.5	Perform Managerial Communication Skills	5	Generic	3	12	15	1.5

Total	**15**	**60**	**75**	**7.5**

Overall Credit Hours Details			**641**	**2598**	**3239**	**323.9**

9. Detail of Qualifications and its Competency Standards

0715.1 Welding

0715-M&MT-1. Interpret Drawing and Execute to Fabricate Parts

Overview: This competency standard covers the skills and knowledge required to Read and Understand Manufacturing Drawings, Interpret Welding Symbols, Recognize Material Specifications and Bill of Material (BOM) and Manufacture Parts

Competency Units	Performance Criteria
CU1. Interpret Manufacturing Drawings	**P1.** Recognize basics of lines used in engineering drawings **P2.** Describe uses of lines in engineering drawings **P3.** Recognize and explain orthographic and isometric views of a drawing **P4.** Identify manufacturing requirements according to drawings **P5.** Prepare job layout according to manufacturing requirements
CU2. Interpret Welding Symbols	**P1.** Understand basic and supplementary welding symbols used in manufacturing drawings **P2.** Understand and differentiate between types of welds and joints **P3.** Identify welding requirements according to welding symbols given in the manufacturing drawings
CU3. Recognize Material Specifications and Bill of Material (BOM)	**P1.** Identify material specifications according to manufacturing drawing **P2.** Identify bill of material (BOM) according to manufacturing drawing
CU4. Manufacture Parts	**P1.** Interpret dimensional tolerances according to manufacturing drawing **P2.** Assemble and tack weld parts according to manufacturing drawing

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 Basic elements of engineering drawing
- **K2.** Describe Drawing symbols
- **K3.** Explain Dimensioning techniques
- **K4.** Define General tolerance
- **K5.** Define Angular tolerance
- **K6.** Define Geometric tolerance
- **K7.** Explain Perspective
- **K8.** Explain Exploded view

K9. Explain Hidden view technique

K10. Explain First angle projections

K11. Explain Third angle projections

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
- ❖ Measuring devices
- ❖ Hand held calculator
- ❖ Fabrication and welding equipment

0715-M&MT-2. Perform Oxy Acetylene Welding

Overview: This competency standard covers the skills and knowledge required to Practice of making Tee Joint, Practice of making Lap Joint and Practice of Making Butt Joint

Competency Units	Performance Criteria
CU1. Practice of making Tee Joint	**P1.** Take Work piece as per drawing **P2.** Straiten it with the help of hammer and anvil **P3.** Grind the work pieces on grinding machine to prepare the edges flat and parallel to each other **P4.** Place the Bottom piece on work table and place the Top plate at 90^0 to each other as per drawing **P5.** Set the flame of welding torch as per standard **P6.** Complete the bead as per standard
CU2. Practice of making Lap Joint	**P1.** Take Work piece as per drawing **P2.** Straiten it with the help of hammer and anvil **P3.** Grind the work pieces on grinding machine to prepare the edges flat and parallel to each other **P4.** Place the Bottom piece on work table and place the Top plate along the marked line **P5.** Set the flame of welding torch as per standard **P6.** Complete the bead as per standard
CU3. Practice of Making Butt Joint	**P1.** Take Work piece as per drawing **P2.** Straiten it with the help of hammer and anvil **P3.** Grind the work pieces on grinding machine to prepare the edges flat and parallel to each other **P4.** Place the work pieces parallel to each other **P5.** Set the flame of welding torch as per standard **P6.** Complete the bead as per standard

Knowledge & Understanding

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

K1. Explain positions of electrode according to work

K2. Knowledge of setting the current on welding machine

K3. Describe motion of electrode in ARC welding

K4. Explain importance of gap between electrode and base metal

K5. Describe use of tri square

K6. Describe importance of cleanliness of surface to be welded

Critical Evidence

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

- Grind the work pieces on grinding machine to prepare the edges flat and parallel to each other
- Set the flame of welding torch as per standard
- Make the Tee Joint.
- Make Lap Joint
- Make Butt Joint

Tools and Equipment

- ❖ Oxygen cylinder
- ❖ Acetylene gas cylinder
- ❖ Pressure regulators
- ❖ Cylinder key
- ❖ Welding torch
- ❖ Rubber house pipe
- ❖ Back fire arrester
- ❖ Flash back arrester

0715-M&MT-3. Evaluate the Use of Hand and Power Tools

Overview: This competency standard covers the skills and knowledge required to Put on hand tools and Put on power tools

Competency Units	Performance Criteria
CU1. Put on hand tools	**P1.** Select hand tools appropriate to the task requirements. **P2.** Use hand tools to produce desired outcomes to job specifications which may include finish, tension, size or shape. **P3.** Adhere all safety requirements to before, during and after use. **P4.** Identify and mark unsafe or faulty tools for repair according to designated procedures before, during and after use. **P5.** Maintain tools, including hand sharpening according to standard operational procedures, principles and techniques. **P6.** Store hand tools safely in appropriate location according to standard operational procedures and manufacturers' recommendations.
CU2. Put on power tools	**P1.** Select power tools appropriate to the task requirements. **P2.** Use power tools for a determined sequence of operations-which may include clamping, alignment and adjustment to produce desired outcomes-to job specifications which may include finish, size or shape. **P3.** Adhere all safety requirements to before, during and after use. **P4.** Identify and mark unsafe or faulty tools for repair according to designated procedures before, during and after use. **P5.** Maintain tools, including hand sharpening according to standard operational procedures, principles and techniques. **P6.** Store power tools safely in appropriate location according to standard operational procedures and manufacturers' recommendations.

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.** Applications of different hand and power tools in a general engineering context
- **K2.** Common faults and/or defects in hand and power tools
- **K3.** Procedures for marking unsafe or faulty tools for repair
- **K4.** Routine maintenance requirements for a range of hand and power tools
- **K5.** Storage location and procedures for a range of hand and power tools
- **K6.** Hazards and control measures associated with using hand and power tools

K7. Benefits and limits of cutting and shaping metal with auxiliary equipment

K8. Environmental benefits of maintaining auxiliary equipment

K9. Clamping /securing methods

K10. Adjustment/alignments to a range of power tools

K11. Tool sharpening techniques for a range of power tools

Critical Evidence

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

- Identify and mark unsafe or faulty tools for repair according to designated procedures before, during and after use.
- Maintain tools, including hand sharpening according to standard operational procedures, principles and techniques.
- Store hand tools safely in appropriate location according to standard operational procedures and manufacturers' recommendations.
- Identify and mark unsafe or faulty tools for repair according to designated procedures before, during and after use.
- Store power tools safely in appropriate location according to standard operational procedures and manufacturers' recommendations.

Tools and Equipment

- Work bench
- Bench vice
- Hammer
- Tri-square
- Hand hacksaw
- Scriber
- Vernier caliper
- Flat File
- Number/alphabet punch
- Scriber
- Vernier caliper
- Hand drill machine
- Disk grinder
- Pin grinder

0715-M&MT-4. Perform Pre-Welding Operations

Overview: This competency standard covers the skills and knowledge required to Set Welding Equipment, Prepare materials for welding, Cut and Prepare Edge/s of Base Materials and Prepare Welding Consumables

Competency Units	Performance Criteria
CU.1 Set Welding Equipment	**P1.** Adjust pressure of both gas cylinders with the help of regulator **P2.** Open acetylene gas knob of welding torch Make carburizing flame by increasing acetylene gas quantity **P3.** Make neutral flame by adjusting both gases at same quantity **P4.** Make oxidizing flame by increasing oxygen gas quantity **P5.** Adjust pressure of both gas cylinders with the help of regulator **P6.** Select the correct size of the nozzle **P7.** Set the both gas flame of welding torch as per standard
CU2. Prepare materials for welding	**P1.** Select and obtain required material/s as per job requirements **P2.** Select appropriate marking tools as per job requirements **P3.** Mark the area to be cut as per drawing/job requirements
CU3. Cut and Prepare Edge/s of Base Materials	**P1.** Select appropriate cutting equipment as per job requirements **P2.** Set-up cutting equipment as per manufacturer's instructions/job requirements **P3.** Cut the base material as per job specifications and dimensions provided in the drawing **P4.** Prepare edges of the base materials as per drawing/WPS **P5.** Check dimensions of the prepared edges as per drawing/WPS **P6.** Select proper tools and chemicals for cleaning **P7.** Clean the edges of the base materials as per job requirements
CU4. Prepare Welding Consumables	**P1.** Select relevant welding consumables as per job requirements/WPS **P2.** Prepare consumables in accordance with required specifications

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 about welding torch
- **K2.** Identify Gas pressure regulators
- **K3.** Explain temperature and its units
- **K4.** Describe pre heating
- **K5.** Explain importance of pre heating
- **K6.** Explain metal properties
- **K7.** Describe malleability
- **K8.** Describe types of grinder
- **K9.** Explain use of tri square

K10. Describe importance of filing

K11. Describe the filler rod

K12. Describe electrode baking oven

K13. Describe purpose of flux

Critical Evidence

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

- Adjust pressure of both gas cylinders with the help of regulator
- Make oxidizing flame by increasing oxygen gas quantity
- Adjust pressure of both gas cylinders with the help of regulator
- Cut the base material as per job specifications and dimensions provided in the drawing

Tools and Equipment

- Oxygen cylinder
- Acetylene gas cylinder
- Pressure regulators
- Cylinder key
- Welding torch
- Rubber house pipe
- Back fire arrester
- Flash back arrester
- Spark lighter
- Steel wire brush
- Work bench
- Bench vice
- Hammer
- Tri-square
- Hand hacksaw
- Scriber
- Vernier caliper
- Flat File
- Pedestal grinder
- Disk grinder
- Pin grinder
- Flat file
- Welding electrode
- Metal Filler rod

- Welding flux

0715-M&MT-5. Cut Metal by Oxy-Acetylene / Oxy-Fuel Flame/Grinding (Manually and Auto Cutting)

Overview: This competency standard covers the skills and knowledge required to cut metal by oxy-acetylene Welding Manually, Cut metal by oxy-acetylene Welding Automatically, Cut metal by Grinding Manually and Cut metal by Grinding Automatically

Competency Units	Performance Criteria
CU1. Cut metal by oxy-acetylene Welding Manually	**P1.** Take Work piece as per drawing **P2.** Straiten it with the help of hammer and anvil if required **P3.** Set the flame of welding torch in oxidizing flame as per standard **P4.** Start cutting for one side of work piece **P5.** Maintain standard distance between welding torch nozzle and work piece **P6.** Complete the cut as per standard
CU2. Cut metal by oxy-acetylene Welding Automatically	**P1.** Take Work piece as per drawing **P2.** Straiten it with the help of hammer and anvil if required **P3.** Set the flame of welding torch in oxidizing flame as per standard **P4.** Set cutting torch in Auto Feed machine **P5.** Set Feed Rate of machine **P6.** Start cutting for one side of work piece **P7.** Maintain standard distance between welding torch nozzle and work piece **P8.** Complete the cut as per standard
CU3. Cut metal by Grinding Manually	**P1.** Take Work piece as per drawing **P2.** Straiten it with the help of hammer and anvil if required **P3.** Perform marking on work piece where cutting is required **P4.** Set disk grinder on grinding machine **P5.** Set r.p.m of disk grinding machine as per standard **P6.** Cut on marked line with disk grinder by hand
CU4. Cut metal by Grinding Automatically	**P1.** Take Work piece as per drawing **P2.** Straiten it with the help of hammer and anvil if required **P3.** Perform marking on work piece where cutting is required **P4.** Set disk grinder on grinding machine **P5.** Set r.p.m of disk grinding machine as per standard **P6.** Set the guide blade of disk grinding machine as per requirement **P7.** Set feed of disk grinding machine **P8.** Cut on marked line with disk grinding machine

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:

0715-M&MT-6. Perform Gas Welding On Mild Steel Plates (1F, 2F, 3F)

Overview: This competency standard covers the skills and knowledge required to Gas Welding on Mild Steel Plates (1F), Gas Welding on Mild Steel Plates (2F) and Gas Welding on Mild Steel Plates (3F)

Competency Units	Performance Criteria
CU1. Gas Welding On Mild Steel Plates (1F)	**P1.** Open gas cylinder with the help of cylinder key **P2.** Adjust pressure of both gas cylinders with the help of regulator **P3.** Open acetylene gas knob of welding torch **P4.** Ignite acetylene gas with help of spark lighter **P5.** Open oxygen gas knob of welding torch **P6.** Set work piece as per standard **P7.** Perform fore hand welding method **P8.** Perform post welding operations
CU2. Gas Welding On Mild Steel Plates (2F)	**P1.** Open gas cylinder with the help of cylinder key **P2.** Adjust pressure of both gas cylinders with the help of regulator **P3.** Open acetylene gas knob of welding torch **P4.** Ignite acetylene gas with help of spark lighter **P5.** Open oxygen gas knob of welding torch **P6.** Set work piece as per standard **P7.** Perform welding in right hand welding method **P8.** Perform post welding operations
CU3. Gas Welding On Mild Steel Plates (3F)	**P1.** Open gas cylinder with the help of cylinder key **P2.** Adjust pressure of both gas cylinders with the help of regulator **P3.** Open acetylene gas knob of welding torch **P4.** Ignite acetylene gas with help of spark lighter **P5.** Open oxygen gas knob of welding torch **P6.** Set work piece as per standard **P7.** Perform welding in downward welding method **P8.** Perform post welding operations

Knowledge & Understanding

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

0715-M&MT-7. Gas Metal Arc Welding (GMAW) in Flat (1F, 1G), Hori (2F, 2G), Ver(3F, 3G) and O. head (4F, 4G) Positions

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

Competency Units	Performance Criteria
CU1. Prepare Welding Machine and Accessories for GMAW	**P1.** Identify welding requirements from the job, welding procedure specifications and/or technical drawings **P2.** Prepare GMAW welding machine in accordance with welding procedure specifications/ manufacturer instructions **P3.** Set up welding machine accessories and consumables as per job requirements, welding procedure specifications and/or manufacturer instructions **P4.** Connect welding machine to an independent power supply **P5.** Set polarity indicated in the welding procedure specifications
CU2. Make Fillet Welds on Carbon Steel Plate	**P1.** Adjust welding parameters (current, voltage, wire feed speed etc.) as per welding procedure specifications/job requirements to produce acceptable weld **P2.** Maintain gap between electrode and base metal as per standard practices **P3.** Carry out welding in Flat (1F) and Horizontal (2F) positions following standard procedures **P4.** Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
CU3. Make Groove Welds on Carbon Steel Plate	**P1.** Adjust welding parameters (current, voltage, wire feed speed etc.) as per welding procedure specifications/job requirements to produce acceptable weld **P2.** Maintain gap between electrode and base metal as per standard practices **P3.** Carry out welding in Flat (1G) and Horizontal (2G) positions following standard procedures **P4.** Deposit root pass as per welding procedure specifications/job requirements **P5.** Deposit filling passes as per welding procedure specifications/job requirements

	P6. Deposit capping pass as per welding procedure specifications/job requirements **P7.** Check root, filling and capping passes for any visual discontinuities as per acceptance standards **P8.** Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
CU4. Make Fillet Welds on Carbon Steel Plate	**P1.** Adjust welding parameters (current, voltage, wire feed speed etc.) as per welding procedure specifications/job requirements to produce acceptable weld **P2.** Maintain gap between electrode and base metal as per standard practices **P3.** Carry out welding in Vertical (3F) and Overhead (4F) positions following standard procedures **P4.** Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
CU5. Make Groove Welds on Carbon Steel Plate	**P1.** Adjust welding parameters (current, voltage, wire feed speed etc.) as per welding procedure specifications/job requirements to produce acceptable weld **P2.** Maintain gap between electrode and base metal as per standard practices **P3.** Carry out welding in Vertical (3G) and Overhead (4G) positions following standard procedures **P4.** Deposit root pass as per welding procedure specifications/job requirements **P5.** Deposit filling passes as per welding procedure specifications/job requirements **P6.** Deposit capping pass as per welding procedure specifications/job requirements **P7.** Check root, filling and capping passes for any visual discontinuities as per acceptance standards **P8.** Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
CU6. Perform Post Welding Operations	**P1.** Carry out finishing work of welds following standard procedures **P2.** Inspect weld visually and mark any visual defects, as required **P3.** Carry out repair work in accordance with approved procedures, as required **P4.** Clean work area in accordance with workplace safety practices

	P5.	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. Describe Double J joint
K19. Explain Polarity setting according to standard specifications
K20. 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
K21. Define Visual welding defects
K22. Describe Welding codes and standards
K23. State the purpose of using shielding gas in TIG welding
K24. Identify various gases/combination of gases for shielding

0715-M&MT-8. Gas Tungsten Arc Welding (GTAW) in Flat (1F, 1G), Horizontal (2F, 2G), Vertical (3F, 3G) and Overhead (4F, 4G) Positions

Overview: This competency standard covers the skills and knowledge required to Prepare Welding Machine and Accessories for GTAW, Make Fillet Welds on Carbon Steel Plate, Make Groove Welds

on Carbon Steel Plate, Make Fillet Welds on Carbon Steel Plate, Make Groove Welds on Carbon Steel Plate and Perform Post Welding Operations

Competency Units	Performance Criteria
CU1. Prepare Welding Machine and Accessories for GTAW	**P1.** Identify welding requirements from the job, welding procedure specifications and/or technical drawings **P2.** Prepare GTAW welding machine in accordance with welding procedure specifications/ manufacturer instructions **P3.** Set up welding machine accessories and consumables as per job requirements, welding procedure specifications and/or manufacturer's instructions **P4.** Connect welding machine to an independent power supply **P5.** Set polarity indicated in the welding procedure specifications
CU2 . Make Fillet Welds on Carbon Steel Plate	**P1.** Adjust welding parameters (current, voltage etc.) as per welding procedure specifications/job requirements to produce acceptable weld **P2.** Maintain gap between electrode and base metal as per standard practices **P3.** Carry out welding in Flat (1F) and Flat (1G) positions following standard procedures **P4.** Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
CU3. Make Groove Welds on Carbon Steel Plate	**P1.** Adjust welding parameters (current, voltage etc.) as per welding procedure specifications/job requirements to produce acceptable weld **P2.** Maintain gap between electrode and base metal as per standard practices **P3.** Carry out welding in Horizontal (2F) and Horizontal (2G) positions following standard procedures **P4.** Deposit root pass as per welding procedure specifications/job requirements **P5.** Deposit filling passes as per welding procedure specifications/job requirements **P6.** Deposit capping pass as per welding procedure specifications/job requirements **P7.** Check root, filling and capping passes for any visual discontinuities as per acceptance standards **P8.** Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects

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

CU5. Make Groove Welds on Carbon Steel Plate	**P1.** Adjust welding parameters (current, voltage etc.) as per welding procedure specifications/job requirements to produce acceptable weld **P2.** Maintain gap between electrode and base metal as per standard practices **P3.** Carry out welding in Overhead (4F) and Overhead (4G) positions following standard procedures **P4.** Deposit root pass as per welding procedure specifications/job requirements **P5.** Deposit filling passes as per welding procedure specifications/job requirements **P6.** Deposit capping pass as per welding procedure specifications/job requirements **P7.** Check root, filling and capping passes for any visual discontinuities as per acceptance standards **P8.** Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects

CU6. Perform Post Welding Operations	**P1.** Carry out finishing work of welds following standard procedures **P2.** Inspect weld visually and mark any visual defects, as required **P3.** Carry out repair work in accordance with approved procedures, as required **P4.** Clean work area in accordance with workplace safety practices **P5.** 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 GTAW

K3. Describe the principle of TIG welding

K4. Explain various welding positions

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

K6. Demonstrate the method to correctly wear PPE

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

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

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

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

K2 Explain Welding techniques as per WPS/instruction sheet

K1. Describe Welding procedure specifications (WPS)

K2. Describe Method of Pre- heating of base metal

K3. Describe Fillet lap joint

K4. Describe Tee-fillet joint

K5. Describe Corner joint

K6. Describe Butt joint

K7. Describe Double J joint

K1. Explain Polarity setting according to standard specifications

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

K1. Define Visual welding defects

K2. Describe Welding codes and standards

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

K4. Identify various gases/combination of gases for shielding

0715-M&MT-9. Shielded Metal Arc Welding (SMAW) in Flat (1F, 1G), Horizontal (2F, 2G), Vertical (3F, 3G) and Overhead (4F, 4G) Positions

Overview: This Competency Standard is designed to gain basic knowledge and skills required to perform Shielded Metal Arc Welding (SMAW) operations in Flat (1F, 1G) and Horizontal (2F, 2G) positions at workplace. The standard covers specific knowledge of performing Shielded Metal Arc Welding (SMAW) by selecting and setting up welding equipment, installing consumables, adjusting welding parameters and making fillet and groove welds in Flat (1F, 1G) and Horizontal (2F, 2G) positions of plate. The standard also covers post welding operations comprising cleaning, measuring, inspecting and repairing welds at workplace

Competency Units	Performance Criteria
CU1. Prepare Welding Machine and Accessories for SMAW	**P1.** Identify welding requirements from the job, welding procedure specifications and/or technical drawings **P2.** Prepare SMAW welding machine in accordance with welding procedure specifications/ manufacturer instructions **P3.** Set up welding machine accessories and consumables as per job requirements, welding procedure specifications and/or manufacturer's instructions **P4.** Connect welding machine to an independent power supply **P5.** Set polarity indicated in the welding procedure specifications
CU2 . Make Fillet Welds on Carbon Steel Plate	**P1.** Adjust welding parameters (current, voltage etc.) as per welding procedure specifications/job requirements to produce acceptable weld Maintain gap between electrode and base metal as per standard practices **P2.** Carry out welding in Flat (1F) and Flat (1G) positions following standard procedures **P3.** Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
CU3. Make Groove Welds on Carbon Steel Plate	**P1.** Adjust welding parameters (current, voltage etc.) as per welding procedure specifications/job requirements to produce acceptable weld **P2.** Maintain gap between electrode and base metal as per standard practices **P3.** Carry out welding in Horizontal (2F) and Horizontal (2G) positions following standard procedures **P4.** Deposit root pass as per welding procedure specifications/job requirements **P5.** Deposit filling passes as per welding procedure specifications/job

	requirements **P6.** Deposit capping pass as per welding procedure specifications/job requirements **P7.** Check root, filling and capping passes for any visual discontinuities as per acceptance standards **P8.** Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
CU4. Make Fillet Welds on Carbon Steel Plate	**P1.** Adjust welding parameters (current, voltage etc.) as per welding procedure specifications/job requirement to produce acceptable weld **P2.** Maintain gap between electrode and base metal as per standard practices **P3.** Carry out welding in Vertical (3F) and Vertical (3G) positions following standard procedures **P4.** Deposit root pass as per welding procedure specifications/job requirements **P5.** Deposit filling passes as per welding procedure specifications/job requirements **P6.** Deposit capping pass as per welding procedure specifications/job requirements **P7.** Check root, filling and capping passes for any visual discontinuities as per acceptance standards **P8.** Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
CU5. Make Groove Welds on Carbon Steel Plate	**P1.** Adjust welding parameters (current, voltage etc.) as per welding procedure specifications/job requirements to produce acceptable weld **P2.** Maintain gap between electrode and base metal as per standard practices **P3.** Carry out welding in Overhead (4F) and Overhead (4G) positions following standard procedures Deposit root pass as per welding procedure specifications/job requirements **P4.** Deposit filling passes as per welding procedure specifications/job requirements **P5.** Deposit capping pass as per welding procedure specifications/job requirements **P6.** Check root, filling and capping passes for any visual discontinuities as per acceptance standards **P7.** Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects

CU6. Perform Post Welding Operations	**P1.** Carry out finishing work of welds following standard procedures **P2.** Inspect weld visually and mark any visual defects, as required **P3.** Carry out repair work in accordance with approved procedures, as required **P4.** Clean work area in accordance with workplace safety practices **P5.** 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.** Understanding of technical drawings
- **K2.** Electrical supply AC and DC
- **K3.** Specifications/ classification of electrode/s required for the job
- **K4.** Electrical parameters like (voltage, current etc.) and their effects on weld
- **K5.** Welding techniques as per WPS/instruction sheet
- **K6.** Welding procedure specifications (WPS)
- **K7.** Method of Pre- heating of base metal
- **K8.** Polarity setting according to standard specifications
- **K9.** Visual welding defects
- **K10.** Welding codes and standards

0715-M&MT-10. Flux Cored Arc Welding (FCAW)

Overview: This competency standard covers the skills and knowledge required to Prepare Welding Machine and Accessories for FCAW, Make Fillet Welds on Carbon Steel Plate, Make Groove Welds on Carbon Steel Plate, Make Fillet Welds on Carbon Steel Plate, Make Groove on Carbon Steel Plate and Preform Post Welding Operations

Competency Units	Performance Criteria
CU1. Prepare Welding Machine and Accessories for FCAW	**P1.** Identify welding requirements from the job, welding procedure specifications and/or technical drawings

	P2. Prepare FCAW welding machine in accordance with welding procedure specifications/manufacturer instructions **P3.** Set up welding machine accessories and consumables as per job requirements, welding procedure specifications and/or manufacturer instructions **P4.** Connect welding machine to an independent power supply **P5.** Set polarity indicated in the welding procedure specifications
CU2 . Make Fillet Welds on Carbon Steel Plate	**P1.** Adjust welding parameters (current, voltage, wire feed speed etc.) as per welding procedure specifications/job requirements to produce acceptable weld Maintain gap between electrode and base metal as per standard practices **P2.** Carry out welding in in Flat (1F) and Horizontal (2F) Positions following standard procedures **P3.** Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
CU3. Make Groove Welds on Carbon Steel Plate	**P1.** Adjust welding parameters (current, voltage, wire feed speed etc.) as per welding procedure specifications/job requirements to produce acceptable weld **P2.** Maintain gap between electrode and base metal as per standard practices **P3.** Carry out welding in Flat (1G) and Horizontal (2G) Positions following standard procedures **P4.** Deposit root pass as per welding procedure specifications/job requirements **P5.** Deposit filling passes as per welding procedure specifications/job requirements **P6.** Deposit capping pass as per welding procedure specifications/job requirements **P7.** Check root, filling and capping passes for any visual discontinuities as per acceptance standards **P8.** Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
CU4. Make Fillet Welds on Carbon Steel Plate	**P1.** Adjust welding parameters (current, voltage, wire feed speed etc.) as per welding procedure specifications/job requirements to produce acceptable weld **P2.** Maintain gap between electrode and base metal as per standard practices

	P3. Carry out welding in Vertical (3F) and Overhead (4F) positions following standard procedures **P4.** Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
CU5. Make Groove on Carbon Steel Plate	**P1.** Adjust welding parameters (current, voltage, wire feed speed etc.) as per welding procedure specifications/job requirements to produce acceptable weld **P2.** Maintain gap between electrode and base metal as per standard practices **P3.** Carry out welding in Vertical (3G) and Overhead (4G) positions following standard procedures **P4.** Deposit root pass as per welding procedure specifications/job requirements **P5.** Deposit filling passes as per welding procedure specifications/job requirements **P6.** Deposit capping pass as per welding procedure specifications/job requirements **P7.** Check root, filling and capping passes for any visual discontinuities as per acceptance standards **P8.** Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
CU6. Preform 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 **P5.** 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:

0715-M&MT-11. Perform Submerged Arc Welding

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

Competency Units	Performance Criteria
CU1. Prepare Welding Machine and Accessories for SAW	**P1.** Identify welding requirements from the job, welding procedure specifications and/or technical drawings **P2.** Prepare SAW welding machine in accordance with welding procedure specifications/manufacturer instructions **P3.** Set up welding machine accessories and consumables as per job requirements, welding procedure specifications and/or manufacturer instructions **P4.** Connect welding machine to an independent power supply **P5.** Set polarity indicated in the welding procedure specifications
CU2 . Make Fillet Weld on Carbon Steel Plate	**P1.** Adjust welding parameters (current, voltage, wire feed speed, welding speed etc.) as per welding procedure specifications/job requirements to produce acceptable weld **P2.** Maintain gap between electrode and base metal as per standard practices **P3.** Carry out welding in 1F position following standard procedures **P4.** Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
CU3. Make Groove Weld on Carbon Steel Plate	**P1.** Adjust welding parameters (current, voltage, wire feed speed, welding speed etc.) as per welding procedure specifications/job requirements to produce acceptable weld **P2.** Maintain gap between electrode and base metal as per standard practices **P3.** Carry out welding in 1G position following standard procedures **P4.** Deposit root pass as per welding procedure specifications/job requirements **P5.** Deposit filling passes as per welding procedure specifications/job requirements **P6.** Deposit capping pass as per welding procedure specifications/job requirements **P7.** Check root, filling and capping passes for any visual discontinuities as per acceptance standards

	P8.	Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects
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
	P5.	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. Identify and explain characteristics of ferrous material – carbon steel, stainless steel

K2. Explain various systems of measurements

K3. Explain basic principle of a mechanized and automated welding equipment

K4. Identify key components and explain features of the equipment used in SAW

- Define Power source
- Define Parameter setting
- Define Wire feed mechanism
- Define Flux dispensing unit

K5. Describe various welding processes including Submerged Arc Welding process

K6. State characteristics of an electric arc used for welding purposes

- Voltage distribution across the arc
- Alternating current (AC)
- Direct Current (DC)
- Effects and influence of magnetic fields

K7. Describe various weld features and related terminology

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

- Rood radius
- Land
- Bevel angle
- Included angle
- Weld width
- Leg length
- Fusion zone
- Excess weld metal
- Penetration
- Throat thickness

0715-M&MT-12. Perform Forged Welding

Overview: This competency standard covers the skills and knowledge required to Perform Pre Welding Operation in Forged Welding, Perform Forged Welding Using Lap Weld Technique and Perform Post Welding Operations in Forged Welding

Competency Units	Performance Criteria
CU1. Perform Pre Welding Operation in Forged Welding	**P1.** Identify welding requirements from the job, welding procedure specifications and/or technical drawings **P2.** Bevel the edges of both work pieces to overlap on each other **P3.** Remove any oil or grease if necessary
CU2 . Perform Forged Welding Using Lap Weld Technique	**P1.** Select coal or gas to fire hearth **P2.** Set temperature of hearth as per job material **P3.** Perform heating of work piece until it became red hot **P4.** Put both work piece on anvil **P5.** Use sledge hammer and stroke on work piece as per standard **P6.** Put work piece in water tank when both pieces join each other
CU3. Perform Post Welding Operations in Forged Welding	**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 **P5.** 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:

0715-M&MT-13. Perform Friction Welding

Overview: This competency standard covers the skills and knowledge required to Perform Inertia Friction Welding and Perform Linear Friction Welding.

Competency Units	Performance Criteria
CU1. Perform Inertia Friction Welding	**P1.** Prepare both work pieces for smooth square surface **P2.** Mount one piece on a rotor driven chuck **P3.** Mount other piece in stationary chuck **P4.** Set r.p.m to rotate mounted work piece

	P5. Apply a little pressure force on the stationary work piece **P6.** Apply high pressure force to the stationary work piece and force it toward rotating work piece to generates a high friction force **P7.** Apply the pressure until the plastic forming temperature is achieved. **P8.** Stop the rotor and apply pressure force increasingly until the whole weld is formed.

CU2. Perform Linear Friction Welding	**P1.** Prepare both work pieces for smooth square surface **P2.** Mount one piece on lateral motion chuck **P3.** Mount other piece in stationary chuck **P4.** Set oscillating speed of lateral motion chuck **P5.** Apply high pressure force to the stationary work piece and force it toward oscillating work piece to generates a high friction force **P6.** Apply the pressure until the plastic forming temperature is achieved. **P7.** Stop the rotor and apply pressure force increasingly until the whole weld is formed.

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:

0715-M&MT-14. Perform Soldering and Brazing Operations

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

Competency Units	Performance Criteria
CU1. 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
CU2 . 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

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 soldering
- **K2.** Describe sheet metal gauge
- **K3.** Explain disadvantages of soldering
- **K4.** Describe brazing
- **K5.** Define carburizing flame
- **K6.** Define neutral flame
- **K7.** Define oxidizing flame

Tool & 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

0715-M&MT-15. Non-Destructive Welding Tests

Overview: This competency standard covers the skills and knowledge required to Visual Inspection, X-Ray Test and Magna Flux Test

Competency Units	Performance Criteria
CU1. Visual Inspection	**P1.** Prepare weld joint as per standard **P2.** Check for cracks **P3.** Check for pits **P4.** Check for surface pores **P5.** Check for Under cut **P6.** Check for Missed joint
CU2 . X-Ray Test	**P1.** Prepare weld joint as per standard **P2.** Place work piece in x-ray machine **P3.** Set x-ray machine as per standard **P4.** Expose welded area to x-ray beam **P5.** Produce a negative film of welded area **P6.** Mark dark spots on negative film identifying defects
CU3. Magna Flux Test	**P1.** Prepare weld joint as per standard **P2.** Sprinkle very small iron particles on welded joint **P3.** Slide a magnet underneath the welded joint **P4.** Mark the area where iron particles are gathered

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 non-destructive tests
- **K2.** Describe advantages of non-destructive tests
- **K3.** Describe visual inspection
- **K4.** Describe x- ray welding
- **K5.** Explain wave length of x-rays
- **K6.** Explain difference between x-ray and gamma ray
- **K7.** Describe dis advantages of magna flux test
- **K8.** Describe applications of magna flux tests

Tool & Equipment

- ❖ Magnifying glass
- ❖ Vernier caliper

- x-ray machine

- Magnet

- Iron particles

0715-M&MT-16. Destructive Welding Tests

Overview: This competency standard covers the skills and knowledge required to tensile test and Impact Test

Competency Units	Performance Criteria
CU1. Tensile test	**P1.** Prepare weld joint as per standard **P2.** Place work piece on universal testing machine(UTM) **P3.** Mount work piece in jaws of UTM **P4.** Start UTM machine as per standard **P5.** Note ultimate tensile strength of welded joint **P6.** Note Poisson's ratio of welded joint
CU2 . Impact Test	**P1.** Prepare weld joint as per standard **P2.** Set machine for Izod test method a per standard **P3.** Prepare and Mount work piece for Izod test method as per standard **P4.** Strike the test piece with striker **P5.** Note test readings

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 destructive tests
- **K2.** Describe dis advantages of destructive tests
- **K3.** Explain tensile strength
- **K4.** Explain UTM machine
- **K5.** Explain difference between Charpy and Izod test method

Tool and Equipment

- UTM machine
- Hammer
- Scriber
- Vernier calliper
- Impact testing machine
- Hammer
- Scriber
- Vernier calliper

0715.2 Foundry & Casting

0715-M&MT-17. Preform Pattern Making

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. Make a pattern for a pipe casting	**P1.** Prepare layout by adding allowances (draft, machining, shrinkage, shaking) **P2.** Arrange a 60mm square deodar wood piece with 160 mm length. **P3.** Face outer end by holding wooden piece chuck. **P4.** Turn outer diameter 50mm with shrinkage allowance. **P5.** Turn outer diameter 25mm and into length 25mm for core print. **P6.** Repeat procedure by changing direction of pattern. **P7.** Prepare another core print diameter. **P8.** Remove pattern from lathe machine and mark parting line. **P9.** Cut the pattern and fit dowel pin holes. **P10.** Assemble the pattern symmetrically.
CU2. Practice of making a pattern, on CNC Router	**P1.** Prepare the drawing in CAD system keeping in view allowances for the job. **P2.** Arrange a wood block size 75 mm* 310 mm*310 mm and clamp it on the table of CNC router. **P3.** Send the drawing in CAM system. **P4.** Select the cutting tool as per material and operation. **P5.** Enter the raw material detail. **P6.** Check the tool off setting **P7.** See the simulation before starting the work. **P8.** Locate the pattern. **P9.** Press the push bottom to start the operation. **P10.** Pattern will be prepared as per drawing automatically. **P11.** Draw out pattern from fixture **P12.** Close the machine and check the dimensions of pattern as per drawing 70 300 300
CU3. Make a single piece pattern of any English word from a wood plate 1 x 4 x 7cm	**P1.** Prepare the drawing of word E in CAD system along with draft and machining allowance.

	P2. Send the drawing in CAM system. **P3.** Enter the raw material size in machine. **P4.** Select the engraving cutting tool **P5.** Check the simulation. **P6.** Get a rectangular plate of deoder wood and prepare it in 1 6 9cm size and hold the job in fixture at proper location on reference point on the table of CNC. **P7.** Press the start button to start the operation. **P8.** Check the tool off- setting. **P9.** Machine started engraving the word E on the wood plate **P10.** Remove the job from fixture after completion **P11.** Check the size of job along with draft and machining allowance. **P12.** Switch off the machine. **P13.** Check the dimension of pattern as per requirement.
CU4. Make two-piece patterns (step pulley) along with core prints shaped pattern	**P1.** Arrange deodar wood block 3 square and length 8. **P2.** Hold the job in machine chuck and lathe center. **P3.** Mount the turning tool on machine. **P4.** Turn the diameter as per drawing **P5.** After preparing the dia 70mm and 50 mm, turn the size of core prints as shown in fig. **P6.** Mark the parting line on pattern with the help of try square and pencil. **P7.** Hold the pattern in vice and cut it in longitudinally in two halves. **P8.** Mark the dowel holes and insert the dowel pins in one side of pattern **P9.** Again, hold in chuck and turn the accurate dia meter like 65mm, 45mm, and 25mm core print dia. **P10.** The pattern is ready as per drawing. **P11.** Polish the pattern with varnish and store it
CU5. Application of CNC Router for complex	**P1.** Prepare drawing in auto CAD considering the pattern allowances. **P2.** Send the drawing in CAM. **P3.** Feed the size of raw material along with nature of material **P4.** Select the cutting with respect to the radius and fillets **P5.** Observe the simulation for fool proofing **P6.** Switch on the CNC router **P7.** Check the tool off setting **P8.** Locate and clamp the work piece at proper location **P9.** Consider the tool compensation **P10.** Press the button to start the machine.

	P11. As the operation completes, the machine will stop. **P12.** Remove the pattern and check its dimension **P13.** 13 Remove the burr from the sharp corner. **P14.** Check the dimensions of pattern as per requirements

Knowledge & Understanding

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

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

Tools & Equipment

- Vernier caliper
- Deodar wood
- Hacksaw
- Tri square
- Steel tape
- Vernier caliper
- Wood work lath
- Chisels
- Wood work files

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

0715-M&MT-18. Perform Molding

Overview: This competency standard covers the skills and knowledge required to Basic moulding with two piece pattern, Practice of bedding in pit moulding method, Practice of moulding irregular pattern with CO2 process and Practice of moulding with three piece pattern by CO2 process.

Competency Units	Performance Criteria
CU1.Basic moulding with two piece pattern	**P1.** Prepare green sand by using sieve sand with riddle **P2.** Place pattern on molding plate form (without dowel) **P3.** Place drag part of the mould and ram moulding sand by jolt and squeezing head of rammer. **P4.** Roll over the drag part and strike off. Extra green sand. **P5.** Place other half of the pattern (with dowel) and match it. Place runner at appropriate place. **P6.** Create a parting line by pouring river sand on drag part. **P7.** Place cope part and sprue pin on runner. Add riddled moulding sand and ram it with jolt and squeezing head. **P8.** Strike off extra sand and make pouring basin. **P9.** Make vents for gas escaping with vent wire at appropriate place. **P10.** Remove cope part and make pouring gate with gate cutter. **P11.** Make cavity by drawing out pattern halves politely.
CU2. Practice of bedding in pit molding method.	**P1.** Dig a pit on floor. **P2.** Prepare coke bed by ramming moulding sand on it with jolt and squeezing end of rammer **P3.** Place vent pipes and then pattern and press it in sand. **P4.** Place the cope on pattern and place sprue pins on runner for gating system. **P5.** Fill coup with molding sand and ram it. **P6.** Pick up cope and draw pattern. **P7.** Prepare gate with gate cutter and repair mold cavity. **P8.** Place coup over the bed within locating pegs.
CU3. Practice of molding irregular pattern with CO2 process	**P1.** Riddle silica sand. **P2.** Mix sodium silicate in silica sand. **P3.** Put the drag part of the mould on molding board. **P4.** Place pattern on molding board in taper cutting. **P5.** Pour silicate molding sand in and ram it with jolt and squeezing end of rammer alternatively **P6.** Turn over the drag in and remove extra sand.

	P7. Place coup over drag and sprue pin and runner for gating system. **P8.** Fill molding sand and ram it. **P9.** Do the venting and pick up coup from drag. **P10.** Pick up coup part, draw out pattern and repair mold cavity. **P11.** Blow out dropped sand and pass CO2. **P12.** Assemble coup and drag and place it in casting area.
CU4. Practice of moulding with three piece pattern by CO2 process.	**P1.** Riddle silica sand. **P2.** Mix sodium silicate in silica sand. **P3.** Add adequate moisture in it. **P4.** Put the drag on molding board. **P5.** Place pattern on molding board in taper cutting. **P6.** Pour and sieve sodium silicate molding sand in and ram it with jolt and squeezing head of rammer. **P7.** Roll over the drag and expose pattern. **P8.** Ram sand around pattern and in corners. **P9.** Place cope over the check and through guide pins. **P10.** Place third part over middle part. **P11.** Fill molding sand and level off sand. **P12.** Perform venting and cut poring basin. **P13.** Pick up coup and check and draw pattern from check. **P14.** Pass CO2 and assemble mold, check and drag.

Knowledge & Understanding

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

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

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
- CO_2 cylinder
- Silica sand
- Molding tools
- Three piece pattern

0715-M&MT-19. 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. Practice of making 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. **P5.** Put core in oven for baking. **P6.** Draw out core from oven and core is ready.
CU2. Practice of making half core.	**P1.** Mix riddle sand with molasses as per required. **P2.** Get single piece 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.
CU3. Practice of baking and assembling half 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 and apply paste on one part of parting line and place it in fixture. **P5.** Place other half on it and give half an hour for drying. **P6.** Laminate small parting line for proper finish.

Knowledge & Understanding

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

K1. 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

0715-M&MT-20. Perform Foundry Work

Overview: This competency standard covers the skills and knowledge required to carry out Sand casting With Single Piece Pattern, Make English Letters (Alphabet), Make Paper Weight, Perform Casting for Hexagonal Pattern, Perform casting With Split Pattern, Cast Anvil, Cast Journal Bearing Body, Cast Pulley and Practice casting through shell moulding

Competency Units	Performance Criteria
CU1. Carryout Sand casting With Single Piece Pattern	**P1.** Prepare green sand **P2.** Place the drag on Moulding Board **P3.** Place the pattern in the drag **P4.** Pour sand in drag and perform ramming operation **P5.** Remove excessive sand from drag with strike of bar. **P6.** Flip the drag and sprinkle parting sand **P7.** Fit the cope on drag and place runner riser and sprue pin accordingly **P8.** Fill cope with green sand and perform ramming operation **P9.** Remove excessive sand from cope with strike of bar. **P10.** Perform venting as per standard and Produce the poring basin and draw out sprue pin. **P11.** Split cope and drag and extract pattern, runner and produce gating system. **P12.** Pre heat the mold after matching coup and drag to minimize moisture content. **P13.** ignite crucible furnace and start blower **P14.** Charge metal to be melt .After melting dross out slag by adding slag coagulants. **P15.** Pour molten metal with help of crucible and let it cool in the mold.
CU2. Make English Letters (Alphabet)	**P1.** Prepare green sand **P2.** Place the drag on Moulding Board **P3.** Place the alphabet ‘A’ pattern in the drag **P4.** Pour sand and perform ramming operation **P5.** Remove excessive sand from drag with strike of bar. **P6.** Flip the drag and sprinkle parting sand **P7.** Fix the cope on drag and place runner and riser accordingly **P8.** Fill cope with green sand and perform ramming operation **P9.** Remove excessive sand from cope **P10.** Perform venting as per standard and Produce the gates. **P11.** Split cope and drag and extract pattern

	P12. Remove moisture by preheating the mould. **P13.** Melt metal in the crucible to be pour. **P14.** Pour molten metal with help of crucible.
CU3. Make Paper Weight	P1. Prepare green sand P2. Place the drag on Moulding Board P3. Place the pattern of paper weight in drag part of the mould. P4. Pour sand and perform ramming operation P5. Remove excessive sand from drag P6. Flip the drag and sprinkle parting sand P7. Fix the cope on drag and place runner and riser accordingly P8. Fill cope with green sand and perform ramming operation P9. Remove excessive sand from cope with the help of strike of bar. P10. Perform venting as per standard and Produce the gating system. P11. Split cope and drag and extract pattern P12. Remove moisture content of coup and drag by preheating. P13. Charge molten metal to be melt in crucible. P14.dross out slag by adding slag coagulant with the help of skimmer. P15. Pour molten metal with help of crucible and let it cool.
CU4. Perform Casting for Hexagonal Pattern	P1. Prepare green sand P2. Place the drag on Moulding Board P3. Place the hexagonal pattern in drag P4. Pour sand and perform ramming operation P5. Remove excessive sand from drag with the help of strike of bar. P6. Flip the drag and sprinkle parting sand to create parting line between mould halves. P7. Match cope on drag and place runner and riser accordingly P8. Fill cope with green sand and perform ramming operation P9. Remove excessive sand from cope with the help of strike of bar. P10. Perform venting as per standard and Produce the gate under runner P11. Split cope and drag P12. Carefully extract pattern and repair Mould cavity if required. P13.Pour molten metal with help of crucible and let it cool.
CU5. Perform casting With Split Pattern	P1. Prepare green sand P2. Place the drag on Moulding Board P3. Place the pattern without dowel pin in the drag P4. Pour sand and perform ramming operation P5. Remove excessive sand from drag

	P6. Flip the drag and place the pattern with dowel pins on the pattern without dowel pins, and clamp them firmly P7. Fix the cope on drag and place runner and riser accordingly P8. Fill cope with green sand and perform ramming operation P9. Remove excessive sand from cope P10. Perform venting as per standard and Produce the gate under runner P11. Split cope and drag P12. Carefully extract pattern and repair cavity. P13. Pour molten metal with help of crucible and let it cool.
CU6. Cast Anvil	P1. Prepare molasses sand. P2. Place the drag on Moulding Board P3. Place the Anvil shaped pattern in the drag as per drawing P4. Pour sand and perform ramming operation P5. Remove excessive sand from drag P6. Flip the drag and sprinkle parting sand P7. Fix the cope on drag and place runner and riser accordingly P8. Fill cope with green sand and perform ramming operation P9. Remove excessive sand from cope P10. Perform venting as per standard and Produce the gate under runner P11. Split cope and drag P12. Carefully extract pattern and repair Mould cavities. P13.Preheat the mould. P14.Melt molten metal in crucible. P15.Dross out slag with the help of skimmer by adding slag coagulants. P16. Pour molten metal from crucible into mould.
CU7. Cast Journal Bearing Body	P1. Prepare green sand P2. Place the drag on Moulding Board P3. Place the split pattern of journal bearing in the drag as per drawing P4. Pour sand and perform ramming operation P5. Remove excessive sand from drag with the help of strike of bar. P6. Flip the drag and sprinkle parting sand P7. Fix the cope on drag and place runner, sprue pin and riser accordingly P8. Fill cope with green sand and perform ramming operation P9. Remove excessive sand from cope P10. Perform venting as per standard and Produce pouring basin. P11. Split cope and drag and produce gating system. P12. Carefully extract pattern and repair Mould cavities.

	P13.Preheat the mould to remove moisture content before pouring. P14.Melt metal to be pour in crucible P15.Dross out slag by adding slag coagulants with the help of skimmer. P16.Pour molten metal into the mould from crucible and let it cool.
CU8. Cast Pulley	P1. Prepare molasses sand. P2. Place the drag on Moulding Board P3. Place the pulley shaped pattern in the drag as per drawing P4. Pour sand and perform ramming operation P5. Remove excessive sand from drag. P6. Flip the drag and sprinkle parting sand P7. Fix the cope on drag and place runner and riser accordingly P8. Fill cope with molasses sand and perform ramming operation P9. Remove excessive sand from cope P10. Perform venting as per standard and Produce the gate under runner P11. Split cope and drag P12. Carefully extract pattern and repair Mould cavties if required. P13.Give curing time to mould. P14 charge metal to be melt in crucible and melt it. **P15**.skim off slag from surface of the molten metal and Pour it into the mold from crucible.
CU9.Practice casting through shell molding	**P1**. Prepare sand mixed thermosetting binder. **P2.** Pour this sand into a mould **P3.** Firmly clamp heated match plate pattern on the molding box. **P4.** Invert or roll over the mold box containing sand mixed with thermosetting material. **P5.** Reposition the moulding box so that all loose sand fell down and form a hard shell after curing. **P6.** Heat sand shell for a few minutes in oven for the purpose of complete curing. **P7.** Stripped shell mould from the pattern. **P8.** Assemble or match two halves of the shell mould and support them by metal shots and pouring sand into a box. **P9.** Pour molten metal into the cavity.

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. Knowledge of Moulding tools

K2. Types of sand used according to casting.

K3. Describe Types of mould

K4. Casting processes.

K5. Describe Slag coagulants and their types.

K6. Explain cope and drag

K7. Define reaming

K8. Define tempering

K9. Describe riddling

K10. Describe venting

K11. Define gating

K12. Define shell moulding.

K13. Describe types of binders

K14. Advantages and disadvantages of shell moulding.

K15. Describe preheating ovens

Tools and Equipment

- Moulding board
- Moulding box
- Shovel
- Riddle
- Rammer
- Trowels
- Slicks
- Strike off bar
- Swab
- Vent wire
- Sprue pin
- Sprue cutter
- Draw spike
- Gate cutter
- Wooden pattern
- ‘A’ shaped pattern
- Paper weight rectangular pattern
- Hexagonal pattern
- Split piece pattern (Bush)
- Skimmer.
- Journal Bearing split pattern

0715-M&MT-21. Perform casting

Overview: This competency standard covers the skills and knowledge required to Practice use of optical pyro metre, Practice of complete operation of cupola furnace and Practice of casting of nonferrous metal

Competency Units	Performance Criteria
CU1. Practice use of optical pyrometre	**P1.** Focus optical pyrometer on molten cast iron. **P2.** Fit red filter between eye and filament and absorption screen between objective lens and filament. **P3.** Install rheostat and measure value of current. **P4.** Note the reading of pyrometer
CU2. Practice of complete operation of cupola furnace	**P1.** Repair refractory lining of tap hole and slag hole of furnace. **P2.** Prepare sand be sand close bottom door. **P3.** Pour soft wood inside cupola and light it up. **P4.** Add coke from coke bed charge. **P5.** Pour iron charge plus limestone. **P6.** Fill cupola by Adding coke layer then metal layer turn by turn. **P7.** Start air blast when droplets of metal start tickling down through coke opening and from tap hole. **P8.** Stop the air and again start air blast and receive molten metal. **P9.** Open tap hole after some time to receive molten metal. **P10.** Repeat tapping after regular interval. **P11.** Stop to charge further melting is finished. **P12.** Pour metal in moulds and wait for solidification. **P13.** Break up mould and clean casting.
CU3. Practice of casting of non ferrous metal	**P1.** Place crucible with 10kg aluminium in crucible pit furnace. **P2.** Open gas and light spark and run blower. **P3.** Pick out crucible after proper melting. **P4.** Skim off slag and pour molten metal in the mould. **P5.** Breakup mould and clean casting after cooling of casting.

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 Optical pyrometer and its use

K2. Define Advantages of pyrometer

K1. Describe Cupola furnace and how to prepare cupola for melting.

K2. Elaborate Charge of cupola

K3. Preparation of cupola lining

K4. Define Tapping process of cupola furnace.

K5. Describe operation of Crucible furnace

K6. Elaborate properties of Aluminum and its alloys

K7. Define Drossing

K8. Describe chemical reaction in melting of aluminum melting**.**

Tools & Equipment

- Optical pyrometer
- Battery
- Molten cast iron
- Ammeter
- Cupola furnace with all accessories
- Ladles
- Tongue
- Bot stick
- Bolt clay
- Pig iron
- Mold
- Coke
- Calcium carbonate
- Crucible pit furnace
- Crucible
- Pick up tongs
- Mold
- Natural gas
- Goggles

0715-M&MT-22. Perform Cleaning and Finishing Of Casting

Overview: This competency standard covers the skills and knowledge required to Cleaning and finishing of casting by hand with hand hacksaw, steel wire brush, hammer and chisel, Cleaning and finishing of casting by sand blasting and hand grinding and Cleaning and finishing by tumbling barrel machine.

Competency Units	Performance Criteria
CU1. Cleaning and finishing of casting	**P1.** Brake mold and pick aluminum casting. **P2.** Remove sand and cut sprue runner and riser with hand hacksaw. **P3.** Hold casting in vice and remove projected part by cape chisel and hammer and apply wire brush. **P4.** Remove all fins and casting is ready.
CU2. Cleaning and finishing of casting by sand blasting and hand grinding.	**P1.** Place cast iron component in sand blasting machine. **P2.** Hold sand blasting gun and direct stream towards casting. **P3.** Apply on the surface and change direction. **P4.** Bring the casting out after all surface is cleaned. **P5.** Clean excessive parts by hand grinder after holding it in vice. **P6.** Component is finished now.
CU3. Cleaning and finishing by tumbling barrel machine.	**P1.** Charge the cast component by opening hole of drum. **P2.** Close drum after charging. **P3.** Run machine at 20 rpm and carry out this for 45 min. **P4.** Stop machine and open charging hole. **P5.** Drop cast component on ground before other cleaning operations.

Knowledge & Understanding

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

- **K1.** Describe tools used for cleaning of casting.
- **K2.** Define sand blasting and its procedure.
- **K3.** Describe use of hand grinder.
- **K4.** Describe properties of sand blasting
- **K5.** Describe operation of tumbling barrel machine
- **K6.** Describe Hydro-blasting
- **K7.** Define of pickling process
- **K8.** Elaborate Fettling operation.

Tools & Equipment

- Mold with casting

- Wire brush
- Chisel
- Hammer
- Vice
- file
- Hand grinder
- Sand blasting
- Tumbling barrel machine
- Star shaped cast iron
- Wrench

0715-M&MT-23. Perform Sand Testing

Overview: This competency standard covers the skills and knowledge required to Moisture contents of molding sand, Clay contents test of molding sand, Permeability number test for molding sand, Green compressive strength test of molding sand and testing fineness number of various sand samples

Competency Units	Performance Criteria
CU1. Moisture contents of molding sand	**P1.** Prepare sand and take some sample and weight it. **P2.** Put the pan in electric drying oven and dry at 105 degree. **P3.** Reweight sample and note difference. **P4.** Calculate percentage of moisture.
CU2. Clay contents test of molding sand	**P1.** Take sample of 50-gram dry sand and put sample in AFS clay jar. **P2.** Add 475 cc distilled water and 20cc 3% solution of NAOH and stir it. **P3.** Wash sand on stirrer and fill jar up to 6 inch and allow it to settle down. **P4.** Siphon off upper 5-inch water and again add distilled water upto 6 inch. **P5.** Siphon off upper 5 inch and repeat practice until water is clear to depth of 5 inch. **P6.** Remove sand grains from jar, dry and weigh. Difference between dried weight and original weight multiplied by 2 give clay %
CU3. Permeability number test for molding sand	**P1.** Prepare permeability meter and install ram tube with molding sand specimen. **P2.** Place ram tube on tapered nose piece and fill outer cylinder with water. **P3.** Install a bell and allowed to sink by its own weight by multi position cock. **P4.** Record permeability number when air escapes through nozzle by sand specimen. **P5.** Calculate permeability number by formula.
CU4. Green compressive strength test of molding sand	**P1.** Pour 50 mm sample in ram tube and give three blows of ram rod. **P2.** Remove specimen from ram tube with pusher rod. **P3.** Place specimen in compressive strength tester. **P4.** Apply load by turning hand wheel. **P5.** Record reading when specimen fail. **P6.** Calculate compressive strength by formula.
CU5. Testing fineness number of various sand samples	**P1.** Prepare sample of 50 gram dried molding sand. **P2.** Arrange 11 sieves in specific order. **P3.** Pour dried sand on top sieve and shake it for 15 min. **P4.** Collect portion from each sieve and weight and calculate percentage. **P5.** Calculate multiplier factor and add all multiplications and divide by sum of total percentages. The number obtained is fineness number.

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 testing of foundry sand
- **K2.** Define Properties of green sand.
- **K3.** Describe quality of moulding sand
- **K4.** Define AFS in sand
- **K5.** Define Permeability of sand
- **K6.** AFS standard permeability meter
- **K7.** Describe Parts of permeability meter.
- **K8.** Knowledge of compressive strength tester
- **K9.** Types of strength test
- **K10.** How to prepare specimen for compression test
- **K11.** Describe sieve analysis of green sand.
- **K12.** Purpose of coal dust in moulding sand

Tools & Equipment

- Digital balance
- Moisture drying oven
- Sample pan
- AFS graduated clay jar
- Thermometer
- Sodium hydroxide
- Stirrer
- Oven
- Permeability meter
- Standard specimen
- Calculator
- Molding sand
- Sand rammer
- Compressive strength tester
- Green sand
- Sieves of different sizes
- Balance

0715.3 Basic Machining

0715-M&MT-24. Perform Metal/Bench Work

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

Competency Units	Performance Criteria
CU1. Develop Name Plate manually	**P1.** Select marking tools **P2.** Hold the sheet in vice. **P3.** Cut sheet as per drawing **P4.** Perform surface finishing with file **P5.** Level the surface with tri-square **P6.** Mark the plate as per name requirements **P7.** Punch the marked area **P8.** Perform finishing with sand paper
CU2. Prepare Dovetail Joint	**P1**. Select marking tools **P2**. Cut sheet as per drawing **P3**. Perform surface finishing with file **P4**. Level the surface of both work pieces with tri-square **P5**. Mark both work pieces according to drawing **P6**. Create outer notch on work piece using flat file and hacksaw **P7**. Create inner notch using hacksaw and chisel **P8**. Compare both pieces by inserting outer notch into inner notch **P9**. Perform finishing with sand paper
CU3. Prepare Bottle Opener	**P1**. Select marking tools **P2**. Cut sheet as per drawing **P3**. Perform surface finishing with file **P4**. Level the surface with tri-square **P5**. Mark radius as per drawing **P6**. Develop radius as per drawing **P7**. Make the notch with round file **P8**. . Perform finishing with sand paper
CU4. Cut Threads on Work Piece with tap and die	**P1**.Identify different kind of taps & die according to requirement **P2**. Identify the work piece clamping method. **P3**. Apply tap and die alignment.

	P4. Apply lubricants while threading. **P5**. Avoid unwanted engraving and slips. **P6**. Identify proper threading procedure
CU5. Cut Pipe Threads	**P1**.Select marking tools **P2**. Cut pipe as per drawing **P3**. Select die as per pipe size **P5**. Set die into die holder **P6**. Select relevant vice for pipe clamping **P7**. Perform pipe threading using appropriate method **P8**. Perform finishing with sand paper
CU6. Prepare spanner (small size)	**P1**.Select marking tools **P2**. Cut sheet as per drawing **P3**. Perform surface finishing with file **P4**. Level the surface with tri-square **P5**. Mark radius as per drawing **P6**. Develop radius as per drawing **P7**. Make the notch with round file **P8**. Perform finishing with sand paper
CU7. Prepare Funnel	**P1**. Select marking tools **P2**. Cut sheet as per drawing **P3**. Perform surface finishing with file **P5**. Mark the sheet according to drawing **P6**. Cut the sheet with hand shear **P7**. Create radius of funnel using appropriate tools **P8**. Perform flat lock seam bend using bench vice **P9**.Perform finishing with sand paper.

Knowledge & Understanding

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

- **K1.** Define basic measurement
- **K2.** Describe basic measuring /Marking /cutting tools
- **K3.** Describe clamping/holding methods.
- **K4.** Describe types of chisels
- **K5.** Understanding of chiseling process
- **K6.** Understanding of types of fits.
- **K7.** Knowledge of radius gauge
- **K8.** Describe use of round file
- **K9.** Knowledge of different kind of taps & die according to requirement

K10. Knowledge of calculation for drill size for internal threading

K11. Knowledge about clamping of work piece.

K12. Knowledge about threading by die and taps

K13. Knowledge of standard bolts

K14. Understanding proper use of hand shear

K15. knowledge of flat lock seam end in metal sheet working

Tool & Equipment

- Work bench
- Bench vices
- Hammer
- Tri-square
- Hand hacksaw
- Scriber
- Vernier caliper
- Flat File
- Number/alphabet punch
- Round file
- Metal working chisel
- Punching tools
- Tap set
- Tap handle
- Pipe vice

0715-M&MT-25. Demonstrate general machining

Overview: This competency standard covers the skills and knowledge required to determine job requirements and sequence of operations, Select and mount tools, perform machining operations and Measure components, Adjust and maintain machine

Competency Units	Performance Criteria
CU1. Determine job requirements and sequence of operations	P1. Interpret and understand drawings, instructions and specifications. P2. Determine sequence of operations including job specifications and set-up for maximum efficiency P3. Select appropriate material and establish datum as required
CU2. Select and mount tools	P1. Appropriate tools for job are selected, sharpened and shaped as required. P2. Tools are mounted and positioned correctly
CU3. Perform machining operations	P1. Basic marking out techniques are used where required P2. Machining parameters are set for job requirements and maximum tool life. P3. Work is held or correctly clamped without damage to product, and all safety requirements are met. P4. Machining is performed in a safe manner utilizing all guards, safety procedures and personal protective clothing and equipment
CU4. Measure components, Adjust and maintain machine	P1. Use appropriate instruments or gauges to check components are compliant with measurement requirements and specifications. P2. Carry out routine maintenance and adjustments as required including slide and collar adjustment, cleaning and lubrication

Knowledge & Understanding

- **K1.** Describe basic measurement
- **K2.** Describe basic measuring /Marking /cutting tools
- **K3.** Describe clamping/holding methods
- **K4.** Define Machine shop tool their working and safety procedure during work.
- **K5.** Describe the safety procedure using marking tools.
- **K6.** Describe Proper Usage of Measuring Tools
- **K7.** Describe machine types according to their work and rotation.
- **K8.** Describe maintenance and its types.
- **K9.** Describe the safety procedure during maintenance.

Tool &Equipment

Measuring tools
Marking tools
Work holding devices
Cutting tools
Machine tools
Gauges
Set of spanners
Set of Allen keys

0715-M&MT-26. Perform cutting on Metal Circular/Power Heck 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. Carry out Sawing	**P1**.Mark the job according to given drawing **P2**. Select appropriate blade according to job requirement **P3**. Set blade in frame of hacksaw as per procedure **P4**. Ensure the work piece is clamped firmly and properly **P5**. Adopt methods and techniques for sawing that is appropriate to job requirement **P6**. Follow marked line during sawing to ensure accuracy.
CU2. Carry out Sawing at differet angles	**P1.** Mark the job according to given drawing **P2.** Select appropriate blade according to job requirement **P3.** Set blade in frame of metal circular saw as per procedure. **P4.** Ensure the blade tightness and rotating side. **P5.** Ensure the work piece is clamped firmly and properly **P6.** Adopt methods and techniques for sawing that is appropriate to job requirement **P7.** Follow marked line during sawing to ensure accuracy.

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

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

0715-M&MT-27. 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
- Wheel Dresser stand
- Dresser

0715-M&MT-28. 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
CU1. Perform centering operations	P1. Select facing tools according to job requirement.

	P2. Mount and set the required work-holding devices, work piece and cutting tools. P3. Follow the correct specifications for the part or component to be produced. P4. Select safe procedures and tools to accomplish the work. P5. Adjust the operating parameters (e.g. speed and feed) of machine tool for centering the job. P6. Ensure all safety mechanisms are in place.
CU2. Perform facing Operations	P1. Select facing tools according to job requirement. P2. Mount and set the required work-holding devices, work piece and cutting tools. P3. Follow the correct specifications for the part or component to be produced. P4. Select safe procedures and tools to accomplish the work. P5. Adjust the operating parameters (e.g. speed and feed) of machine tool to achieve the work specification. P6. Ensure all safety mechanisms are in place.
CU3. Perform turning operations	**P1**. Obtain and follow work specifications, drawings or sketches to accomplish the work. P2. Set up and adjust the machine as per work specifications and procedures. P3. Ensure the components produced have the required quality and within the specified dimensional accuracy. P4. Shut down the machine and equipment on conclusion of the machining activities.
CU4. Perform drilling or boring operations	**P1**. Select drill or boring tools according to drawings. P2. Mount and set the required work-holding devices, work piece and cutting tools. P3. Adjust the RPM of machine according to the cutting speed. P4. Perform the boring operation according to the drawing. P5. Check quality of the component produced at different intervals. P6. Observe personal and workplace safety.
CU5. Perform step turning operations	**P1**. Mount and set the required work-holding devices, work piece and cutting tools. P2. Select and adjust appropriate speeds and feeds of turning machine. P3. Produce a component which matches the work specifications using appropriate methods and techniques.

	P4. Check quality of the component produced at different intervals. P5. Follow safety precautions to ensure safe work and to avoid any injury.
CU6. Perform knurling Operations	P1.Select the knurling tool according to drawing. P2. Set the tool and work piece in the machine according to procedure. P3. Adapt methods and techniques to produce proper knurling on work piece. P4. Select and adjust appropriate speeds and feeds of lathe machine. Use coolants during knurling to achieve smooth impression on work piece. P6. Observe personal and workplace safety.
CU7. Taper turning by tail stock off-set method	**P1.** Loosen tailstock clamp out. **P2.** Offset tailstock required amount. **P3.** Centre cutting tool. **P4.** Setup cutting tool for parallel turning. **P5.** Starting at small diameter take excessive cuts until the taper is .05 to .06 in oversize. **P6.** Check taper for accuracy using a taper ring gauge. **P7.** Finish turn the taper to size and fit required.
CU8. Taper turning by plain taper turning attachment	**P1.** Remove the binding screw that cross slide to cross feed screw nut. **P2.** Tighten the lock screw and set cutting tool on center. **P3.** Set workpiece in lathe and mark length of taper. **P4.** Use binding screw to connect sliding block to side of taper attachment. **P5.** Select depth of feed cut by compound rest feed handle. **P6.** Take a light cut and recheck taper fit. **P7.** Finish turn and fit the taper to gauge.
CU9. Taper turning by telescopic taper turning attachment	**P1.** Clean and oil the guide bar. **P2.** Loose lock screws and offset end of guide bar, **P3.** Set the bar to required taper in degrees. **P4.** Tighten the lock screw and set cutting tool on center. **P5.** Set workpiece in lathe and mark length of taper and tighten connecting screw on sliding block. **P6.** Move carriage until center of attachment is opposite to length of taper. **P7.** Lock anchor bracket to lathe bed. **P8.** Take a cut and select depth of cut. **P8.** Readjust the taper attachment, Take a light cut and recheck taper fit. **P9.** Finish turn and fit the taper to gauge.
CU10. Perform Internal and External threading Operations	**P1**. Mount and set the required work-holding devices, work piece and cutting tools. P2. Select and adjust appropriate speeds and feeds of turning machine.

	P3. Produce a component which matches the work specifications using appropriate methods and techniques. P4. Check quality of the component produced at different intervals. P3.Use Proper cutting tool with required dimensions. P5. Follow safety precautions to ensure safe work and to avoid any injury.

Knowledge & Understanding

- **K1.** Safety precautions involved in work.
- **K2.** Methods and techniques of mounting and setting of work-piece.
- **K3.** Methods and techniques of adjusting operating parameters of machine tool.
- **K4.** Procedure of adjusting speed and feed.
- **K5.** Calculation of speed and feed.
- **K6.** Use of holding and cutting tools
- **K7.** Reading and interpreting work specifications, drawings and sketches.
- **K8.** Method and technique of setting up and adjusting the machine.
- **K9.** Techniques to check quality of component produced.
- **K10.** Procedure of shutting down of machine and equipment after closure of activities.
- **K11.** Safety precautions and procedures need to be observed during work.
- **K12.** Types of drilling or boring tools and their function.
- **K13.** Procedure of mounting and setting up of work-holding devices, work pieces and cutting tools.
- **K14.** Method and technique of adjusting RPM of lathe machine.
- **K15.** Safe boring procedures.
- **K16.** Techniques of checking quality of components.
- **K17.** Calculation of RPM.
- **K18.** Safety precautions and procedures.
- **K19.** Kinds of tapers.
- **K20.** Types of taper turning methods.
- **K21.** Calculation of tapers.
- **K22.** Methods and techniques of adjusting speeds and feeds of turning machine.
- **K23.** Method of checking quality of components produced.
- **K24.** Specific safety guidelines and precautions.
- **K25.** Types of knurling tools.
- **K26.** Types of knurling.
- **K27.** Procedure of setting tools and work piece in the machine.
- **K28.** Methods of knurling.
- **K29.** Procedure of adjusting speeds and feeds of lathe machine. Importance of using coolants during knurling.
- **K30.** Safety precautions and guidelines.
- **K31.** Knowledge of lathe operations
- **K32.** Use of dial indicator
- **K33.** Calculations for taper turnings
- **K34.** Knowledge of lathe operations
- **K35.** Types of threading tool.
- **K36.** Types of threading.
- **K37.** Procedure of setting tools and work piece in the machine.
- **K38.** Methods of threading.

Tool & Equipment

- Lathe Machine
- Cutting Tools
- Measuring Tools
- Personal Protective Equipment
- Files

- Vernier Caliper

- Checking gauges

- Threading Tools

0715-M&MT-29. Perform Drilling Machine Operations

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

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

Knowledge & Understanding

- **K1.** Safety precautions.
- **K2.** Procedure of setting up of drilling machine.
- **K3.** Safe procedure for operating drilling machines.
- **K4.** Types of drilling machines.
- **K5.** Selecting and adjusting speed and feed of drilling machine.
- **K6.** Importance of coolants in drilling operations.
- **K7.** Methods and techniques of quality checks.
- **K8.** Different types of drilling tools and their implications.
- **K9.** Importance of selecting right drilling tool for the job specifications.

K10. Methods and techniques for positioning the work-piece in the drill to ensure proper alignment and stability during drilling.

K11. Using speeds and feeds chart for different types of materials and their hardness.

K12. Specific safety precautions during boring and sinking operations.

K13. Safety precautions.

K14. Selecting reamer according to hole size.

K15. Types of reamers (straight teeth or helical teeth).

K16. Method of setting reamer in the drill chuck.

K17. Importance of using lubricants during reaming.

K18. Importance of alignment of the reamer during operations.

Tool & Equipment

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

0715-M&MT-30. Perform Shaper, Planar and Slotter Machining Operations

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

Competency Units	Performance Criteria
CU1. Produce a squared shape work piece	P1. Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident. P2. Dial the machine vice according to job requirement. P3. Select point cutting tool and set machine as per requirements. P4. Mount cutting tool and work piece in the machine. P5. Check quality of the component at suitable intervals. P6. Shut down the machine at safe position after finishing the work.
CU2. Produce V shaped work piece	P1. Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident. P2. Dial the machine vice according to job requirement. P3. Select point cutting tool and set machine according to job requirements. P4. Mount cutting tool and work piece in the machine. P5. Check quality of the component at suitable intervals. P6. Shut down the machine in safe position after finishing the work
CU3. Machining a Rack Gear	P1. Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident. P2. Dial the machine vice according to job requirement. P3. Select point cutting tool and set machine according to job requirements. P4. Mount cutting tool and work piece in the machine. P5. Set the job/Tool Movement According to specified speed P6. Check quality of the component at suitable intervals. P7. Shut down the machine in safe position after finishing the work
CU4. T-slot Machining	P1. Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident. P2. Dial the machine vice according to job requirement. P3. Select point cutting tool and set machine according to job requirements. P4. Mount cutting tool and work piece in the machine. P5. Check quality of the component at suitable intervals. P6. Shut down the machine in safe position after finishing the work
CU5. Machining Irregular	P1. Identify safety hazards related with shaping operations and take

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

Knowledge & Understanding

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

Tool & Equipment

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

- Bevel protector

0715-M&MT-31. 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. Prepare Blank for Generating the Gear	**P1**. Interpret drawing and arrange the material according to job requirement P2. Prepare the work-piece by required machining (sawing and filing etc.) and get it ready for turning the blank P3. Check and verify the dimensions of blank for generating gear as per drawing
CU2. Select Tools and Equipment for Gear Cutting	P1. Select the material, type, shape and size of cutter(s) according to the job requirements P2. Arrange the measuring instruments and holding devices to attain accuracy of the work as per prescribed method
CU3. Produce a square shaped work piece	P1. Identify safety hazards related with milling operations and take appropriate steps to avoid any injury or accident. P2. Dial the machine vice according to job requirement. P3. Select cutters and set machine as per requirements. P4. Mount cutters and work piece in the machine. P5. Produce a part matching the process plan and the part print specifications. P6. Check quality of the component at suitable intervals. P7. Shut down the machine at safe position after finishing the work.
CU4. Generate spur gear (Direct Indexing) On Milling Machine.	**P1.** Select gear cutter and indexing plate on a milling machine **P2.** Mount indexing plate on indexing head. **P3.** Centre indexing head and its tail stock. **P4.** Fix indexing head and tail stock on milling table. **P5.** ENGAGE worm shaft from worm wheel **P6.** Adjust speed feed and direction of the cutter. **P7.** Mount Gear blank on mandrel. **P8.** Hold one side of mandrel on chuck of indexing head and other side in tail stock

	P9. Start machine and carry out cutter at zero point vertically. **P10.** Carry out cutter at zero point horizontally. **P11.** Apply depth for rough cut and engage machine automatically in longitudinal direction **P12.** Move table back at zero point. **P13.** Apply full depth for final cut and engage machine automatically in forward direction. **P14.** Repeat the process simultaneously until tooth is obtained.
CU5. Generate spur gear (Differential Indexing) On Milling Machine.	**P1.** Select gear cutter and indexing plate on a milling machine **P2.** Mount indexing plate on indexing head. **P3.** Centre indexing head and its tail stock. **P4.** Fix indexing head and tail stock on milling table. **P5.** Revolve index plate forward or backward part of turn while index crank turn to proper spacing **P6.** Choose the number close to required division that can be indexed by simple indexing **P7.** Adjust speed feed and direction of the cutter. **P8.** Mount Gear blank on mandrel. **P9.** Hold one side of mandrel on chuck of indexing head and other side in tail stock **P10.** Start machine and carry out cutter at zero point vertically. **P11.** Carry out cutter at zero point horizontally. **P12.** Apply depth for rough cut and engage machine automatically in longitudinal direction **P13.** Move table back at zero point. **P14.** Apply full depth for final cut and engage machine automatically in forward direction. **P15.** Repeat the process simultaneously until tooth is obtained.
CU6. Generate Helical Gear On Milling Machine	**P1.** P1.Select a indexing plate to machine a helical gear on a manual machine, **P2.** Mount gear set to engage lead screw and indexing head spindle **P3.** Centre indexing head and its tail stock. **P4.** Fix indexing head and tail stock on milling table. **P5.** Adjust speed feed and direction of the cutter. **P6.** Mount Gear blank on mandrel. **P7.** Hold one side of mandrel on chuck of indexing head and other side in tail stock **P8.** Start machine and carry out cutter at zero point vertically.

	P9. Carry out cutter at zero point horizontally. **P10.** Apply depth for rough cut and engage machine automatically in longitudinal direction **P11.** Move table back at zero point. **P12.** Apply full depth for final cut and engage machine automatically in forward direction. **P13.** Repeat the process simultaneously until tooth is obtained.
CU7. Perform slotting or grooving on work piece	P1. Identify safety hazards related with milling operations and take appropriate steps to avoid any injury or accident. P2. Set the work piece in machine vice according to procedure. P3. Select the appropriate cutter as per specifications. P4. Adjust the milling cutter for slotting and grooving. P5. Determine the touching point of the work piece. P6. Produce slotting or grooving on the workpiece to the required quality. P7. Check quality of the component at suitable intervals. P8. Shut down the machine at safe position after finishing the work. P9. Observe personal and workplace safety at all time.
CU8. Perform drilling or boring using milling machine	P1. Identify safety hazards related with milling operations and take appropriate steps to avoid any injury or accident. P2. Select drill or boring tools according to drawings. P3. Mount and set the required work-holding devices, work piece and cutting tools. P4. Adjust the RPM of machine according to the standard chart. P5. Perform the boring operation according to the drawing. P6. Check quality of the component produced at different intervals. P7. Shut down the machine at safe position after finishing the work. P8. Observe personal and workplace safety at all time.
CU9. Milling a T slot	**P1.** Layout position of a T slot. **P2.** Square vertical milling machine with machine table. **P3.** Mount work in milling machine. **P4.** Machine the center slot to proper depth of T slot by end mill. **P5.** Remove end mill and mount proper t slot cutter. **P6.** Machine lower part of the slot.
CU10.Bevel gear cutting on milling machine.	**P1.** Cut The materials to size **P2.** Cut workpiece with lathe that is shaped into a gear blank. **P3.** Cut gear with a Coniflex generator. **P4.** Remove Burrs on the teeth with a deburring machine.

CU11. Practice of spur rack cutting.	**P1.** Hold the work piece in milling machine. **P2.** Hold milling cutter in rack milling attachment. **P3.** Hold cutter at 90 degree for spur cutting. **P4.** Move the table for each tooth by rack indexing attachment. **P5.** Continue operation until required length is obtained.
CU11. Practice of helical rack cutting	**P1.** Hold the work piece in milling machine. **P2.** Hold milling cutter in rack milling attachment. **P3.** Hold cutter at some angle for helical cutting. **P4.** Move the table for each tooth by rack indexing attachment. Continue operation until required length is obtained.

Knowledge & Understanding

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

Tools & Equipment

- Measuring and Marking Tools
- Surface Table
- Machine Vice
- Tri square
- Vernier Caliper

- Dial indicator with magnet stand
- Milling cutters
- Personal Protective Equipment
- Milling machine and its accessories
- Slotting cutter
- Depth gauge
- End mil cutter
- Boring unit
- Boring tools
- Drill
- Internal Micrometer

0715-M&MT-32. Generate Gears on Hobbing Machine

Overview: This competency standard covers the skills and knowledge required to Prepare Blank for Generating the Gear, Select Tools and Equipment for Gear Cutting, Set Hobbing Machine for Operations, Carry out Hobbing Operations for spur Gear Generating and Carry out Hobbing Operations for Helical Gear Generating

Competency Units	Performance Criteria
CU1. Prepare Blank for Generating the Gear	**P1**. Interpret drawing and arrange the material according to job requirement P2. Prepare the work-piece by required machining (sawing and filing etc.) and get it ready for turning the blank P3. Check and verify the dimensions of blank for generating gear as per drawing
CU2. Select Tools and Equipment for Gear Cutting	P1. Select the material, type, shape and size of cutter(s) according to the job requirements P2. Arrange the measuring instruments and holding devices to attain accuracy of the work as per prescribed method
CU3. Set Hobbing Machine for Operations	P1. Clamp the gear blank and hob cutter into their holding devices as per standard practice P2. Maintain safe distance between gear blank and hub cutter as per prescribed method P3. Adjust the revolution per minute (rpm) of hob cutter and table according to the specifications of work-piece P4. Adjust the parameters of speed and feed from control unit as per prescribed method
CU4. Carry out Hobbing Operations for spur Gear Generating	P1. Produce simple/angled/differential indexing and divide the gear into required number of divisions P2. Check the hob cutter and the gear blank that both are positioned properly and adjust them, if required P3. Adjust speed feed and direction of the cutter. P4.Mount Gear blank on mandrel. P5.Hold one side of mandrel on chuck of indexing head and other side in tail stock P6.Start machine and carry out cutter at zero point vertically. P7.Carry out cutter at zero point horizontally. P8.Apply depth for rough cut and engage machine automatically in longitudinal direction

	P9.Move table back at zero point. P10.Apply full depth for final cut and engage machine automatically in forward direction. P11.Repeat the process simultaneously until tooth is obtained.

CU5. Carry out Hobbing Operations for Helical Gear Generating	P1.Check the hob cutter and the gear blank that both are positioned properly and adjust them, if required P2.Fix indexing head and tail stock on milling table. P3.Adjust speed feed and direction of the cutter. P4.Mount Gear blank on mandrel P5.Hold one side of mandrel on chuck of indexing head and other side in tail stock P6.Start machine and carry out cutter at zero point vertically. P7.Carry out cutter at zero point horizontally. P8.Apply depth for rough cut and engage machine automatically in longitudinal direction P9.Move table back at zero point. P10.Apply full depth for final cut and engage machine automatically in forward direction. P11.Repeat the process simultaneously until tooth is obtained

Knowledge & Understanding

K1. Spur gear design

K2. Hobbing machine operations

K3. HELICAL gear design

Tool &Equipment

- Measuring and Marking Tools
- Surface Table
- hobbing machine and its accessories
- Hobbing machine

0715-M&MT-33. Perform broaching operation

Overview: This competency standard covers the skills and knowledge required to Machining Irregular Surfaces, Make keyways and Make internal gears

Competency Units	Performance Criteria
CU1. Machining Irregular Surfaces	P1. Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident. P2. Dial the machine vice according to job requirement. P3. Select point cutting tool and set machine according to job requirements. P4. Mount cutting tool and work piece in the machine. P5. Use Different feed and speed of cutting and different points according to given drawing P6. Check quality of the component at suitable intervals. P7. Shut down the machine in safe position after finishing the work
CU2.Make keyways	P1. Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident. P2. Dial the machine vice according to job requirement. P3. Select broaching tool and set machine according to job requirements. P4. Mount broaching tool and work piece in the machine. P5. Use Different feed and speed of cutting and different points according to given drawing P6. Check quality of the component at suitable intervals. P7. P6. Shut down the machine in safe position after finishing the work
CU3. Make internal gears	P1. Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident. P2. Dial the machine vice according to job requirement. P3. Attach indexing head on the machine. P4. Select broaching tool and set machine according to job requirements. P5. Mount broaching tool and work piece in the machine. P6. Use Different feed and speed of cutting and different points according to given drawing P7. Check quality of the component at suitable intervals. P8. Shut down the machine in safe position after finishing the work

Knowledge & Understanding

K1. List safety hazards related with the shaper machine operations.

K2. Use of Dial indicator

K3. Method of mounting of cutting tool

K4. Checking of angle with the bevel protector.

K5. V-Shape cutting procedure.

K6. Safety guidelines and procedures.

K7. Safety checks for operating shaper machine.

K8. Interpreting information given in the engineering drawings and job specifications.

Tool & Equipment

- Broaching Machine
- Machine Vice
- Tri square/bevel protector
- Vernier Caliper
- Dial indicator with magnet stand
- Point cutting tools
- Personal Protective Equipment

0715.4 Advance machining

0715-M&MT-34. Carry Out Computerized Numerical Control (CNC) Machine Operations

Overview: This competency standard covers the skills and knowledge required to Set CNC machine according to job requirements, Perform Milling Operations Using CNC Machine and Perform turning operations using CNC machine

Competency Units	Performance Criteria
CU1 Comply with occupational health and safety and environmentally sustainable work practices	**P1.** Follow safe work practices **P2.** Report workplace hazards and accidents **P3.** Follow emergency procedures **P4.** Identify current resource use and environmental issues. **P5.** Comply with environmental regulations. **P6.** Seek opportunities to improve environmental practices and resource efficiency.
CU2 Set CNC machine according to job requirements	**P1.** Mount and set the work-piece and cutting tool according to procedures. **P2.** Set up and adjust machine according to parameters to achieve work specification. **P3.** Report uncertainties and deviations to person concerned for timely action. **P4.** Observe safety and workplace precautions to avoid any injuries.
CU3 . Perform Milling Operations Using CNC Machine	**P1.** Match work piece data with CAD data through software simulation. **P2.** Execute program on CNC milling to perform milling operations (e.g. surfacing, drilling, slotting, tapping, key ways, step cutting etc.) to achieve work specifications. **P3.** Follow correct specifications for the component to be produced. **P4.** Report uncertainties and deviations to person concerned for timely action. **P5.** Observe safety and workplace precautions to avoid any injuries
CU4 Perform turning operations using CNC machine	**P1.** Match work piece data with CAD data through software simulation. **P2.** Execute program on CNC Lathe to perform turning operations to achieve work specifications. **P3.** Follow correct specifications for the component to be produced. **P4.** Report uncertainties and deviations to person concerned for timely action. **P5.** Observe safety and workplace precautions to avoid any injuries.

Knowledge & Understanding

K1. Basic knowledge of CNC machine.

K2. Machine process standards and functions.

K3. Methods and techniques of adjusting operating parameters of machine.

K4. Interpreting work specifications.

K5. Techniques for checking quality of components produced.

K6. Basic knowledge of G-Code and M-Code.

K7. Basic computer operations.

K8. Procedure for reporting uncertainties and deviations to person concerned for timely action.

K9. X, Y, and Z axis.

K10. Safety precautions and guidelines.

K11. Use of control panel.

K12. Quality check points with standards.

K13. Basic knowledge of machine margins and alignments.

K14. Interpret drawing and work specifications.

K15. Reporting procedures in case of UN certainties and deviations.

K16. G-Code and M-Code.

K17. Use of coordinate system

K18. Functions of CNC Lathe Machine and range of turning operations which include facing, grooving, tapering, taper turning, step turning, form turning, threading, knurling, drilling, boring, reaming.

K19. Interpreting machine check sheet.

K20. Safety precautions and guidelines.

Tools & Equipment

- CNC machine
- CNC Manual
- CNC milling machine with all accessories
- Cutting Tools
- Tool Kit
- Gauges
- Measuring Instruments

0715-M&MT-35. Perform CNC Lathe Operations

Overview: This competency standard covers the skills and knowledge required to mount the Job, Generate the Program, Run Simulation, Feed the Program, Perform CNC Lathe Operations

Competency Units	Performance Criteria
CU1. Mount the Job	**P1.** Mount the work-piece by considering the working capacity of machine as well as job requirement according to the drawing/design **P2.** Select appropriate work holding device(s) in order to achieve dimensional accuracy and clamp the job firmly as per standard practice **P3.** Attain proper alignment of tool/ cutter and work-piece e.g. concentricity of rotating jobs as per set practice **P4.** Keep safe measures while mounting the work-piece so that unwanted operation by machine may not be initiated as per safety precautions
CU2. Generate the Program	**P1.** Interpret job requirements, calculate extra material to be removed and define reference point as per drawing/design **P2.** Define absolute or incremental coordinates system, tool path strategies, machining features and tool compensation for generating the tool path as per standard procedure **P3.** Use appropriate part programming credentials (Sequence, G-codes, M-codes, coordinates, feed, speed, tooling information etc.) according to the CNC machine control unit **P4.** Keep record of generated part program in soft/hard form in order to feed into machine control unit as per standard procedure
CU3. Run Simulation	**P1.** Feed the generated part program into appropriate simulation platform and run simulation for checking the tool gouge according to safety measures **P2.** Run simulation and verify movements of tool/cutter to get same results as per defined sequence **P3.** Identify occurrence of errors and modify the program as per defined procedure
CU4. Feed the Program	**P1.** Ensure proper synchronization between machine control unit and part program file as per standard operating procedure **P2.** Switch machine to receiving mode and feed the desired part program file into machine control unit for further execution as per standard operating

	procedure **P3.** Select the desired part program file for execution as per standard operating procedure
CU5. Perform CNC Lathe Operations	**P1.** Ensure to control the safe operation of working on CNC machines before executing part program according to the safety measures **P2.** Control the feeds, speeds and override of machine before operating according to the prescribed procedure **P3.** Switch machine to execution mode (single block or auto) and press cycle start to run the machining sequence as per prescribed method **P4.** Compare the block-wise movements of machining sequence thoroughly during operating of machine according to the part program file **P5.** Complete the job and inspect its accuracy and precision according to the drawing/design

Knowledge & Understanding

K1. Work place safety and health considerations
   a. Use of Personal Protective Equipment
   b. Reading Drawing.
   c. Mechanism of working of CNC lathe machine

K2. Use of control panel and commands
K3. Program debugging techniques
K4. Use of Simulation software
K5. Use of portable devices for CNC lathe
K6. Use of Turret / Magazine and their sequence of tool mounting
K7. Possible accidents and their counteractions
K8. Coolant types along with benefits and uses
K9. Methods of calculating Coordinates techniques
K10. G codes and M codes
K11. Feed and speed concepts in Lathe Machine
K12. Lathe operations such as Facing, Turning, Drilling, Grooving, Threading, Knurling, Boring etc.
K13. Use of Lathe tools and their types with respect to operations and materials

Tools & Equipment

K14. CNC Lathe Machine or Turning Centre along with Standard Accessories
K15. Lathe Tooling (Assorted Range)
K16. CNC Programming Manual
K17. CAM Software with Simulation Module
K18. Measuring Instruments (Vernier, Inside/Outside Calipers, Micrometer, Steel Rule,
K19. Tri-Square, Bevel Protractor etc.)

K20. Work Holding Devices

K21. Measuring Gauges

K22. Tooling Catalogue

K23. CNC Manual

K24. Complete Set of Computer System with Multimedia Projector

K25. Personal Protective Equipment (PPE)

0715-M&MT-36. Perform CNC Milling Operations

Overview: This competency standard covers the skills and knowledge required to Mount the job on Milling Machine, Generate the Program for CNC Milling, Run Simulation, Feed the Program into CNC Milling and Perform CNC Milling Operations

Competency Units	Performance Criteria
CU1. Mount the job on Milling Machine	**P1.** Mount the work-piece by considering the working capacity of machine as well as job requirement according to the drawing/design **P2.** Select appropriate work holding device(s) in order to achieve dimensional accuracy and clamp the job firmly as per standard practice **P3.** Attain proper alignment of tool/ cutter and work-piece e.g. co-axiality, concentricity of rotating jobs as per set practice **P4.** Keep safe measures while mounting the work-piece so that unwanted operation by machine may not be initiated as per safety precautions
CU2. Generate the Program for CNC Milling	**P1.** Select appropriate CAM software according to the machine control unit and import 3D model into it as per standard procedure **P2.** Define reference point and apply material/stock for machining to the design/model as per job requirements **P3.** Apply machining feature(s), toolpath strategies and leads/links as per prescribed procedure **P4.** Generate part program file against the applied machining sequence according to the post processor of CNC machine **P5**. Use appropriate part programming credentials (Sequence, G-codes, M-codes, Coordinates, Feed, Speed, Tooling Information etc.) according to the CNC machine control unit **P6**. Keep record of generated part program file in order to feed into machine control unit as per standard procedure
CU3. Run Simulation	P1. Feed the generated part program into appropriate simulation platform and run simulation for checking the tool gouge according to safety measures P2. Run simulation and verify movements of tool/cutter to get same results as per defined sequence P3. Identify occurrence of errors and modify the program as per defined

	procedure
CU4. Feed the Program into CNC Milling	**P1**. Ensure proper synchronization between machine control unit and part program file as per standard operating procedure P2. Switch machine to receiving mode and feed the desired part program file into machine control unit for further execution as per standard operating procedure P3. Select the desired part program file for execution as per standard operating procedure
CU5. Perform CNC Milling Operations	P1. Ensure to control the safe operation of working on CNC machines before executing part program according to the safety measures P2. Control the feeds, speeds and override of machine before operating according to the prescribed procedure P3. Switch machine to execution mode (single block or auto) and press cycle start to run the machining sequence as per prescribed method P4. Compare the block-wise movements of machining sequence thoroughly during operating of machine according to the part program file P5. Complete the job and inspect its accuracy and precision according to the drawing/design

Knowledge & Understanding

K1. Work place safety and health considerations

K2. Use of PPE's

K3. Use of CAM and 3D models

K4. Mechanism of working of CNC Milling Machine

K5. Use of control panel and commands

K6. Program debugging techniques

K7. Use of Simulation Software

K8. Use of portable devices for CNC Milling

a. Use of turret / Magazine and their sequence of tool mounting
b. Possible accidents and their counteractions
c. Coolant types along with benefits and uses
d. Methods of calculating Coordinates techniques
e. G codes and M codes
f. Use of Clamping devices and their types
g. Feed and speed concepts in Milling machine

K9. Milling machine operations such as Facing, Drilling, Grooving, threading, Boring etc.

h. Use of Milling tools and their types with respect to operations and materials

Tools & Equipment

- CNC Milling Machine or Machining Centre along with Standard Accessories
- Zero Setter, Edge Finder and Dial Indicator
- Power Vice
- CNC Programming Manual
- CAM Software with Simulation Module
- Measuring Instruments (Vernier, Inside/Outside Calipers, Micrometer, Steel Rule,
- Tri-Square, Bevel Protractor etc.)
- Work Holding Devices
- Measuring Gauges
- Tooling Catalogue
- Complete Set of Computer System with Multimedia Projector
- CNC Manual
- Personal Protective Equipment (PPEs)

0715-M&MT-37. Perform CNC EDM Wire-Cut Operations

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

Competency Units	Performance Criteria
CU1. Mount the Job on EDM Wire Cut Machine	P1. Mount the work-piece by considering the working capacity of machine as well as job requirement according to the drawing/design P2. Select appropriate work holding device(s) in order to achieve dimensional accuracy and clamp the job firmly as per standard practice P3. Install and adjust proper alignment of installed wire to the vertical direction as per standard practice P4. Keep safe measures while mounting the work-piece and installing the wire so that unwanted operation by machine may not be initiated as per safety precautions
CU2. Generate the Program	P1. Select appropriate CAM software according to the machine control unit and import drawing/sketch into it as per standard procedure P2. Define reference point also known as start point and apply toolpath by considering the wire compensation according to the prescribed procedure P3. Execute the generated part program file in order to perform wire cutting operation as per prescribed method
CU3. Run Simulation	P1. Refer to the simulation platform and run simulation of wire cutting sequence as per prescribed method P2. Run simulation and verify movements of wire cutting to get same results as per defined sequence P3. Identify occurrence of errors and modify the applied toolpath as per prescribed procedure
CU4. Feed the Program	P1. Ensure proper synchronization between machine control unit and part program file as per standard operating procedure P2. Select and execute the desired part program file as per standard operating procedure
CU5. Perform CNC EDM Wire-cut	P1. Ensure to control the safe operation of working on EDM wire-cut machine

Operations	before execution of part program according to the safety measures P2. Adjust the feeds, speeds by adjusting amperes and current setting before operating according to the prescribed procedure P3. Switch machine to execution mode and start to work on defined toolpath as per prescribed method P4. Compare the movements of machining sequence thoroughly during operating of machine according to the part program file P5. Complete the job and inspect its accuracy and precision according to the drawing/design

Knowledge & Understanding

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

Tools & Equipment

- CNC EDM Wire-cut Machine along with Standard Accessories
- Wire Spool(s) with Wire Dia 0.18mm
- Wire-cut Software (YH, YL or HF)
- Measuring Gauges with Dial Indicator
- Tooling Catalogue
- CNC Manual
- Measuring Instruments (Vernier, inside/ Outside Calipers, Micrometer, Steel Rule, Tri-Square, Bevel Protractor etc.)
- Work Holding Devices
- Personal Protective Equipment (PPEs)
- Complete set of computer system with multimedia projector
- Work Holding Devices

0715-M&MT-38. Perform advance mechanical machining processes

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

Competency Units	Performance Criteria
CU1 Perform Ultra-Sonic Machining	**P1.** Analyze the machining characteristics of ultrasonic machining and identify the effect of various machining parameter. **P2.** Develop the work holding unit and tool holding arrangement. **P3.** Perform analysis of variance (ANOVA) to find out percentage contribution of USM process parameters on material removal rate, surface roughness, hole taper and radial overcut. **P4.** Analyzing the influence of process parameters on material removal rate and surface roughness during machining
CU2. Mount the Job on CNC water jet Cutting Machine	P1. Mount the work-piece by considering the working capacity of machine as well as job requirement according to the drawing/design. P2. Select appropriate work holding device(s) in order to achieve dimensional accuracy and clamp the job firmly as per standard practice P3. Install and adjust proper alignment of water jet to the vertical direction as per standard practice P4. Keep safe measures while mounting the work-piece and installing the water jet nozzle so that unwanted operation by machine may not be initiated as per safety precautions.
CU3. Generate the Program	P1. Select appropriate CAM software according to the machine control unit and import drawing/sketch into it as per standard procedure P2. Define reference point also known as start point and apply toolpath by considering the wire compensation according to the prescribed procedure P3. Execute the generated part program file in order to perform wire cutting operation as per prescribed method
CU4. Run Simulation	P1. Refer to the simulation platform and run simulation of water jet cutting sequence as per prescribed method P2. Run simulation and verify movements of water jet cutting to get same results as per defined sequence P3. Identify occurrence of errors and modify the applied toolpath as per prescribed procedure
CU5. Feed the Program	P1. Ensure proper synchronization between machine control unit and part

	program file as per standard operating procedure P2. Select and execute the desired part program file as per standard operating procedure
CU6. Perform CNC water jet cutting Operations	P1. Ensure to control the safe operation of working on CNC water jet cutting machine before execution of part program according to the safety measures. P2. Adjust the feeds, speeds by adjusting amperes and current setting before operating according to the prescribed procedure P3. Switch machine to execution mode and start to work on defined toolpath as per prescribed method P4. Compare the movements of machining sequence thoroughly during operating of machine according to the part program file P5. Complete the job and inspect its accuracy and precision according to the drawing/design

Knowledge & Understanding

- **K1.** Describe USM process for machining
- **K2.** Describe Rotary ultrasonic vibration machining.
- **K3.** Describe Chemical-assisted ultrasonic vibration machining.
- **K4.** Describe transducer and a sonotrode
- **K5.** Describe Piezo electric transducer
- **K6.** Describe Magneto-strictive transducer
- **K7.** Describe CNC system.
- **K8.** Work place safety and health considerations.
- **K9.** Use of PPE's.
- **K10.** Use of CAD/CAM and 3D models.
- **K11.** Coolant types along with benefits and uses.
- **K12.** Use of control panel and commands
- **K13.** Program debugging techniques
- **K14.** Use of Simulation
- **K15.** Use of portable devices for CNC water jet machine.
- **K16.** Possible accidents and their counteractions
- **K17.** Methods of calculating Coordinates techniques
- **K18.** G codes and M codes
- **K19.** Use of Clamping devices and their types
- **K20.** Feed and speed concepts
- **K21.** Explain Working Principle
- **K22.** Explain schematic diagram

Tool and Equipment

- Magneto-strictive Transducer

- Tool Holder
- Job Holder
- Hydraulic unit
- Intensifier
- Accumulator
- Filter
- Water transmission lines
- On/Off Valve
- Water jet nozzle
- Water jet catchers
- Fluid additives

0715-M&MT-39. Perform Laser Beam Machining & electroplating/chemical machining

Overview: This competency standard covers the skills and knowledge required to mount the Job on CNC Laser Cutting Machine, Generate the Program, Run Simulation, Feed the Program, Perform CNC laser cutting Operations and Prepare for electroplating process

Competency Units	Performance Criteria
CU1. Mount the Job on CNC Laser Cutting Machine	P1. Mount the work-piece by considering the working capacity of machine as well as job requirement according to the drawing/design. P2. Select appropriate work holding device(s) in order to achieve dimensional accuracy and clamp the job firmly as per standard practice P3. Install and adjust proper alignment of Laser cutting to the direction as per standard practice P4. Keep safe measures while mounting the work-piece and installing the laser beam so that unwanted operation by machine may not be initiated as per safety precautions.
CU2. Generate the Program	P1. Select appropriate CAM software according to the machine control unit and import drawing/sketch into it as per standard procedure P2. Define reference point also known as start point and apply toolpath by considering the wire compensation according to the prescribed procedure P3. Execute the generated part program file in order to perform wire cutting operation as per prescribed method
CU3. Run Simulation	P1. Refer to the simulation platform and run simulation of water jet cutting sequence as per prescribed method P2. Run simulation and verify movements of water jet cutting to get same results as per defined sequence P3. Identify occurrence of errors and modify the applied toolpath as per prescribed procedure
CU4. Feed the Program	P1. Ensure proper synchronization between machine control unit and part program file as per standard operating procedure P2. Select and execute the desired part program file as per standard operating procedure
CU5. Perform CNC laser cutting Operations	P1. Ensure to control the safe operation of working on CNC laser cutting machine before execution of part program according to the safety

	measures. P2. Adjust the feeds, speeds by adjusting amperes and current setting before operating according to the prescribed procedure P3. Switch machine to execution mode and start to work on defined toolpath as per prescribed method P4. Compare the movements of machining sequence thoroughly during operating of machine according to the part program file P5. Complete the job and inspect its accuracy and precision according to the drawing/design
CU6. Prepare for electroplating process	**P1.** Identify electroplating requirements **P2.** Materials and racking arrangement are checked for non-conformance to specifications/job requirements. **P3.** .All plant and equipment relevant to process are checked for compliance with safety and operational requirements. **P4.** . Instrumentation/gauges are checked for operation. **P5.** Condition of solution is checked

Knowledge & Understanding

K1. Work place safety and health considerations.

K2. Use of PPE's.

K3. Use of CAD/CAM and 3D models.

K4. Coolant types along with benefits and uses.

K5. Mechanism of working of CNC laser cutting machine

K6. Use of control panel and commands

K7. Program debugging techniques

K8. Use of Simulation

K9. Use of portable devices for CNC laser cutting machine.

K10. Possible accidents and their counteractions

K11. Methods of calculating Coordinates techniques

K12. G codes and M codes

K13. Use of Clamping devices and their types

K14. Feed and speed concepts

K15. Explain Working Principle

a. Explain schematic diagram

K16. Describe high pressure pumps.

K17. Describe Valves.

K18. Basic knowledge of electroplating process, machine components, treatment solutions, process parameters

K19. A basic knowledge of electroplating solutions and handling procedures

K20. Treatment stages

K21. Information relevant to plating products, treatment baths, settings

K22. Characteristics of a variety of base materials that can be plated

K23. Pre-treatment s, treatments and post treatments in relation to task requirements

K24. Required equipment checks

K25. Hazards and control measures associated with electroplating processes

K26. Operational requirements of all plant and equipment associated with the relevant process

K27. The purpose and typical settings of different instruments/gauges

K28. Sequences and requirements involved in moving materials

K29. The range of adjustments permissible for given operating parameters including voltage, current and temperature

K30. Variances outside the control of the operator

K31. Common faults and imperfections/deviations

K32. Adjustments to suit specific process deviations

K33. Effects of rust, corrosion and other contaminants and the reasons for rejecting incorrectly loaded work

K34. Safe operating procedures, safety and personal protective equipment, hazards of specific solutions

Tool and Equipment

- Hydraulic unit
- Intensifier
- Accumulator
- Filter
- Water transmission lines
- On/Off Valve
- Water jet nozzle
- Water jet catchers
- Fluid additives

0715.5 Grinding operator

0715-M&MT-34. Perform off hand grinding

Overview: Overview: This competency standard covers the skills and knowledge required to Adjust Grinding wheel, Adjust tool Rest, Prepare a single point cutting tool for Basic machining purposes, Dress the Wheel and Perform Angle Grinding for finishing

Competency Units	Performance Criteria
CU1. Adjust Grinding wheel	**P1.** Select the right tool for job **P2.** Remove the safety guard of grinding wheel. **P3.** Select the wheel type according to material/speed. **P4.** Mount the wheel on the spindle. **P5.** Balance the wheel **P6.** Put back the safety covers. **P7.** Ensure that wheel is properly mounted.
CU2. Adjust tool Rest	**P1.** Select the right tool for job **P2.** Remove the safety guard of grinding wheel. **P3.** Mount the tool rest. **P4.** Balance the wheel **P5.** Put back the safety covers **P6.** Ensure that wheel is properly mounted.
CU3. Prepare a single point cutting tool for Basic machining purposes	**P1**. Select marking tools **P2**. Cut the material as per requirement. **P3**. Perform surface finishing with file **P4**. Level the surface with tri-square **P5**. Give the angle to the tool according to cutting requirement.
CU4 Dress the Wheel	P1. Select dressing tools P2. Ensure that wheel is properly mounted. P3. Use dressing tool to remove the material from grinding wheel which is creating problems. P4. Balance the grinding wheel.
CU5. Perform Angle Grinding for finishing	**P1**. Select marking tools **P2**. Cut the material as per requirement. **P3**. Perform surface finishing with angle grinder machine **P4**. Level the surface with tri-square

Knowledge & Understanding

K1. Define types of grinding wheels

K2. Describe basic measuring

K3. Describe the Grinding machine types.

K4. Describe clamping/holding methods.

K5. Define safe distance from grinding wheel for tool rest

K6. Describe basic measuring /Marking /cutting tools

K7. Knowledge of different cutting tool materials.

K8. Describe the different type of dressing tools.

K9. Describe safety during handling the angle grinder

Tool & Equipment

- Offhand Grinding Machine
- Bench vices
- Hammer
- Scriber
- Vernier calliper
- Set of spanners
- Angle Grinding Machine

0715-M&MT-35. Perform Surface Grinding

Overview: This competency standard covers the skills and knowledge required to determine job requirements and sequence of operations, Operate surface grinding and Dress the Wheel

Competency Units	Performance Criteria
CU1. Determine job requirements and sequence of operations	P4. Interpret and understand drawings, instructions and specifications. P5. Determine sequence of operations including job specifications and set-up for maximum efficiency P6. Select appropriate grinding wheel for job. P7. Mounted and positioned grinding wheel correctly.
CU2. Operate surface grinding	P1. Select the suitable size and type of grinding wheel. P2. Mount the work piece over the holding devices to ensure proper clamping. P3. Dress the wheel with diamond tip if required. P4. Identify reference points on work piece before grinding. P5. Adjust depth of cut according to speed of machine table. P6. Use coolant continuously to avoid over heating of the job. P7. Observe personal and workplace safety.
CU3. Dress the Wheel	P5. Select dressing tools P6. Ensure that wheel is properly mounted. P7. Use dressing tool to remove the material from grinding wheel which is creating problems. Balance the grinding wheel.

Knowledge & Understanding

- **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

Tool &Equipment

- Surface Grinding
- Machine
- Holding Devices

- Wheel Dresser

- Grinding Wheels

- Wheel Dresser Stand

- Measuring Tools

- Adjustable Wrench

- Allen Key Set

0715-M&MT-36. Perform Universal cylindrical grinding and centerless grinding

Overview: This competency standard covers the skills and knowledge required to determine job requirements and sequence of operations, Adjust Grinding wheel, Operate Universal cylindrical grinding and Operate centre less grinding

Competency Units	Performance Criteria
CU1 Determine job requirements and sequence of operations	**P1.** Interpret and understand drawings, instructions and specifications. **P2.** Determine sequence of operations including job specifications and set-up for maximum efficiency **P3.** Select appropriate grinding wheel for job. **P4.** Mounted and positioned grinding wheel correctly.
CU2 Adjust Grinding wheel	**P1.** Select the right tool for job **P2.** Select the wheel type according to material/speed. **P3.** Set the wheel on tool post **P4.** Balance the wheel **P5.** Ensure that wheel is properly mounted.
CU3 Operate Universal cylindrical grinding	P1. Select the suitable size and type of grinding wheel. P2. Mount work piece according to procedure (e.g. between two centers, chuck, collet, face plate). P3. Ensure the grinding wheel is balanced. P4. Follow suitable method for universal cylindrical grinding to ensure work specifications. P5. Use coolant continuously to avoid overheating of job. P6. Observe personal and workplace safety.
CU4.Operate centerless grinding	**P1**. Select the suitable size and type of grinding wheel. P2. Mount work piece with a blade instead of by centers or chucks. P3. Ensure the grinding wheel is balanced. P4. Follow suitable method for universal cylindrical grinding to ensure work specifications. P5. Use coolant continuously to avoid overheating of job. P6. Observe personal and workplace safety

Knowledge & Understanding

K1. Define types of grinding wheels
K2. Describe basic measuring
K3. Describe the Grinding machine types.
Describe clamping/holding methods.

K1. Types of grinding.

K2. Types and sizes of grinding wheels.

K3. Procedure of mounting of work piece according to requirements which include:

a. Between Two Centers

b. Chuck

c. Collet and

d. Face Plate

K4. Importance of balancing the grinding wheel.

K5. Procedure of universal cylindrical grinding.

K6. Safety precautions and guidelines specific to cylindrical grinding.

K7. Procedure of mounting of work piece according to requirements which include:

a. Blade

b. Collet and

c. Face Plate

Tool & Equipment

- Universal cylindrical grinding Machine
- Bench vices
- Hammer
- Scriber
- Vernier calliper
- Set of spanners
- Measuring Instruments
- Grinding Wheels
- Wheel Dresser
- Dog Carrier
- Screw Wrench
- Allen key Set
- Personal Protective Equipment

0715-M&MT-37. Perform Tool & Cutter Grinding

Overview: This competency standard covers the skills and knowledge required to Adjust Grinding wheel, Adjust tool Rest and Operate the Tool and cutter grinding

Competency Units	Performance Criteria
CU1 Adjust Grinding wheel	**P1.** Select the right tool for job **P2.** Remove the safety guard of grinding wheel. **P3.** Select the wheel type according to material/speed. **P4.** Mount the wheel on the spindle. **P5.** Balance the wheel **P6.** Put back the safety covers. **P7.** Ensure that wheel is properly mounted.
CU2 Adjust tool Rest	**P1.** Select the right tool for job **P2.** Remove the safety guard of grinding wheel. **P3.** Mount the tool rest. **P4.** Balance the wheel **P5.** Put back the safety covers Ensure that wheel is properly mounted.
CU3 Operate the Tool and cutter grinding	P1. Select the suitable size, type and shape of grinding wheel. P2. Mount work piece onto correct attachment for required procedure. P3. Adjust the attachments according to different types of tools and cutter grinding. P4. Follow procedure for sharpening of tools and cutter that is safe and appropriate. P5. Observe personal and safety precautions.

Knowledge & Understanding

- **K1.** Define types of grinding wheels
- **K2.** Describe basic measuring
- **K3.** Describe the Grinding machine types.
- **K4.** Describe clamping/holding methods.
- **K5.** Define safe distance from grinding wheel for tool rest
- **K6.** Types, sizes and shapes of grinding wheels.
- **K7.** Types of attachments and their use.
- **K8.** Procedure of mounting of work-piece on to related attachments.
- **K9.** Different tools and cutter angles.
- **K10.** Procedure of sharpening of tools and cutters.
- **K11.** Safety guidelines and precautions.

Tool & Equipment

- Tool and cutting grinding Machine
- Bench vices
- Hammer
- Scriber
- Vernier calliper
- Set of spanners
- Offhand Grinding Machine
- Diamond dresser tool
- Grinding attachment
- Universal bevel Protector

0715-M&MT-38. Perform Form, High Speed Peel Grinding and Plunge Cut Grinding

Overview: This competency standard covers the skills and knowledge required to Adjust Grinding wheel, Operate form grinding wheel, Grind cylindrical components having various diameters and Plunge Cut Grinding

Competency Units	Performance Criteria
CU1 Adjust Grinding wheel	**P1.** Select the right tool for job **P2.** Remove the safety guard of grinding wheel. **P3.** Select the wheel type according to material/speed. **P4.** Mount the wheel on the spindle. **P5.** Balance the wheel **P6.** Put back the safety covers. **P7.** Ensure that wheel is properly mounted.
CU2 Operate form grinding wheel	**P1.** Select the right tool for job **P2.** Remove the safety guard of grinding wheel. **P3.** Select the wheel that have mirror image of the required job. **P4.** Mount the wheel. **P5.** Balance the wheel **P6.** Put back the safety covers. **P7.** Ensure that wheel is properly mounted.
CU3 Grind cylindrical components having various diameters	**P1.** Set the grinding wheel. **P2.** Set the computer numerical control speed and feed. **P3.** Make a cylinder job which have different diameter at different places.
CU4 Plunge Cut Grinding	P1. Select and Mount the grinding wheel on the spindle of Machine. P2. Set the wheel and job as they are perpendicular with each other. P3. Set the feed for getting required dimensions.

Knowledge & Understanding

- **K1.** Define special types of grinding wheel for forming and peel grinding operations.
- **K2.** Describe basic measuring
- **K3.** Describe the Grinding machine types.
- **K4.** Describe clamping/holding methods.
- **K5.** Describe Peel grinding machine
- **K6.** Describe computer numerical control system
- **K7.** Describe Flexibility of machine.
- **K8.** Describe Plunge Cut Grinding.
- **K9.** Describe forming and cutting tool.
- **K10.** Describe feed and speed.

Tool & Equipment

Form and High Speed Peel Grinding

Bench vices

Hammer

Scriber

Vernier calliper

Set of spanners

Form Grinding Machine.

Peel grinding machine.

Computer numerical control system.

Plunge Cut Grinding

0715-M&MT-39. Perform Belt and Jig Grinding

Overview: This competency standard covers the skills and knowledge required to perform finishing on Belt grinding machine, Operate Jig Grinding

Competency Units	Performance Criteria
CU1 Perform finishing on Belt grinding machine.	**P1.** Chose the abrasive coated belt type according to requirements **P2.** Adjust the abrasive coated Belt on the machine. **P3.** Hold the work piece against the abrasive coated belt. **P4.** Complete the finishing process according to the dimensions.
CU2 Operate Jig Grinding	**P1.** Select the right tool for job **P2.** Select the wheel that have mirror image of the required job. **P3.** Mount the grinding tool. **P4.** Balance the wheel **P5.** Put back the safety covers. **P6.** Ensure that wheel is properly mounted.

Knowledge & Understanding

- **K1.** Describe Belt grinding operations.
- **K2.** Describe finishing importance
- **K3.** Elaborate Belt Grinding machine
- **K4.** Define special types of grinding wheel for jig grinding and boring operations.
- **K5.** Describe basic measuring
- **K6.** Define operations of jig grinding.
- **K7.** Describe the Grinding machine types.
- **K8.** Describe clamping/holding methods.

Tool & Equipment

Belt grinding machine

Bench vices

Hammer

Scriber

Vernier calliper

Set of spanners

Jig Grinding.

0715.6 Power Plant

0715-M&MT-34. Operate Internal Combustion Engine

Overview: This competency standard covers the skills and knowledge required to perform two stroke diesel engine, perform four stroke diesel engine, perform two stroke ignition engine, perform four stroke ignition engine and perform wankel engine.

Competency Units	Performance Criteria
CU1: Perform four stroke diesel engine	**P1**. Select Engine type four stroke internal combustion **P2**. Attach it on engine test bench **P3.** Start the engine. **P4.** Mention all the readings on the given data
CU2: Perform two stroke ignition engine	**P1**. Select Engine type two stroke internal combustion **P2**. Attach it on engine test bench **P3.** Start the engine. **P4.** Mention all the readings on the given data
CU3: Perform four stroke ignition engine	**P1**. Select Engine type four stroke internal combustion **P2**. Attach it on engine test bench **P3.** Start the engine. **P4.** Mention all the readings on the given data
CU4: Perform Wankel Engine	**P1**. Select the Wankel engine type **P2**. Place it on the Bench **P3.** Start to rotate the engine **P4.** Mention the behavior with efficiency of the wankel engine

Knowledge and Understanding

K1. Knowing about the compression and ignition engines

K2. Knowing about the Internal and external types of Engine

K3. Differentiate between the two strokes four stroke engine and wankel engine

K4. Calculate the efficiency of the engine w.r.t. time

Tools & Equipment

- Engine test bench
- Various types of engine
- Safety equipment (gloves, helmet, goggles, noise protectors etc…)
- Pressure Gauges with sensors
- Thermometers with gauges

0715-M&MT-35. Operate External Combustion Engine

Overview: This competency standard covers the skills and knowledge required to Operate Steam Engine, Operate Rocket Engine and Operate Reaction Engine

Competency Units	Performance Criteria
CU1: Operate Steam Engine	**P1**. Select the external combustion engine type **P2**. Place it on the proper place **P3.** Start to produce the steam and create pressure **P4.** Note the readings and then calculate the efficiency on given data
CU2: Operate Rocket Engine	**P1**. Select the external combustion engine type **P2**. Place it on the proper place **P3.** Start to produce the pressure **P4.** Note the readings and then calculate the efficiency on given data
CU3: Operate Reaction Engine	**P1.** Select the external combustion engine type **P2**. Place it on the proper place **P3.** Start to produce the pressure **P4.** Note the readings and then calculate the efficiency on given data

Knowledge and Understanding

K1. Knowing about the Internal and external types of Engine

K2. Differentiate between the various types of External Combustion engine and select the steam engine

K3. Calculate the efficiency of the engine w.r.t. time and also with pressure

Tools & Equipment

Engine test bench

Various types of engine

Safety equipment (gloves, helmet, goggles, noise protectors etc…)

Pressure Gauges with sensors

Thermometers with gauges

0715-M&MT-36. Operate Turbine

Overview: this competency standard covers the skills and knowledge required to perform water turbine, perform reaction turbine, perform steam turbine, perform gas turbine and perform wind turbine.

Competency Units	Performance Criteria

CU1: Perform water turbine	**P1**. Select the pelton/ impulse turbine **P2**. Choose the pelton/ impulse wheel turbine to perform this, firstly **P3.** Secondly, Choose the Cross-flow and then perform the action **P4.** Calculate the efficiency of both the flows
CU2: Perform reaction turbine	**P1**. Select the reaction turbine **P2**. Choose the flow type and then perform the action **P3.** Also perform with another flow behavior **P4.** Calculate the efficiency of the turbines
CU3: Perform steam turbine	**P1.** Select the steam turbine **P2**. Choose the flow behavior **P3.** Choose the Cross-flow and then perform. **P4.** Calculate the efficiency of both the flow behaviors
CU4: Perform gas turbine	**P1**. Select the gas turbine **P2**. Choose the flow behavior **P3.** Choose the Cross-flow and then Perform. **P4.** Calculate the efficiency of both the flow behaviors
CU5. Perform wind turbine	**P1.** Select the wind turbine **P2**. Choose the location and timing of the wind **P3.** Choose the suitable site and angle to install it **P4.** Calculate the efficiency of both the turbines

Knowledge and Understanding

K1. Knowing about the types of turbines with their flow behavior
K2. Selection of the flow behaviors
K3. Mathematical modeling of the turbine analysis

Tools & Equipment

Water source
Turbines
Gauges
Thermometers
Sensors

0715-M&MT-37. Operate Boilers

Overview: This competency standard covers the skills and knowledge required to Operate Water Tube Boiler, Operate Fire Tube Boiler, Operate Stoker Fired Boiler, Operate Pulverized Fuel Boiler, Operate Waste heat Boiler and Operate Fluidized bed boiler

Competency Units	Performance Criteria

CU1: Operate Water Tube Boiler	**P1**. Choose the type of the water tube boiler **P2**. Heat the water according to the requirement **P3**. Calculate the temperature of the water w.r.t. time **P4**. Calculate efficiency of the boiler
CU2: Operate Fire Tube Boiler	**P1**. Choose the type of the fire tube boiler **P2**. Heat the water according to the requirement **P3**. Calculate the temperature of the water w.r.t. time **P4**. Calculate efficiency of the boiler
CU3: Operate Stoker Fired Boiler	**P1**. Choose the type of the stoker fired boiler **P2**. Heat the water according to the requirement **P3**. Calculate the temperature of the water w.r.t. time **P4**. Calculate efficiency of the boiler
CU4: Operate Pulverized Fuel Boiler	**P1.** Choose the type of the pulverized fuel boiler **P2**. Heat the water according to the requirement **P3**. Calculate the temperature of the water w.r.t. time **P4**. Calculate efficiency of the boiler
CU5: Operate Waste heat Boiler	**P1.** Choose the type of the waste heat boiler **P2**. Heat the water according to the requirement **P3**. Calculate the temperature of the water w.r.t. time **P4**. Calculate efficiency of the boiler
CU6: Operate Fluidized bed boiler	**P1.** Choose the type of the fluidized bed boiler **P2**. Heat the water according to the requirement **P3**. Calculate the temperature of the water w.r.t. time **P4**. Calculate efficiency of the boiler

Knowledge and Understanding

K1. Knowing about the types of boilers with their flow behaviour and pressure capacities

K2. Selection of the water flow behaviours

K3. Mathematical modelling of the boiler analysis

K4. Knowledge about the Major components of the fuel (combustion chamber, grate, furnace, heat surface, mountings etc…)

Tools and Equipment

Fuel (Wood, Coal, Diesel, Natural Gas, Nuclear Energy)

Water resource

Space

Filters

Measuring Devices with sensors

0715-M&MT-38. Operate Pumps

Overview: This competency standard covers the skills and knowledge required to Operate gear pump, Operate lobe pump, Operate ge-rotor pump, Operate screw pump, Operate vane pump, Operate axial piston pump, Operate radial piston pump and Operate centrifugal pump.

Competency Units	Performance Criteria
CU1: Operate gear pump	**P1**. Choose the type of the gear pump either its internal or external **P2**. Create pressure according to the requirement **P3**. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the pump
CU2: Operate Lobe pump	**P1.** Choose the type of the lobe pump **P2**. Create pressure according to the requirement **P3**. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the pump
CU3: Operate Ge-rotor pump	**P1**. Choose the type of the ge-rotor pump **P2**. Create pressure according to the requirement **P3**. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the pump
CU4. Operate screw pump	**P1.** Choose the type of the screw pump **P2**. Create pressure according to the requirement **P3**. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the pump
CU5. Operate vane pump	**P1.** Choose the type of the vane pump **P2**. Create pressure according to the requirement **P3**. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the pump
CU6. Operate axial piston pump	**P1.** Choose the type of the axial piston pump **P2**. Create pressure according to the requirement **P3**. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the pump
CU7. Operate radial piston pump	**P1.** Choose the type of the radial piston pump **P2**. Create pressure according to the requirement **P3**. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the pump
CU8. Operate centrifugal pump	**P1.** Choose the type of the centrifugal pump **P2**. Create pressure according to the requirement

	P3. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the pump

Knowledge and Understanding

K1. Knowing about the types of pump with their flow behavior and pressure capacities

K2. Selection of the water flow Behaviors w.r.t. mass flow rate

K3. Mathematical modeling of the pump analysis

K4. Knowledge about the Major components of the pump also pressure gauges

0715-M&MT-39. Operate Compressors

Overview: This competency standard covers the skills and knowledge required to Operate reciprocating compressor with single stage, Operate reciprocating compressor with double stage, Operate reciprocating compressor with multi stage, Operate rotary compressor with positive displacement, Operate rotary compressor with non-positive displacement.

Competency Units	Performance Criteria
CU1: Operate reciprocating compressor with single stage	**P1**. Choose the type of the reciprocating compressor with single stage **P2**. Create pressure according to the requirement **P3**. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the compressor
CU2: Operate reciprocating compressor with double stage	**P1**. Choose the type of the reciprocating compressor with double stage **P2**. Create pressure according to the requirement **P3**. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the compressor
CU3: Operate reciprocating compressor with multi stage	**P1.** Choose the type of the reciprocating compressor with multi stage **P2**. Create pressure according to the requirement **P3**. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the compressor
CU4: Operate rotary compressor with positive displacement	**P1**. Choose the type of the rotary compressor with positive displacement **P2**. Create pressure according to the requirement **P3**. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the compressor
CU5. Operate rotary compressor with negative displacement	**P1.** Choose the type of the rotary compressor with non-positive displacement **P2**. Create pressure according to the requirement **P3**. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the compressor

Knowledge and Understanding

K1. Knowing about the types of compressor with their flow behavior and pressure capacities
K2. Selection of the water flow Behaviors w.r.t. mass flow rate
K3. Mathematical modeling of the compressor analysis
K4. Knowledge about the Major components of the compressor also pressure gauges

Tools & Equipment

- Various types of compressor
- Pressure gauges
- Water resources
- Pipe lines
- Compressive test bench

0715-M&MT-40. Operate valves/ Gauges

Overview: This competency standard covers the skills and knowledge required to operate gate valve, Operate globe valve, Operate check valve, Operate plug valve, Operate ball valve, Operate butterfly valve, Operate needle valve, Operate pinch valve, Operate relief valve, pressure gauges, temperature gauges, Flow gauges and Different types of sensor.

Competency Units	Performance Criteria
CU1: Operate gate valve	**P1**. Choose the type of valve **P2**. Create pressure according to the requirement **P3**. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the valve **P5**. Perform the same procedure for remaining types of the valves
CU2: Operate globe valve	**P1**. Choose the type of valve **P2**. Create pressure according to the requirement **P3**. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the valve
CU3: Operate chuck valve	**P1.** Choose the type of valve **P2**. Create pressure according to the requirement **P3**. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the valve
CU4: Operate plug valve	**P1**. Choose the type of valve **P2**. Create pressure according to the requirement **P3**. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the valve
CU5. Operate ball valve	**P1.** Choose the type of valve **P2**. Create pressure according to the requirement **P3**. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the valve
CU6. Operate butterfly valve	**P1.** Choose the type of valve **P2**. Create pressure according to the requirement **P3**. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the valve
CU7. Operate needle valve	**P1.** Choose the type of valve **P2**. Create pressure according to the requirement **P3**. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the valve

CU8. Operate pinch valve	**P1.** Choose the type of valve **P2**. Create pressure according to the requirement **P3**. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the valve
CU9. Operate relief valve	**P1.** Choose the type of valve **P2**. Create pressure according to the requirement **P3**. Calculate the pressure and mass flow rate of the water w.r.t. time **P4**. Calculate efficiency of the valve
CU10. Demonstrate Pressure gauges, temperature gauges, Flow gauges and Different types of sensor.	**P1.** Choose the type of gauge **P2**. Create pressure according to the requirement **P3**. Calculate the pressure, temperature and mass flow rate of the water w.r.t. time **P4**. Compare gauges values with sensors

Knowledge and Understanding

K1. Knowing about the motion of the valves
K2. Knowledge about the measurements of pressure
K3. Calculate mass flow rate in both cases either fully opened or fully closed
K4. Able to control air, fuel gas, feed water, steam, lube oil hydrocarbon and other services
K5. Prepare the efficiency calculation of the valves
K1. Knowing about the motion of the valves
K2. Knowledge about the measurements of pressure
K3. Calculate mass flow rate in both cases either fully opened or fully closed
K4. Able to control air, fuel gas, feed water, steam, lube oil hydrocarbon and other services
K5. Prepare the efficiency calculation of the valves
K1. Knowing about the motion of the valves
K2. Knowledge about the measurements of pressure
K3. Calculate mass flow rate in both cases either fully opened or fully closed
K4. Able to control air, fuel gas, feed water, steam, lube oil hydrocarbon and other services
K5. Prepare the efficiency calculation of the valves
K1. Knowing about the motion of the valves
K2. Knowledge about the measurements of pressure
K3. Calculate mass flow rate in both cases either fully opened or fully closed
K4. Able to control air, fuel gas, feed water, steam, lube oil hydrocarbon and other services
K5. Prepare the efficiency calculation of the valves
K1. Knowing about the motion of the valves
K2. Knowledge about the measurements of pressure
K3. Calculate mass flow rate in both cases either fully opened or fully closed
K4. Able to control air, fuel gas, feed water, steam, lube oil hydrocarbon and other services
K5. Prepare the efficiency calculation of the valves
K1. Knowing about the motion of the valves
K2. Knowledge about the measurements of pressure

K3. Calculate mass flow rate in both cases either fully opened or fully closed
K4. Able to control air, fuel gas, feed water, steam, lube oil hydrocarbon and other services
K5. Prepare the efficiency calculation of the valves
K1. Knowing about the motion of the valves
K2. Knowledge about the measurements of pressure
K3. Calculate mass flow rate in both cases either fully opened or fully closed
K4. Able to control air, fuel gas, feed water, steam, lube oil hydrocarbon and other services
K5. Prepare the efficiency calculation of the valves
K1. Knowing about the motion of the valves
K2. Knowledge about the measurements of pressure
K3. Calculate mass flow rate in both cases either fully opened or fully closed
K4. Able to control air, fuel gas, feed water, steam, lube oil hydrocarbon and other services
K5. Prepare the efficiency calculation of the valves
K1. Knowing about the motion of the valves
K2. Knowledge about the measurements of pressure
K3. Calculate mass flow rate in both cases either fully opened or fully closed
K4. Able to control air, fuel gas, feed water, steam, lube oil hydrocarbon and other services
K5. Prepare the efficiency calculation of the valves
K1. Knowing about the gauges
K2. Knowledge about the measurements of pressure, temperatures and flows
K3. Calculate mass flow rate in both cases either fully opened or fully closed
K4. Able to control air, fuel gas, feed water, steam, lube oil hydrocarbon and other services
K5. Prepare the efficiency calculation of the gauges w.r.t. sensor values
Tools and Equipment
Various types of valves
Pressure gauges
Water resources
Pipe lines
Valve test bench
Various types of valves
Pressure gauges
Water resources
Pipe lines
Valve test bench
Various types of valves
Pressure gauges
Water resources
Pipe lines
Valve test bench
Various types of valves
Pressure gauges
Water resources
Pipe lines
Valve test bench
Various types of valves
Pressure gauges
Water resources
Pipe lines

Valve test bench

Various types of valves

Pressure gauges

Water resources

Pipe lines

Valve test bench

Various types of valves

Pressure gauges

Water resources

Pipe lines

Valve test bench

Various types of valves

Pressure gauges

Water resources

Pipe lines

Valve test bench

Various types of valves

Pressure gauges

Water resources

Pipe lines

Valve test bench

Various types of pressures, temperatures

And flow gauges

Water resources

Heat resources

Pipe lines

Valve test bench

Sensors

0715-M&MT-41. Operate Thermal Power Plant

Overview: This competency standard covers the skills and knowledge required to Design of coal power plant by using previous components (Boiler, valves, compressor, turbine, condenser etc…), Design of coal power plant by using previous components with economizer, Design of furnace oil power plant, Design of gas power plant, and Design of nuclear power plant.

Competency Units	Performance Criteria
CU1. Design of coal power plant by using previous components (Boiler, valves, compressor, turbine, condenser etc…)	**P1.** Choose the components of the power plant **P2.** Select the burning fuel **P3**. Create layout diagram on table or on floor where to be install all the components **P4**. Assembled all the components and make sure is it ok? **P5**. Calculate the pressure and mass flow rate of each component **P6**. Calculate the overall efficiency of the plant
CU2. Design of coal power plant by using previous components with economizer	**P1.** Choose the components of the power plant **P2.** Select the burning fuel **P3**. Create layout diagram on table or on floor where to be install all the components **P4**. Assembled all the components and make sure is it ok? **P5**. Calculate the pressure and mass flow rate of each component **P6**. Calculate the overall efficiency of the plant
CU3. Design of furnace oil power plant	**P1.** Choose the components of the power plant **P2.** Select the burning fuel **P3**. Create layout diagram on table or on floor where to be install all the components **P4**. Assembled all the components and make sure is it ok? **P5**. Calculate the pressure and mass flow rate of each component **P6**. Calculate the overall efficiency of the plant
CU4. Design of gas power plant	**P1.** Choose the components of the power plant **P2.** Select the burning fuel **P3**. Create layout diagram on table or on floor where to be install all the components **P4**. Assembled all the components and make sure is it ok? **P5**. Calculate the pressure and mass flow rate of each component **P6**. Calculate the overall efficiency of the plant
CU5. Design of nuclear power plant	**P1.** Choose the components of the power plant

	P2. Select the burning fuel **P3**. Create layout diagram on table or on floor where to be install all the components **P4**. Assembled all the components and make sure is it ok? **P5**. Calculate the pressure and mass flow rate of each component **P6**. Calculate the overall efficiency of the plant

Knowledge and Understanding

K1. Knowing about the introduction of the power plant

K2. Knowledge about the components of the power plants

K3. Able to calculate the different kind of readings (Pressure, velocity, temperature, flow rate etc.)

K4. Able to control air, fuel gas, feed water, steam, lube oil hydrocarbon and other services

K5. Prepare the efficiency calculation of the plant

Tools & Equipment

- Various types of valves
- Pressure gauges
- Water resources
- Pipe lines
- Various types of compressor
- Fuel as a Coal,
- Space
- Filters
- Measuring Devices with sensors
- Manual of the power plant
- Manual of safety precautions
- Economizer

0715-M&MT-42. Demonstrate/ Operate/ Overview of Wind Power Plant

Overview: This competency standard covers the skills and knowledge required to Design Wind Power Plant and Install/Maintain & Repair of Wind Power Plant

Competency Units	Performance Criteria
CU1: Design Wind Power Plant	**P1**. Quantifies customers' energy needs including peak-load demand **P2**. Identifies suitable site based on soil types and obstructions **P3**. Determine minimum tower height **P4**. Estimates wind shear, average annual wind speed and turbulence **P5**. Establishes system performance expectations **P6**. Selects major components and determines general configuration **P7**. Identifies zoning, building permit, setback, right-of-way and FAA requirements **P8**. Determines appropriate footer, tower configuration/design, earth anchors and guy lengths based on site, soil, structural code requirements and equipment manufacturer specifications **P9**. Determines wire sizing, de-rated implicitly, voltage drops, over-current and disconnect devices and Appropriate grounding based on equipment manufacturer specifications.
CU2: Install/Maintain & Repair of Wind Power Plant	**P1**. Reads and follows plans, drawings, schematics and installation manuals **P2**. Ensures proper assembly and safe installation of tilt-up towers and turbine including fasteners and guy cables and appropriate tensioning of cables **P3**. Utilizes crane operator signals and protocols when working with a crane operator **P4**. Installs all electrical components including inverters, controllers, grounding, lightning, surge and over current protection devices, junction boxes, batteries, disconnects and monitoring equipment according to NEC and equipment specifications **P5**. Programs, adjusts and configures inverters and controllers for desired set-points and operating modes **P6**. Visually inspects mechanical installation for structural integrity **P7**. Verifies proper wiring practice, polarity or phase, grounding and integrity of terminations Observes and listens to turbine and equipment to determine if system is operating correctly **P8**. Checks fasteners and guy cables for proper tension **P9**. Verifies and demonstrates complete functionality and performance of the system including start-up, shut-down, normal operation and emergency or bypass operation **P10**. Performs mechanical and electrical diagnostic procedures, implementing service procedures for the tower, fasteners, guy wires, turbine, wiring, grounding system, lightning protection and batteries **P11**. Identifies and corrects performance issues and safety concerns

Knowledge and Understanding

K1. Has knowledge of location of material and parts storage

K2. Has knowledge of lifting equipment and ability to access manufacturer's specifications

K3. Has knowledge of wind turbine components and how they interact

K4. Has knowledge of how the site collection system operates and interacts with the substation

K5. Is able to test for and determine status of wind turbines

K6. Is knowledgeable of normal operations of wind turbines and the ability to acquire and verify base line readings

K7. Knowledge able of standard operating procedures, documentation requirements and required logs

K8. Understands how plant systems interrelate and the impact of this interrelationship on plant performance

K9. Is knowledgeable of industry, plant, company, equipment, scientific, technical, tool, safety and personnel terminology

K10. Is knowledgeable of corrective actions and responses for specific problems

K11. Is able to read and document equipment histories and trend data

K12. Is knowledgeable of the types of adjustments to make on equipment and the correct quantity of adjustment

0715-M&MT-43. Operating Solar Power Plant

Overview: This competency standard covers the skills and knowledge required to identify parts of solar plant, assemble solar module, install active solar system and activate photovoltaic system

Competency Units	Performance Criteria
CU1. Identify parts of solar plant	**P1**. Differentiate between the types (poly, mono or multi crystal) of solar and select according to the requirement **P2**. Observe sun behavior and get the peak hour of the solar radiation **P3**. Calculate required load **P4**. Choose parts like (photovoltaic panel, batteries, invertor or convertor as per requirement)
CU 2. Assemble solar module	**P1**. Differentiate between the types (poly, mono or multi crystal) of solar and select according to the requirement **P2**. Observe sun behavior and get the peak hour of the solar radiation **P3**. Calculate required load **P4**. Choose parts like (photovoltaic panel, batteries, invertor or convertor as per requirement) **P5**. Select solar stand capacity
CU3.Install active solar system	**P1**. Differentiate between the types (poly, mono or multi crystal) of solar and select according to the requirement **P2**. Observe sun behavior and get the peak hour of the solar radiation **P3**. Calculate required load **P4**. Choose parts like (photovoltaic panel, batteries, invertor or convertor as per requirement) **P5**. Select solar stand capacity **P6**. Read manual carefully and then install according to the given instructions
CU4.Activate photovoltaic system	**P1**. Differentiate between the types (poly, mono or multi crystal) of solar and select according to the requirement **P2**. Observe sun behavior and get the peak hour of the solar radiation **P3**. Calculate required load **P4**. Choose parts like (photovoltaic panel, batteries, invertor or convertor as per requirement) **P6**. Read manual carefully and then install according to the given instructions **P7.** Perform electrical connection by keeping in mind about the positive and negative priorities

Knowledge and Understanding

K1. Knowing about the solar technology

K2. Able to calculate the sun angle

K3. Keep knowledge of the solar power plant parts

K4. Perform mathematical relationships between the radiations (input) and load (output)

K5. Select power controllers

K6. Select power storage capacity unit

K7. Basic knowledge of the fitter

K8. Basic knowledge of the electrical systems

Tools & Equipment

- Open air space without shadows
- Photovoltaic Cells
- Measuring Devices (DMM, Thermometer, radiation controller) with sensors
- Manual of the components (panel, battery, invertor or convertor etc…)
- Manual of safety precautions
- Best quality copper wires without resistance
- Open air space without shadows
- Photovoltaic Cells
- Mechanical Tool kit with all testing meters (DMM, solar meter etc…)

0715-M&MT-44. Design and operation of Hydel Power Plant

Overview: This competency standard covers the skills and knowledge required to operation of hydro-power plant and visit to hydel power Plant

Competency Units	Performance Criteria
CU1: Operate Hydro-Power Plant	**P1**. Identifies and addresses malfunctions of hydroelectric plant operational equipment, such as generators, transformers and turbines **P2**. Monitors hydroelectric power plant equipment operation and performance, adjusting to performance specifications, as necessary **P3**. Starts, adjusts and stops generating units, operating valves, gates or auxiliary equipment in hydroelectric power generating plants **P4**. Communicates status of hydroelectric operating equipment to dispatchers or supervisors **P5**. Implements load and switching orders in hydroelectric plants in accordance with specifications or instructions **P6**. Inspects water-powered electric generators and auxiliary equipment in hydroelectric plants to verify proper operation and to determine maintenance or repair needs **P7**. Installs and calibrates electrical and mechanical equipment, such as motors, engines, switchboards, relays, switch gears, meters, pumps, hydraulics and flood channels **P8**. Maintains logs, reports, work requests and other records of work performed in hydroelectric plants **P9**. Maintains or repairs hydroelectric plant electrical, mechanical and electronic equipment, such as motors, transformers, voltage regulators, generators, relays, battery systems, air compressors, sump pumps, gates and valves **P10**. Operates high voltage switches and related devices in hydropower stations
CU2: Visit to Hydel Power Plant	**P1**. Arrange a visit to Hydel Power Plant for better understanding about the cycle and operation of the plant, after completely demonstrate the cycle and after successful visit students will submit a grand visit report and a presentation clearly mentioning what they have learnt during the visit, and what is the difference in theatrical and practical knowledge.

Knowledge and Understanding

- **K1.** Defines hydropower
- **K2.** Explains how hydropower works
- **K3.** Describes ways that hydropower can be utilized without harming fish and wildlife

K4. Defines marine energy

K5. Explains how marine energy works

K6. All the schematic of Hydel Power Plant

0715-M&MT-45. Operate Biomass Power Plant

Overview: This competency standard covers the skills and knowledge required to Recover Energy from vegetables waste, Design Biogas Power Plant and Operate Biogas Power Plant

Competency Units	Performance Criteria
CU1: Recover Energy from vegetables waste.	**P1**. **Strategic issue**: Using wood as an energy source represents a strategic issue. The use of wood as energy source contributes for energy independence of the country. A country energy availability and self-sufficiency represent an economic stability factor towards global fluctuations in the cost of fossil fuels. **P2**. **Economic and Social Issue**: The ability to generate primary energy at home and in their own areas of consumption, represents the possibility of injecting local investments to generate this energy, but also save money or prevent the export of foreign currency. Represents an additional option to generate wealth, to move the economy and create jobs. The electricity generated from diesel fuel, costs about 9times more than the electricity generated from biomass from waste wood from planted forests. **P3**. Environmental Protection Using wood as an energy source to replace fossil fuels in industry, limits the growth of greenhouse gases by reducing emissions of carbon dioxide - CO2 - and removes the pollution by sulfur, absent in the wood. Energy recovery from waste wood industry, for example, also avoids polluting by the burning of waste in the open, and the acidification of groundwater or watercourses caused by their improper deposition.
CU2: Design Biogas Power Plant	**P1**. Chose type of the boiler **P2**. Choose the type of Super heater. **P3**. Choose the type of furnace & Grate. **P4**. Choose the type of fuel. **P5**. Choose the type of turbine. **P6**. Choose the type of Re-heater if required. **P7**. Choose the type of Alternator. **P8**. Choose the type of Condenser & Cooling Tower. **P9**. Choose the type of makeup water pump. **P10**. Choose the type of condensate pump. **P11**. Choose the type of Feed Pump. **P12**. Choose the type of economizer & Pre-heater.
CU3: Operate Biogas Power Plant	**P1.** Measures and monitors raw biomass feedstock, including wood, waste or

	refuse materials **P2.** Operates valves, pumps, engines or generators to control and adjust production of biofuels or biomass-fueled power **P3.** Performs routine maintenance or make minor repairs to mechanical, electrical or electronic equipment in biomass plants **P4.** Assesses quality of biomass feedstock **P5.** Calculates, measures, loads or mixes biomass feedstock for power generation **P6.** Calibrates liquid flow devices or meters, including fuel, chemical and water meters **P7.** Inspects biomass power plant or processing equipment, recording or reporting damage and mechanical problems **P8.** Operates biomass fuel-burning boiler or biomass fuel gasification system equipment in accordance with specifications or instructions. **P9.** Operates equipment to heat biomass, using knowledge of controls, combustion and firing mechanisms **P10.** Operates equipment to start, stop or regulate biomass-fueled generators, generator units, boilers, engines or auxiliary systems **P11.** Calculates, measures, loads or mixes refined feedstock used in biofuels production **P12.** Operates chemical processing equipment for the production of biofuels **P13.** Operates equipment, such as a centrifuge, to extract biofuels products and secondary by-products or reusable fractions **P14.** Operates valves, pumps, engines or generators to control and adjust biofuels production **P15.** Processes refined feedstock with additives in fermentation or reaction process vessels **P16.** Assesses the quality of biofuels additives for reprocessing **P17.** Calibrates liquid flow devices and meters including fuel, chemical and water meters **P18.** Collects biofuels samples and performs routine laboratory tests or analyses to assess biofuels quality **P19.** Inspects biofuels plant or processing equipment regularly, recording or reporting damage and mechanical problems **P20.** Measures and monitors raw biofuels feedstock

Knowledge and Understanding

K1. All relevant knowledge related to biogas Power Plant

K2. The PNG Biomass power plant will be operated by about 30-40 staff – most will be employed locally from PNG. Staff will include operators – running the plant via computer-controlled systems, mechanical and electrical technicians and fuel handling and plant maintenance roles.

K3. Construction of Biomass Cogeneration systems is, that will produce both electricity and useful heat, configure the most rational technology for the use of fuels. This is the case of the ethanol, pulp and paper industries, which in addition of the electrical and thermal power required, also have residual fuels that are integrated in a favourable manner to the cogeneration process. Cogeneration is used widely in the world, including incentives from governments and from energy distribution companies, knowledge of grate.

K4. Complete schematic diagram and working principle of biogas power plant

K5. Defines biofuels (e.g. ethanol, biodiesel and methanol)

K6. Outlines the pyramid of energy flow, including the different trophic levels

K7. Describes the major sources, scale and impacts of biomass energy

0715.7 Calibration

0715-M&MT-46. Calibrate Mechanical Standards

Overview This competency standard covers the skills and knowledge required to calibrate the measuring devices, machines, tools and equipment by comparing them with the international standards of institutes and systems like ASME, ASHRAE, SMEP, ASCI, ASTM, ANSI standards.

Competency Units	Performance Criteria
CU1: Comparison of devices to be calibrated with the international standards upon which the device, machine or equipment is designed.	**P1.** Choose the right standard which are to be used for the purpose of calibration of the measurement tools, devices, machines and equipment's either we are using the ASME, ASCI, ASHRAE, SI, FPS, MKS CGS systems.

Knowledge & Understanding

K1. Calibration Tolerance: Every calibration should be performed to a specified tolerance. The terms tolerance and accuracy are often used incorrectly. In ISA's The Automation, Systems, and Instrumentation Dictionary, the definitions for each are as follows:

K2. Accuracy: The ratio of the error to the full-scale output or the ratio of the error to the output, expressed in percent span or percent reading, respectively.

K3. Tolerance: Permissible deviation from a specified value; may be expressed in measurement units, percent of span, or percent of reading.

K4. Accuracy Ratio: This term was used in the past to describe the relationship between the accuracy of the test standard and the accuracy of the instrument under test.

K5. Traceability: All calibrations should be performed traceable to a nationally or internationally recognized standard. For example, in the United States, the National Institute of Standards and Technology (NIST), formerly National Bureau of Standards (NBS), maintains the nationally recognized standards. Traceability is defined by ANSI/NCSL Z540-1-1994 (which replaced MIL-STD-45662A) as "the property of a result of a measurement whereby it can be related to appropriate standards, generally national or international standards, through an unbroken chain of comparisons." Note this does not mean a calibration shop needs to have its standards calibrated with a primary standard. It means that the calibrations performed are traceable to NIST through all the standards used to calibrate the standards, no matter how many levels exist between the shop and NIST. Traceability is accomplished by ensuring the test standards we use are routinely calibrated by "higher level" reference standards. Typically the standards we use from the shop are sent out periodically to a standards lab which has more accurate test equipment. The standards Cable05.book Page 4 Wednesday, December 8, 2004 9:36 AM Calibration 5 from the calibration lab are periodically checked for calibration by "higher level"

standards, and so on until eventually the standards are tested against Primary Standards maintained by NIST or another internationally recognized standard.

Tool &Equipment

- Standard Charts

0715-M&MT-47. Calibrate Mechanical Measuring Instruments/Tools

Overview This competency standard covers the skills and knowledge required to calibrate the measuring devices like Vernier calipers, micrometer screw gauge, dial gauge indicator, calibrate pressure and temperature gauges, calibrate pressure and temperature sensors, and calibrate tachometer.

Competency Units	Performance Criteria
CU1: Calibrate Vernier Caliper	**P1.** First of all, close the both jaws of Vernier Caliper. **P2.** Check the zero error **P1.** If there is any zero error then open up the jaws and precisely match the both jaws and then assemble the device **P4.** Again, close the jaws and check the zero error, if both the zeros of Vernier scale and main scales are matching in same location then the caliper is calibrated.
CU2: Calibrate Micrometer Screw Gauge	**P1.** First of all, close the both jaws of Micrometer Screw Gauge **P2.** Check the zero error **P3.** If there is any zero error then open up the jaws and precisely match the both jaws and then assemble the device **P4.** Again, close the jaws and check the zero error, if both the zeros of Vernier scale and main scales are matching in same location then the micrometer is calibrated.
CU3: Calibrate Dial Gauge	**P1.** First of all, place the gauge on a flat surface and check its correctness **P2.** Check the zero error **P3.** If there is any zero error then check the push needle, either its loose or tight? If lose then open the spring and replace it. **P4.** If pin is working properly then, there are two possibilities either it would be the surface base plate fault or the gauge's needle's fault. **P5.** Check the surface flatness base plate **P6.** If everything is working properly then disassemble the gauge and start fixing its needle by checking its position. **P7.** After fixing the inside needle, close the gauge and check its zero error again, if it is giving exact value then the gauge is calibrated.
CU4: Calibrate Gauges	**P1.** First of all, verify the type of gauge **P2.** Check the zero error

	P3. If there is any zero error then disassemble the gauge very carefully by pouring the fluid in a clean bowl **P4.** After dismantling each component of the gauge now check the needle's base either its loose or tight, if loose the fix the problem **P5.** Assemble the gauge and check its zero error, if needle is on exactly upon zero then the gauge is calibrated
CU5: Calibrate Sensors	**P1.** Make it sure which type of sensor is to be calibrated, first **P2.** Trace the fault **P3.** After knowing the fault, fix it
CU6: Calibrate Tachometer	**P1.** Check the speed of any revolving part by using the tachometer **P2.** If rpm is not directly proportional to the regulatory switch, like by increasing or decreasing it had some fluctuations, then it needed to be fix **P3.** Carefully, dismantle the device and find the fault, either it is mechanical issue or some electronic issue

Knowledge & Understanding

K1. What is Vernier caliper?
K2. What are the main components of Vernier Caliper?
K3. What is main scale and Vernier Scale?
K4. How to open/close the VC
K5. What is least count of VC
K6. What is Micrometer Screw gauge?
K7. What are the main components of Micrometer Screw Gauge?
K8. How to open/close the micrometer
K9. What is least count of micrometer?
K10. What is Dial Gauge?
K11. What is gauge?
K12. What are the different types of gauges?
K13. How to open/close the gauge
K14. How to fix the needle
K15. Knowledge of all types of sensors used in mechanical field
K16. Knowledge of working of all types of sensors used in mechanical field
K17. Pre-knowledge of all types of rotating devices.
K18. Knowledge of measuring devices used to measure speed
K19. Terminologies involved in speed and rpm

Tool & Equipment

- Vernier Caliper
- Plier
- Screw Driver
- Scale
- Oil
- Micrometer Screw Gauge
- Gauge
- Plier
- Sensors
- Sensor calibrator
- Tachometer
- Tachometer tools
- Nose plier
- Soldering iron
- Soldering wire

0715-M&MT-48. Calibrate Mechanical Machines

Overview This competency standard covers the skills and knowledge required to Calibrate Power/Circular Heck Saw, Calibrate Lathe Machine, Calibrate Drilling Machine, Calibrate Shaper/Planer Machine, Calibrate CNC Machine, Calibrate Slotter Machine, Calibrate Milling Machine, Calibrate Hobbing Machine, Calibration of Grinding Machine, Calibrate Arc Welding Plant (Digital)

Competency Units	Performance Criteria
CU1: Calibrate Power/Circular Heck Saw	**P1.** Check the teeth of hacksaw **P2.** Check the bottom and top dead centers of the hacksaw **P3.** Check the speed/velocity of one cycle of the hacksaw
CU2: Calibrate Lathe Machine	**P1.** Perform operation on lathe machine and analyze the chuck, tool post, tail stock, barrel, motor, gear, tools, face plate and check thoroughly to trace the fault **P2.** Identify the faults by rotating each circular chuck and handles of the lathe machine **P3.** Dismantle the machine part and fix the problem and assemble the part again and then check the correctness
CU3: Calibrate Drilling Machine	**P1.** Determine the desired seeding rate using the current lot of seed **P2.** Set the drill to the seeding rate desired **P3.** Jack the driving wheel of the drill up, turn 20 revolutions, catching the seed from 1 run of the seed drill in the bag or sack. Weigh sack to determine pounds of seed collected. **P4.** Determine strip length **P5.** determine the current seeding rate of the drill:
CU4: Calibrate Shaper/Planer Machine	**P1.** Perform operations on shaper and planar machines to diagnose the faults, normally experienced faults are the speed of the quick return mechanisms so it needs to be working on replacing or maintenance
CU5: Calibrate CNC Machine	**P1.** Identifying Positional Errors **P2.** Straightness error **P3.** Pitch and yaw errors **P4.** Roll Errors **P5.** Squareness errors
CU6: Calibrate Slotter Machine	**P1.** Check the sloter machine tool and fixture, and diagnose the fault if any

	P2. After diagnosing the fault, it needs to be repair
CU7: Calibrate Milling Machine	**P1.** Operate the milling machine and observe the operation like spindle movement, bed movement and if there is any fault in bed movement note it down. **P2.** Check the alignment of bed by measuring the surface by surface gauge.
CU8: Calibrate Hobbing Machine	**P1.** Check the operation of hobbing gear cutting machine, common type of faults are its tool and chuck alignment, carefully repair it.
CU9: Calibration of Grinding Machine	**P1.** Check the drill chuck (spindle), is it loose of tight. **P2.** Vary the spindle speed **P3.** Change the bush if required
CU10: Calibrate Arc Welding Plant (Digital)	**P1.** Connect the cable clamp electrode to the positive terminal of the welding machine to be tested **P2.** Connect the ground lead plate test and the negative terminal of the welding machine **P3.** Connect the welding machine; **P4.** Set the lever in the desired position amp **P5.** Engage with the volt-ammeter clamp the cable clamp electrode **P6.** Carry out the reading of the clamp volt-ampere ammeter, comparing it with the values shown on the recorder panel welding machine. **P6.** If there is some problem in working then check the electronic card if it needed to be replace then replace it and then start the plant operation.

Knowledge & Understanding

- **K1.** Complete knowledge of circular and power hacksaws
- **K2.** Had a complete knowledge of all types of lathe machines, turret lathe, capstan lathe, copy lathe, etc
- **K3.** Using the current seed lot, determine the pounds per acre of bulk seed that is needed.
- **K4.** Bulk seed of current lot needed (lbs/ac) = Desired rate of seed in PLS (lbs/ac) % PLS of current seed lot
- **K5.** Circumference is the measurement around the outside of the tire in feet. This is easily accomplished by measuring the circumference of the wheel with a tape measure.
- **K6.** *** Remember it needs to be in feet!
- **K7.** Strip length (in shop) = 1.1(No. of revolutions X wheel circumference (ft)

K8. Seeding rate in bulk seed (lbs/ac) = 43560 ft2 /ac X lbs seed collected Drill width (ft) X Strip Length (ft)

K9. The job is rigidly fixed on the machine table. The single point cutting tool held properly in the tool post is mounted on a reciprocating ram. The reciprocating motion of the ram is obtained by a quick return motion mechanism. As the ram reciprocates, the tool cuts the material during its forward stroke. During return, there is no cutting action and this stroke is called the idle stroke. The forward and return strokes constitute one operating cycle of the shaper

K10. Laser interferometer, Step gauge, and Gauge blocks, end bars, ball arrays.

K11. Straightness interferometer, Mechanical and optical straight edge,

K12. Alignment telescope with target, Alignment laser. Displacement indicator or sensors, taut wire etc.

K13. Differential interferometer, Mechanical and Electronic level, Autocollimator, Measurement of positional error along lines with different Abbe's offset. Angular laser interferometer.

K14. Electronic levels, Reference Flat, Measurement of straightness errors of two parallel lines

K15. Optical and Mechanical Squareness standard, Length standard inclined under defined angles. Diagonal measurements.

K16. Cutting grooves, keyways and slots of various shapes.

K17. Used for making regular and irregular surfaces both internal and external.

K18. For handling large and awkward workpiece.

K19. For cutting internal or external gears and many other operations which cannot be easily machined in any other machine tool described before.

K20. Knowledge of milling cutters, gang milling, surface finishing.

K21. Knowledge of horizontal milling machine and vertical milling machine.

K22. Knowledge of vertical and horizontal gear hobbing machine

K23. Hand-cranked knife-sharpening stones (grindstones)

K24. Handheld power tools such as angle grinders and die grinders.

K25. Various kinds of expensive industrial machine tools called grinding machines.

K26. Bench grinders

K27. Complete knowledge of arc welding, safety equipment etc.

Tool &Equipment

- Mechanical Tool Kit
- Lathe Machines
- Drilling machines
- Shaper Machine
- Planar Machine
- CNC Milling Machine
- CNC Lathe Machine
- Tool Kit Electrical

- Laser
- Tachometer
- Slotter Machine
- Vertical Milling
- Horizontal Milling
- Vertical Gear Hobbing machine
- Horizontal Gear Hobbing machine
- Bench grinders
- Hand grinders
- Grinding tools
- Arc Welding Plant

0715-M&MT-49. Calibrate Mechanical Equipment

Overview: This competency standard covers the skills and knowledge required to calibrate universal testing machine, for compression strength, bend strength, shear strength of material using universal testing machine, impact Testing Machine Equipment using Charpy tester and Calibrate hardness testing machine (Rockwell hardness tester).

Competency Units	Performance Criteria
CU1. Calibrate universal testing machine up to standards	**P1**. Check all the dimensions/positions of the chucks of Tensile, Compressive and bending as per standards. **P2**. If there is any error, diagnose it and read carefully the manual and **P3**. Prepare the machine for testing. **P4**. Check the machine as per default readings.
CU2- Calibrate impact Testing Machine Equipment using Charpy tester	**P1.** Calibrate the impact testing machine according to standards and defaults using manufacturer manuals and data. **P2**. Check the machine after calibration.
CU3- Calibrate hardness testing machine (Rockwell hardness tester)	**P1**. Calibrate the hardness testing machine according to defaults manufacturing. **P2**. Read the manuals and dismantle the machine. **P3.** Assemble the machine and check the readings according to manuals.

Knowledge & Understanding

K1. Material properties of common engineering materials/machines.

K2. Operation and maintenance of Universal testing machine.

K3. ASTM A 370

K4. ASTM E-23 18 Standard test methods for notched bar impact testing of metallic materials

K5. Basic knowledge of Hardness testing machine:

K6. Rockwell hardness tester

Tools & Equipment

- Universal Testing Machine
- Vernier Caliper
- Steel rule
- Charpy Impact Tester
- Tongs
- Holder for sample cantering
- Rockwell Hardness Tester
- Spirit Leveller

0715.8 Hydraulics and Hydraulic Machinery

0715-M&MT-50. Operate Hydraulic Bench and Its Functions

Overview: This competency standard covers the skills and knowledge required to provide knowledge for observing Hydraulic Bench, identify various standard parts of Hydraulic Bench and its main functions.

Competency Unit	Performance Criteria
CU-1: Identify parts of hydraulic bench	**P-1.** Enlist all parts of a Hydraulic Bench **P-2.** Identify Control valve, Drain valve and Dump valve. **P-3.** Identify Sump Tank and Volumetric Tank. **P-4.** Identify Open Channel and Vertical Pipe. **P-5.** Identify Centrifugal Pump **P-6.** Identify Actuators
CU-2: Identify/perform Various Functions of/on Hydraulic Bench	**P-1.** Ensure that pump is switched off. **P-2.** Set up the device to be tested. **P-3.** Attach a water supply for open channel flow or a close conduct device to the water inlet. **P-4.** Ensure that all connections are secure. **P-5.** Ensure that supply valve is closed, and dump valve is open. **P-6.** Turn the pump on. **P-7.** Open slowly the supply valve to allow water to circulate the bench. **P-8.** Make appropriate measurement in the device being tested for a given setting of supply valve e.g. pressure reading, water depths etc. **P-9.** Closedown the supply valve upon the completion of test. **P-10.** Turn off the valve. **P-11.** Disconnect the device used for testing.

Knowledge and Understanding

K1. Describe the purpose of a Hydraulic Bench
K2. Explain the working of a hydraulic bench with help of circuit diagram.
K3. Describe the importance of Centrifugal pump in a Hydraulic Bench.
K4. Describe the function of Main Tank and of Sump Tank.
K5. Explain the purpose and working of Control valve, Drain Valve and Dump Valve.
K6. Describe centrifugal pump
K7. Differentiate between sump tank and volumetric tank
K8. Differentiate control valve, drain valve and dump valve
K9. Differentiate main channel and side channels
K10. Describe water level indicator

K11. Describe stilling baffle

K12. Differentiate between overflow and starter

K13. Read a Schematic Diagram of Hydraulic Bench

Apparatus

Hydraulic bench

- Control Valve
- Centrifugal pump
- Sump tank
- Vertical pipe
- Channel
- Drain valve
- Volumetric tank
- Water Level Indicator
- Dump valve
- Actuators
- Side Channel

0715-M&MT-51. Calibrate Bourdon Tube and Diaphragm Pressure Gauge

Overview: This competency standard covers the skills and knowledge required to record the working principle of mechanical Pressure gauges and incorporate the Calibration Methods for Mechanical Gauges.

Competency Units	Performance Criteria
CU-1: Caliberate Bourdon Tube using dead wight Pressure gauge and master gauge Caliberator	**P-1.** Connect Bourdon Tube with the dead weight pressure gauge. **P-2.** Fill the cylinder of dead weight pressure gauge with water. **P-3.** Place a known weight on the plunger of the dead weight pressure gauge. **P-4.** Note the pressure reading of the gauge to be calibrated. **P-5.** Add more weights of known values and note corresponding pressure readings. **P-6.** Compare these readings with the values in the table. **P-7.** Also compare dead weight gauge with the master gauge.
CU-2: Caliberate Diaphragm Pressure Gauge using dead wight pressure gauge and master gauge Caliberator	**P-1.** Connect the Diaphragm Pressure Gauge with the dead weight pressure gauge. **P-2.** Fill the cylinder of dead weight pressure gauge with water. **P-3.** Place a known weight on the plunger of the dead weight pressure gauge. **P-4.** Note the pressure reading of the gauge to be calibrated. **P-5.** Add more weights of known values and note corresponding pressure readings. **P-6.** Compare these readings with the values in the table. **P-7.** Also compare dead weight gauge with the master gauge.

Knowledge & Understanding

- **K1.** Define a pressure gauge
- **K2.** Describe basic types of pressure gauges
- **K3.** Describe Bourdon tube gauge
- **K4.** Differentiate between measuring gauge and calibration gauge
- **K5.** Describe dead weight pressure gauge
- **K6.** Describe Pascal's Law
- **K7.** Describe Diaphragm pressure gauge.
- **K8.** Describe master gauge calibrator
- **K9.** Describe calibration Method and Frequency
- **K10.** Describe Pascal's Law

Apparatus

- Deadweight gauge Tester
- Weights
- Master Gauge Calibrator

- Bourdon Tube

- Deadweight gauge Tester

- Weights

- Master Gauge Calibrator

- Diaphragm Pressure Gauge

0715-M&MT-52. Operate Hydraulic Press

Overview: This competency standard covers the skills and knowledge required to operate a hydraulic press and observe power required to drive it.

Competency Unit	Performance Criteria
CU-1: Operate hydraulic press	**P-1.** Prepare the work piece as per size requirement. **P-2.** Inspect the press for oil level and other necessary elements. **P-3.** Turn on the hydraulic press and select the load according to the thickness of the material. **P-4.** Place the work piece between the die and bench. P-**5.** Exert a force on the work piece with the help of punch. This would prepare the work piece to fit in the die. **P-6.** Turn off the hydraulic press and note all observations and calculate power required to drive the hydraulic press.
CU-2: Obseve the power requirement to drive a Hydraulic press	**P-1.** Prepare the work piece as per size requirement. **P-2.** Inspect the press for oil level and other necessary elements. **P-3.** Turn on the hydraulic press and select the load according to the thickness of the material. **P-4.** Place the work piece between the die and bench. **P-5.** Exert a force on the work piece with the using the punch of the press. This would prepare the work piece to fit in the die. **P-6.** Turn off the hydraulic press and note all observations. **P-7.** Enter values of Area of Ram, Area of Plunger, length of the stroke of the Plunger, loaded arm and weight lifted by the arm in the Formula to calculate the power required.

Knowledge and Understanding

- **K1.** Define a hydraulic press
- **K2.** Describe construction of a hydraulic press
- **K3.** Describe working principle of hydraulic press.
- **K4.** Describe Pascal's Law.
- **K5.** Enlist all the parameters involved in Formula.
- **K6.** Explain Mechanical Advantage of a machine.

Apparatus

- Plunger
- Ram
- Chamber
- Weight

0715-M&MT-53. Verify Bernoulli's Equation

Overview: This competency standard covers the skills and knowledge required to verify Velocity Head, Pressure head and Datum Head as well as Law of Conservation of Energy by measuring pressure and velocity at various points.

Competency Unit	Performance Measure
CU-1: Verification of Velocity Head, Pressure Head and Datum Head	**P-1.** Open inlet valve of hydraulic bench supply tank to allow the water to flow out of the tank. **P-2.** Adjust the valves to obtain continuous flow at inlet and outlet valve. **P-3.** Ensure continuous pressure head in the piezometer tube and note the reading. **P-4.** Determine the water quantity collected in the measuring tank during the time noted by stop watch. **P-5.** Determine the cross-sectional area of piezometer tube. **P-6.** Calculate the velocity head and pressure head. **P-7.** Change input and output supply and note the readings.
CU-2: Observe the performance of friction pipe apparatus	**P-1.** Select a pipe of suitable size as per available equipment for the experiment. **P-2.** Start the flow of water in the pipe with the help of hydraulic bench. **P-3.** Observe the change in mercury level of U-tube manometer due to water flow in the pipe. **P-4.** Note h1 and h2. **P-5.** Note the time from stop watch to fill the water in the tank up to the height of 5 cm. **P-6.** Change the flow and repeat the procedure. **P-7.** Calculate coefficient of discharge.
CU-3: Examine loss of head due to sudden enlargement, Contraction and entrance in a pipe	**P-1.** Note the length and diameter of the pipe present between hydraulic bench and pressure tank. **P-2.** Keep the pressure tank, end of the, pipe open and the other end closed. **P3.** Turn on the power supply of the hydraulic bench. **P-4.** Start the flow water in the circuit. **P-5.** Adjust the flow up to maximum level. **P-6.** Determine the total discharge in the circuit with the help of left and right limbs of U-tube manometer. **P-7.** Keep the pressure tank, end of the, pipe close and the other end opened.

	P-8. Repeat the process.

Knowledge and Understanding

K1. Describe Bernoulli's theorem

K2. Describe piezometer tube

K3. Define velocity head

K4. Define pressure head

K5. Define Datum head

K6. Describe friction pipe apparatus

K7. Describe effects of friction on fluid flow

K8. Describe Differential type U-tube Manometer

K9. Define coefficient of discharge

K10. Explain Darey's friction factor

K11. Describe loss of head

K12. Describe co-efficient of loss

K13. Describe G.I. Pipes

Apparatus

- Hydraulic Bench
- Tapered inclined pipe fitted with number of piezometer tube points
- Measuring tank
- Scale
- Stop watch
- Pipe provided with inlet and outlet and pressure tapping
- Differential U-tube manometer
- Piezometer tube
- Flow circuit of G.I. Pipes of different fittings via Large bend, Small bend
- Sudden enlargement from 25 mm to 50 mm diameter
- Sudden contraction from 50 mm to 25 mm diameter.

0715-M&MT-54. Analyse the performance of Turbines

Overview: This competency standard covers the skills and knowledge required to observe and analyse impulse turbine as well as Reaction turbine.

Competency Units	Performance measures
CU-1: Analyze the performance of impulse turbine/ Pelton Wheel	**P-1.** Prime the pump with water **P-2.** Keep the nozzle-opening to the required position. **P-3.** Open the gate valve 1 or 2 rotations. **P-4.** Start the motor **P-5.** Allow the water into the turbine and the turbine will start rotating. **P-6.** Fix the weigh hanger to the rope of the brake drum with no load on weight hanger. **P-7.** By varying the gate vale, keep the head constant using the pressure gauge to the required head in case of experiment on constant head or keep the speed constant using the tachometer to the required speed in case of experiment on constant speed. **P-8.** Note down the following readings: • Pressure gauge reading G • Vacuum gauge reading V • Speed of the turbine N • Manometer readings h1, and h2 • Load on weight hanger T1 • Spring balance reading indicating the frictional loss between the brake drum and rope T2 **P-9.** Repeat last step for different load conditions by varying the load on the weight hanger either to constant head or for constant speed **P-10.** Note down the above readings G, V, N, h1 and h2, T, T2 **P-11.** Take at least 5 sets of readings by varying the load **P-12.** Calculate the efficiency of the turbine
CU-2: Analyze the performance of Reaction Turbine/ Francis Turbine	**P-1.** Prime the pump with water **P-2.** Keep the nozzle-opening to the required position. **P-3.** Open the gate valve 1 or 2 rotations. **P-4.** Start the motor **P-5.** Allow the water into the turbine and the turbine will start rotating. **P-6.** Fix the weigh hanger to the rope of the brake drum with no load on weight hanger.

	P-7. By varying the gate vale, keep the head constant using the pressure gauge to the required head in case of experiment on constant head or keep the speed constant using the tachometer to the required speed in case of experiment on constant speed. **P-8.** Note down the following readings: • Pressure gauge reading G • Vacuum gauge reading V • Speed of the turbine N • Manometer reading h1, and h2 • Load on weight hanger T1 • Spring balance reading indicating the frictional loss between the brake drum and rope T2 **P-9.** Repeat last step for different load conditions by varying the load on the weight hanger either to constant head or for constant speed **P-10.** Note down the above readings G, V, N, h1 and h2, T, T2 **P-11.** Take at least 5 sets of readings by varying the load **P-12.** Calculate the efficiency of the turbine

Knowledge and Understanding

- **K1.** Describe working principle of Impulse Turbine
- **K2.** Describe Pelton wheel construction
- **K3.** Describe breaking jet
- **K4.** Describe nozzle function
- **K5.** Describe runner and bucket
- **K6.** Describe working principle of Reaction Turbine
- **K7.** Describe spiral casing purpose.
- **K8.** Describe function of guide mechanism.
- **K9.** Describe draft tube

Apparatus

- ❖ Hydraulic Bench
- ❖ Impulse Turbine (Pelton Wheel)
- ❖ Electric Circuit Supply
- ❖ Reaction Turbine (Francis Turbine)
- ❖ Generator assembly and Electric Circuit

0715-M&MT-55. Analyse the performance of Pumps

Overview: This competency standard covers the skills and knowledge required to observe and analyse centrifugal pump as well as reciprocating pump.

Competency Units	Performance
CU-1: Analyze the performance of Centrifugal Pump	**P-1.** Prime the pump **P-2.** Open the gate valve 1 or 2 rotations **P-3.** Start the motor and set the vacuum gauge reading to the required head **P-4.** Note down the following readings • Pressure gauge reading G • Vacuum Gauge Reading V • Time taken for 10 revolutions in the energy meter T • Time taken to fill up 200 cm rise in the collecting tank, t • The difference in the levels of the pressure and vacuum gauges, x **P-5.** Set the vacuum gauge reading to the other heads **P-6.** Note down the above readings G, V, T, and t **P-7.** Take at least 5 sets of readings by varying the head through delivery valve and note down the readings
CU-2: Analyse the performance of Reciprocating Pump	**P-1.** Prime the pump **P-2.** Open the gate valve 1 or 2 rotations **P-3.** Start the motor and set the vacuum gauge reading to the required head **P-4.** Note down the following readings • Pressure gauge reading G • Vacuum Gauge Reading V • Time taken for 10 revolutions in the energy meter T • Time taken to fill up 200 cm rise in the collecting tank, t • The difference in the levels of the pressure and vacuum gauges, x **P-5.** And then set the vacuum gauge reading to the other heads **P-6.** Note down the above readings G, V, T, and t **P-7.** Take at least 5 sets of readings by varying the head through delivery valve and note down the readings.

Knowledge and Understanding

K1. Describe centrifugal pump working principle
K2. Describe pump casing
K3. Describe impeller
K4. Describe suction pipe and delivery pipe
K5. Describe reciprocating pump

K6. Describe suction valve and delivery valve

K7. Describe crank and connecting rod mechanism

K8. Describe suction and delivery pipe

K9. Describe function of Piston

K10. Differentiate between centrifugal and reciprocating pump.

Apparatus

- Centrifugal Pump
- Test Bench
- Pipe Hoses
- Voltmeter
- Ammeter
- Reciprocating Pump
- Tachometer
- Stop watch
- Pressure gauge
- Energy meter

0715-M&MT-56. Actuate Double Acting Hydraulic Cylinder

Overview: This competency standard covers the skills and knowledge required to actuate a double acting hydraulic cylinder by a switch, speed regulation through throttle valve and flow control valves. It also explains actuation of double acting hydraulic cylinder by one-way throttle valve.

Competency Unit	Performance Criteria
CU-1: Actuate double acting hydraulic cylinder by switch and draw a circuit diagram	**P-1.** Complete all connections of hydraulic circuit as per drawing **P-2.** Turn on the push button switch to start the supply of fluid with which double acting cylinder will start moving **P-3.** Move the piston to initiate the supply from forward stroke **P-4.** Turn on the second push button switch after the piston reaches top dead center. This will start supply in the opposite direction **P-5.** Observe the functions from control valve by varying its speed after the completion of supply in the circuit **P-6.** Note all observations.
CU-2: Actuate double acting hydraulic cylinder by oneway throttle valve	**P-1.** Prepare the hydraulic circuit as per drawing **P-2.** Turn on the circuit power supply and ensure that all accessories are working properly **P-3.** Ensure throttle valve on return line of the circuit works properly. **P-4.** Open the valve and ensure extra supply of oil to observe quick return of cylinder. **P-5.** Observe cylinder speed at various positions of the valve. **P-6.** Note all the observations

Knowledge and Understanding

- **K1.** Describe types of hydraulic cylinder
- **K2.** Describe Double acting hydraulic circuit
- **K3.** Describe direction control valve
- **K4.** Describe function of push button
- **K5.** Describe throttle valve function
- **K6.** Describe one way throttle valve
- **K7.** Explain role of cylinder speed

Apparatus

- Hydraulic bench
- Double acting cylinder
- Pipe hoses and fittings
- Pressure gauges
- Flow control valve
- Direction control valve
- Push button

0715-M&MT-57. Setup a Pressure Device and Hold Specific Load on a Double Acting Cylinder

Overview: This competency standard covers the skills and knowledge required to use pressure reducing valve on double acting cylinder and holding load on double acting cylinder.

Competency Unit	Performance Criteria
CU-1: Set-up pressure device on a double acting cylinder using pressure reducing valve	**P-1.** Complete the hydraulic circuit as drawing given **P-2.** Turn on the circuit supply and check if all devices are working properly **P-3.** Ensure Fluid starts flowing and the initially adjusted pressure is passed on to the circuit while passing through the relief valve. **P-4.** Observe and note the pressure reading at various pressure gauges. **P-5.** Change direction with the help of DCV and ensure control of double acting cylinder according to this direction. **P-6.** Re-observe and re-note the readings on all the pressure gauges.
CU-2: Hold specific load using double acting cylinder	**P-1.** Complete the hydraulic circuit as per drawings. **P-2.** Turn on the circuit supply and check if all devices are working properly **P-3.** Adjust pressure according to desired/required load. **P-4.** Ensure fluid flow from port A. This would uplift the load. **P-5.** Now change the position of DCV and ensure fluid entrance from port B. **P-6.** Observe the downward motion of loaded ram. **P-7.** Take the pressure reading and observe the cylinder return.

Knowledge and Understanding

- **K1.** Describe pressure reducing valve
- **K2.** Describe purpose of double acting cylinder as a pressure device
- **K3.** Describe applications of double acting cylinder with the pressure pipe
- **K4.** Describe function of pilot operated check valve
- **K5.** Describe DCV
- **K6.** Describe the role of RAM

Apparatus

- Hydraulic Bench
- Double ACTING Cylinder
- Pressure reading valve
- DCV pipe hoses
- Pilot operated check valve
- Direction control valve

- Various loads

- Pipe hoses

- Pressure gauges

0715-M&MT-58. Construct Circuit of Double Acting Hydraulic Cylinder for Mechanical Interlocking

Overview: This competency standard covers the skills and knowledge required to construct a hydraulic cylinder for mechanical interlocking and use of push buttons, limit switch and stored energy in double acting hydraulic cylinder

Competency Unit	Performance Criteria
CU-1: Construct a hydraulic circuit for double acting hydraulic cyclinder for mechanical interlocking with switch	**P-1.** Complete the hydraulic circuit as per drawings. **P-2**. Turn on the circuit supply and check if all devices are working properly **P-3.** Operate hydraulic circuit **P-4.** Try lift some weight **P-5.** Drop the pressure using pressure gauge before the piston starts moving **P-6.** Construct Hydraulic Circuit Diagram **P-7.** Construct electric circuit diagram
CU-2: Construct circuit to control double acting Hydraulic Cylinder using 2 push buttons and canceling with limit switch	**P-1.** Prepare simulation circuit of double acting cylinder as per drawing **P-2.** Fix the push button and limit switch at their designated place as per drawing **P-3.** Turn on the circuit power supply and ensure proper working of all equipment. **P-4.** Press the push button to start fluid supply and will enable the cylinder for forward stroke supply. **P-5.** Observe that as the push rod touches limit switch the supply of coil would disconnect and the piston would stop. **P-6.** Press the second push button to complete backward stroke of piston, this will enable the supply of side coil and the backward stroke of piston would be completed and as it enters the surroundings of limit switches the supply would be disconnected. **P-7.** Change 5/2 DCV and complete the opposite circuit. **P-8.** Observe this changed circuit and note down all the observations.
CU-3: Construct hydraulic circuit using Accumulator stored Energy by DAC	**P-1.** Complete the hydraulic circuit as per drawing. **P-2.** Turn on the motor power supply and ensure proper working of all devises and equipment. **P-3.** Use flow control valve to ensure fluid flow. **P-4.** Observe the movement of piston rod. **P-5.** When the circuit is burnt/completed the turn off the power supply. **P-6.** Observe that due to accumulator the double acting cylinder completes its stroke and doesn't stop immediately after the burning of circuit.

CU4: Measure pressure at various connections in hydraulic circuits	**P-1.** prepare the hydraulic circuit as per drawing **P-2.** install pressure gauges on the points where pressure is to be noted **P-3.** Turn on the hydraulic circuit **P-4.** Ensure fluid flow through the whole circuit **P-5.** Complete the circuit and note the readings of all gauges **P-6.** Enter all readings in observation table

Knowledge and Understanding

- **K1.** Describe mechanical interlocking function
- **K2.** Describe the function of hydraulic circuit
- **K3.** Describe double acting hydraulic cylinder
- **K4.** Describe 3/2 push buttons
- **K5.** Describe 5/2 double acting side pilot operated DCV
- **K6.** Describe function of connecting tubes
- **K7.** Describe function of limit switches
- **K8.** Describe the role of accumulator
- **K9.** Describe mechanism of energy storage in accumulator
- **K10.** Describe working of hydraulic accumulator
- **K11.** Describe fluid port
- **K12.** Describe construction of hydraulic actuator
- **K13.** Describe function of actuators
- **K14.** Describe coupling
- **K15.** Describe functioning of chillers
- **K16.** Describe proximity switch or limit switch
- **K17.** Describe purpose of hydraulic circuit
- **K18.** Draw analogy between hydraulic and electrical circuit
- **K19.** Describe function of pressure control valve
- **K20.** Describe flow control valve

Apparatus

- Hydraulic bench
- Mechanical interlocking
- Double acting cylinder
- Fluid control valve
- DC pressure Gauges
- Double acting cylinder
- 3/2 push button
- 5/2 double acting side pilot operated DCV
- Contacting tubes
- Limit switch
- Pressure gauges
- Accumulator Flow Control
- DCV
- Pipe Hoses
- Pressure control valve
- Flow control valve
- Hydraulic pump hoses

0715-M&MT-59. Set Speed and Direction of Hydraulic Motor

Overview: This competency standard covers the skills and knowledge required to set-up a hydraulic motor using flow control valve and setting-up direction using direction control valve.

Competency Unit	Performance Criteria
CU-1: Set hydraulic motor R.P.M using flow control valve	**P-1.** Complete the hydraulic circuit as per drawing. **P-2.** Turn on the motor power supply and ensure proper working of all devises and equipment. **P-3.** Fix the tachometer with the rotor to note motor RPM **P-4.** Use flow control valve to control the flow, this would also control the motor RPM. **P-5.** Observe the speed during this process. **P-6**. Note RPM at different flow rates and analyze them.
CU-2: Set hydraulic motor direction by using direction control valve	**P-1.** Complete the hydraulic circuit as per drawing. **P-2.** Turn on the motor power supply and ensure proper working of all devises and equipment. **P-3.** Use DCV to rotor the motor Clockwise and Anti Clockwise. **P-4.** Observe the direction during this process. **P-5.** Repeat the process.

Knowledge and Understanding

- **K1.** Describe hydraulic motor
- **K2.** Describe operating principle of hydraulic motor
- **K3.** Describe tachometer
- **K4.** Describe flow control valve
- **K5.** Describe DCV

Apparatus

- Hydraulic bench
- Hydraulic motors
- Tachometer
- Flow control valve
- Direction control valve
- Pipe hoses
- Pressure gauges

0715-M&MT-60. Perform Pressure Measuring Instruments

Overview: This competency standard covers the skills and knowledge required to identify, and explain the construction and working of various pressure measuring devices.

Competency Unit	Performance Criteria
CU-1: U Tube Manometer	**P-1.** Set up the equipment. Connect one leg of manometer to the inlet port and the other leg to the outlet port. Initiate the flow of fluid through the test pipe. P-2. Observe the difference in head between the two legs of the manometer and record. P-3. Compute the pressure difference between the pipe inlet and outlet. P-4. Repeat the experiment for various flow rates of fluid through the test pipe.
CU-2: Inclined manometer	P-5. Set up the equipment. Connect one leg of inclined manometer to the inlet port and the other leg to the outlet port. Initiate the flow of fluid through the test pipe. P-6. Observe the difference in head between the two legs of the manometer and record. P-7. Compute the pressure difference between the pipe inlet and outlet. P-8. Repeat the experiment for various flow rates of fluid through the test pipe.
Cu-3: Micro Manometer	P-1. Observe the enlarged ends of both tubes of the manometer P-2. Adjust the instrument initially as p1 = p2. P-3. Note the reading of the micrometer P-4. Apply the unknown pressure difference P-5. Observe the meniscus to move off the hairline, which can be restored to the initial position by raising or lowering the well (mercury sump). P-6. Note the difference in the initial and final micrometer readings P-7. Note the height of the mercury column and hence the pressure.
CU-4: Pressure measurement in The Mercury Barometer	P-1. Take a reservoir and fill with any fluid P-2. Put a glass tube in the reservoir in inverted state P-3. Make the top portion of glass tube as air tight while the internal surface as complete vacuum P-4. When the glass tube is dipped in the tank, an improper balanced pressure is created P-5. Observe water from the tank rises in the tube P-6. Note that the water would rise to particular height/ limit P-7. Note that point where the water would stop lifting up P-8. This pressure noted directly from the scale of the tube would give us the

	exact atmospheric/ air pressure
CU-5: Borden Tube	P-1. Observe the device consisting of a metallic tube of elliptical section closed at one end A P-2. Note the other end B being fitted to the gauge point where the pressure is to be measured. P-3. Enter the fluid in the tube P-4. Observe the tube tending to straighten. P-5. Observe a pinion-sector arrangement pivoted with the pointer needle and already calibrated markings P-6. Note the small elastic deformation of the tube is communicated to a pointer over a graduated dial. P-7. Calibrate the device by subjecting it to various known pressures.
CU-6: Piezo Metric Tube	P-1. Close all the valves of the tubes manifold. P-2. Fill the tank until the lower part of the piezo metric tube is in contact with water. P-3. Connect the pump to the upper plug of the tank with the non-return valve in the correct direction and pressurize the tank. P-4. Observe if the water head in the piezo metric tube rises. P-5. Observe the level is kept constant when we stop to pressurize with the pump.
CU-7: Elastic Diaphragms	P-1. Observe the diaphragm fixed in a tubular member. P-2. Observe the initial pressure on a diaphragm P-3. Apply the unknown pressure from one side. P-4. Observe a direct connection between diaphragm and pinion-sector P-5. Observe a pinion-sector arrangement pivoted with the pointer needle and already graduated markings on the dial P-6. Note the small elastic deformation of the diaphragm is communicated to a pointer over the graduated dial.

Knowledge and Understanding

- **K1.** Differentiate between absolute pressure and gauge pressure
- **K2.** Differentiate between u tube inclined and differential manometer
- **K3.** Pressures as low as 0.025mm water column can be measured.
- **K4.** What is a barometer
- **K5.** What is the basic function of a barometer
- **K6.** Explain the selection process of a pressure gauge
- **K7.** Write the types of Bourdon tubes
- **K8.** Explain the purpose of different Bourdon tubes
- **K9.** Explain the formula for calculating a static head

K10. Convert a pressure gauge into a level gauge

K11. mention the units of Pressure

K12. Explain the necessity of putting the plug in the tank

K13. Explain natural frequency

Apparatus

- U Tube Manometer, Hydraulic Bench (if working fluid is water), Air Compressor (if working fluid is air), Scale

- Inclined Manometer, Hydraulic Bench (if working fluid is water), Air Compressor (if working fluid is air), Scale

0715-M&MT-61. Operate Flow Regulating Devices

Overview: This competency standard covers the skills and knowledge required to identify, evaluate and explain different types of valves.

Competency Unit	Performance Criteria
CU-1: Ball Valve	P-1. Identify various parts of the ball valve including Handle, shaft, Ball, Seats and valve body P-1. Observe a ball with a hole drilled through the center swivel mounted within the valve body P-2. Ensure the hole in the ball is orientated in the same direction as the pipe to allow flow P-3. Observe the hole in the ball is oriented away from the direction of the pipe, the flowrate will be restricted and finally cut off completely when the hole is oriented at 90 degrees to the pipe direction Note that the hole in the ball is a lesser diameter than the nominal bore of the pipe
CU-2: Butterfly Valve	P-1. Identify the gear box, handle, butterfly and the body of the butterfly valve P-1. Observe a circular disc in the middle of fluid pipe. P-2. Ensure the butterfly is oriented in the same direction as the pipe to allow full flow. P-3. Oriented the butterfly away from the direction of the pipe, the flowrate will be restricted by the increased area of obstruction to the fluid P-4. Keep the butterfly orienting away from the fluid until 90 degrees to completely restrict the flow
CU-3: Gate valve	P-1. Identify gate and body of the gate valve P-1. Identify the gate in the valve P-2. Identify the shape of the gate with respect to the pipe diameter P-3. Identify the direction of movement of the gate P-4. Ensure the complete upward motion of the gate for full flow of the fluid P-5. Ensure compete downward motion of the gate until the opposite end for complete restriction to the fluid flow.
CU-4: Diaphragm Valve	P-1. Identify bonnet, diaphragm/ flexible sheet, seat and main body of the valve P-2. Identify whether the valve is manual or pneumatic actuated P-3. observe the fluid flow rates from the pipe as the diaphragm is pushed towards the seat for complete obstruction to the flow
CU-5: Non Return Valve	P-1. Identify the following parts in a non-return/ check valve: body, cover plate,

	disc, seats, hinge, hinge pin, nut, cotter pin, stud bolt, gasket, washer P-2. observe the fluid flow as the disk is released P-3. observe the disk being fixed as the flow direction is reversed
CU-6: Pressure Relief Valve	P-1. Identify the following parts in pressure relief valve: set pressure adjusting screw, spring, disk holder, seat disk, nozzle, bonnet, bonnet plug and body P-2. identify various types of pressure relief valve P-3. observe system pressure and spring pressure P-4. observe the valve opening as the system pressure increases then spring pressure

Knowledge and Understanding

- **K1.** Define a valve
- **K2.** Identify applications of Ball Valve
- **K3.** Explain the safety precautions of ball valve
- **K4.** explain the terminology of 'butterfly valve'
- **K5.** identify its industrial applications
- **K6.** Explain the safety precautions of Butterfly Valve
- **K7.** describe Gate/ Knife gate valve
- **K8.** explain the isolation valves
- **K9.** explain the precaution for knife gate valve
- **K10.** Identify its Industrial Applications
- **K11.** Explain the safety precautions of Gate valve
- **K12.** Compare diaphragm and gate valve
- **K13.** Explain the industrial applications of diaphragm valve
- **K14.** Explain the safety precautions of Diaphragm Valve
- **K15.** Mention and explain various types of non-return valve
- **K16.** Explain unidirectional valve working mechanism
- **K17.** Identify various industrial applications of Non-return valve
- **K18.** Explain the safety precautions of Non Return Valve
- **K19.** Explain the safety aspects of pressure relief valve
- **K20.** Describe industrial applications of Pressure relief valve
- **K21.** Explain the safety precautions of Pressure Relief Valve

Apparatus

- Ball Valve
- Butterfly Valve
- Gate Valve
- Diaphragm Valve
- Non Return Valve
- Pressure Relief Valve

0715.9 Metrology

0715-M&MT-62. Take measurements with graduated tools

Overview: This competency standard covers the skills and knowledge required to take measurements Steel rule, Take measurements Hook rule, Take measurements Folding rule and Take measurements with Trammels

Competency Units	Performance Criteria
CU1. Take measurements Steel rule	**P1**. Place ruler on different work pieces. **P2**. Take dimension and record multiple readings on each work piece. **P3**. Take average of readings. **P4**. Record the results.
CU2. Take measurements Hook rule	**P1.** Place hook rule on given different work piece. **P2.** Take dimension and record multiple readings on each work piece. **P3.** Take average of readings. **P4.** Record the results.
CU3. Take measurements Folding rule	**P1.** Take suitable work piece for measurement. **P2.** Measure the dimensions of work pieces. **P3.** Compute surface area, volume, of given work pieces. **P4.** Record the results in data table.
CU4. Take measurements with Trammels	**P1.** Open the trammel according to required dimension. **P2.** Draw circle or arc by fixing one point in the dot and rotate.

Knowledge & Understanding

- **K1.** Decimal and fraction of an inch
- **K2.** Measurement techniques
- **K3.** Calculation of area, volume of geometric shapes.
- **K4.** Arc and circle

Tools & Equipment

- Steel rule
- Work piece
- Surface plate
- Steps and collars
- Hook rule
- Folding rule
- Trammel

0715-M&MT-63. Take measurements with combination set

Overview: This competency standard covers the skills and knowledge required to Take Measurement with Square head, Perform levelling with square head as spirit level, Measure depth with square head as depth gauge, Measure height with square head as height gauge, Perform levelling /measure angle of surfaces with protractor Head, Perform cantering with centre head and Find diameter of round bar

Competency Units	Performance Criteria
CU1. Take Measurement with Square head	**P1**. Place the combination set on given drawing sheet. **P2**. Draw layout of a component with the help of combination square.
CU2. Perform leveling with square head as spirit level	**P1**. Place the spirit level on horizontal work piece. **P2**. Check the deviation of bubbles **P3**. Level the surface by inserting shims. **P4**. Place square head on vertical work piece. **P5**. Note the deviation and correct the level. **P6**. Check the other geometrical shapes.
CU3. Measure depth with square head as depth gauge	**P1**. Place the square head on work piece. **P2**. Apply force at the head to retain contact with the component. **P3**. Set square head and record the depth.
CU4. Measure height with square head as height gauge	**P1**. Place the square head on work piece. **P2**. Measure height of work piece with and without the help of height gauge attachment.
CU5. Perform leveling /measure angle of surfaces with protractor Head	**P1.** Place protractor head of combination set on work piece. **P2.** Loose screws of revolving circular disk and adjust the bubble of level to minimize deviation. **P3.** Study the angle between slopes of a component.
CU6. Perform centering with center head	**P1.** Place the center head on round stock. **P2.** Trace the line with scriber. **P3.** Revolve the center head by 90^{o} and draw another line. **P4.** Find center of round stock by bisecting point of lines.
CU7. Find diameter of round bar	**P1.** Place the center head on round stock **P2.** Note the reference point and measure point by avoiding parallax **P3.** Find the difference between reference point and measure point.

Knowledge and understanding

K1. Measurement techniques

K2. Knowledge of dimensioning of drawings and layouts

Tools & Equipment

- Combination set
- Surface plate
- Scriber
- Tri square
- Divider
- Round stock

0715-M&MT-64. Perform Levelling

Overview: This competency standard covers the skills and knowledge required to Exercise of cast iron, granite and glass surface plate, Check level of surfaces with straight edge and spirit level, Check level by Engineer's level and measurements with Engineer's parallel

Competency Units	Performance Criteria
CU1. Exercise of cast iron, granite and glass surface plate	**P1**. Place the work piece with angle plate on surface plate. **P2**. Check squarness and parallelism of components. **P3**. Check the squareness of angle plate with dial indicator.
CU2. Check level of surfaces with straight edge and spirit level	**P1.** Place straight edge diagonally on the surface plate **P2.** Place spirit level on the straight edge. **P3.** Check the level with bubble. **P4.** Adjust the level by feeler gauge.
CU4. Check level by Engineer's level	**P1**. Clean the level and surface **P2**. Place the level on work piece. **P3**. Record the difference by changing the position of level. **P4**. Calculate mean value. **P5**. Maintain the level of plane by providing packing as per requirement.
CU5. measurements with Engineer's parallel	**P1.** Insert the engineer's parallel in work piece. **P2.** Measure the taper or diameter of cylindrical surface.

Knowledge and understanding

K1. Measurement techniques

K2. Geometric shapes

Tools & Equipment

- Surface plates
- Straight edge and spirit level
- Engineer's level
- Engineer's parallel

0715-M&MT-65. Take measurements through various gauges

Overview: This competency standard covers the skills and knowledge required to take measurement with fixed gauge, plug gauge, adjustable gauge, small hole gauge and telescope gauge

Competency Units	Performance Criteria
CU1. Take measurement with fixed gauge and plug gauge.	**P1**. Check/Compare the dimension of provided work piece against reference standard with the help of fixed gauge. **P2**. Insert plug gauge into the work piece to determine either dimension is of acceptable size or over size.
CU2. Take measurement with adjustable gauge	**P1**. Insert both “go” and “not go” gauges in the work piece. **P2**. Check the size and record the results.
CU3. Take measurement with small hole gauge	**P1**. Insert the small hole gauge of require size into the work piece **P2.** Record the result.
CU4. Take measurement with telescope gauge	**P1**. Insert the telescope gauge into the work piece **P2.** Adjust the gauge and determine the size of work piece.

Knowledge and understanding

K1. Knowledge of dimensioning and measurement techniques

Tools & Equipment

- Fix gauge
- Surface plate
- Surface gauge
- Dial indicator
- Adjustable gauge
- Hole gauge
- Telescope•

0715-M&MT-66. Perform measurements through Micrometer

Overview: This competency standard covers the skills and knowledge required to take measurement with outside micro-meter, inside micrometre, depth micrometre, Measure threads with micrometre and Vernier micrometre

Competency Units	Performance Criteria
CU1. Take measurement with outside micro-meter	**P1**. Clean the gauge and surface of work piece **P2**. Open slightly larger than the part to be measured **P3** Set anvil squarely against reference surface of part **P4**. Using ratchet, slowly until it click once **P5**. Record reading and make average.
CU2. Take measurement with inside micrometer	**P1**. Clean the gauge and surface of work piece. **P2**. Open gauge slightly smaller than the part to be measured **P3**. Set anvil squarely against reference surface of part with ratchet, slowly until it click once. **P4**. Record reading and make average.
CU3. Take measurement with depth micrometer	**P1.** Clean the gauge and surface of work piece. **P2**. Access the depth of groove by steel rule **P3**. Insert the suitable insertion rod **P4**. Place the depth micrometer gauge on the deeper groove and take reading.
CU4. Measure threads with micrometer	**P1.** Clean the gauge and the threads of work piece. **P2.** Use the suitable set of thread shape tips according to thread size which is to be measured. **P3.** Record the reading.
CU5. Take measurement with Vernier micrometer	**P1.** Clean the surface. **P2.** Place specimen on the surface plate **P3.** Take reading accurately. **P4.** Calculate mean reading.

Knowledge and understanding

K1. Measurement techniques
K2. Tools usage
K3. Geometric shapes

Tools & equipment

- **Micrometer**

0715-M&MT-67. Measure dimensions with Vernier tools

Overview: This competency standard covers the skills and knowledge required to take measurement with Vernier calliper, height gauge and Vernier depth gauge

Competency Units	Performance Criteria
CU1. Take measurement with Vernier caliper	**P1**. Clean the gauge and surface of work piece. **P2**. Place the work piece on surface plate. **P3**. Open the lock screws. **P4**. Slide the jaws up to the width or size of jaws. **P5**. Open slightly larger than the part to be measured. **P6**. Set anvil squarely against reference surface of part **P7**. Maintain the proper pressure on the jaws with screw. **P8**. Lock the movable jaw with knurled screw **P9**. Measure and record the dimensions.
CU2. Take measurement with height gauge	**P1**. Clean the gauge and surface of work piece **P2**. Hold the work piece on angle plate. **P3**. Open the lock screws. **P4**. Set the height gauge on stud to check it with fine adjusting screw. **P8**. Lock the measuring head. **P9**. Record the reading.
CU3. Take measurement with Vernier depth gauge	**P1.** Clean the gauge and surface of work piece **P2**. Hold the work piece on sample plate. **P3**. Open the lock screws. **P4**.insert the gauge inside the work piece with fine adjusting screw. **P8**. Lock the measuring head. **P9**. Record the reading

Knowledge & understanding

K1. Vernier gauges

K2. Measurement techniques

K3. Dimensioning

Tools & equipment

- Vernier caliper

0715-M&MT-68. Measure angles with angle measuring Instruments.

Overview: This competency standard covers the skills and knowledge required to take measurement with Bevel protractor, Measure angles with Vernier Bevel protractor, Dial protractor, Steel protractor and Sine bar

Competency Units	Performance Criteria
CU1. Take measurement with Bevel protractor.	**P1**. Clean the instrument and work piece **P2**. Set the work piece and protractor as per requirement **P3**. Make adjustment of the protractor for accurate measurement. **P4**. Record and tabulate the results.
CU2. Measure angles with Vernier Bevel protractor	**P1**. Set the protractor on work piece properly **P2**. Read the Vernier scale **P3**. Measure and record the angle for clock wise and counter clock wise directions
CU3. Measure angles with Dial protractor	**P1**. Set the protractor on work piece properly **P2**. Read the dial scale **P3**. Measure the angle accurately
CU4. Measure angles with Steel protractor	**P1**. Set the protractor on work piece **P2**. Measure the angle
CU5. Measure angles with Sine bar	P1. Select proper size Sine Bar P2. Set the Sine Bar with gauge block to measure taper P3. Calculate tapper angle accurately

Knowledge & understanding

K1. Measurement techniques

K2. Knowledge of Angles

Tools & equipment

- Bevel protractor
- Vernier bevel protractor
- Dial protractor
- Steel protractor
- Sine bar

0715-M&MT-69. Perform different measurements

Overview: This competency standard covers the skills and knowledge required to Take measurement with dial calliper, dial thickness gauge, dial Indicator, Exercise on gauge blocks, tool makers microscope, Practice on Profile Projector, Digital Instruments, Measure with coordinate measuring machine and Calculate tolerance and allowances

Competency Units	Performance Criteria
CU1. Take measurement with dial calliper	**P1**. Set the pointer on zero properly **P2**. Set the work piece correctly **P3**. Read the dial scale accurately **P4**. Record the results
CU2. Take measurement with dial thickness gauge	**P1**. Remove zero error **P2**. Set the work piece properly **P3**. Measure the size accurately **P4**. Record the results
CU3. Take measurement with dial Indicator	**P1**. Set the Indicator on magnetic stand **P2**. Set the pointer on zero **P3**. Set the pointer on work piece **P4**. Read the dial scale
CU4. Exercise on gauge blocks	**P1**. Adjust the gauge block as per desired size **P2**. Hold the specimen in position **P3**. Measure the angle accurately sine bar and gauge blocks
CU5. Exercise on tool makers microscope	**P1**. Prepare the microscope for examining the job **P2**. Hold the job on anvil **P3**. Observe the size and profile of the job by setting eye piece **P4**. Record the observations
CU6. Practice on Profile Projector	**P1**. Make complete setting of work piece on Profile Projector **P2**. Set the axis **P3**. Observe the size
CU7. Practice Of Digital Instruments	**P1**. Select digital instrument and specimen for measurement. **P2**. Take measurement of specimen with digital instrument
CU8. Measure with coordinate measuring machine	**P1**. Hold the job properly. **P2**. Set and locate zero point. **P3**. Take the dimensions for different coordinates properly. **P4**. Take point to point/linear measurements.

	P5. Take measurements profile in 2D and 3D.

CU9. Calculate tolerance and allowances	**P1**. Measure the job for upper and lower limits. **P2**. Calculate the maximum and minimum size. **P3**. Calculate tolerance and allowance **P4**. Represent tolerance in results.

Knowledge & understanding

K1. Measurement techniques and dimensioning

K2. Microscope

K3. Digital measuring instruments

K4. Knowledge of dimensioning and layouts.

K5. ISO standards of fits and tolerance

K6. ISO systems of fits and limits

K7. Knowledge of components e.g. shafts, holes etc.

Tools & equipment

- Vernier caliper
- Dial thickness gauge
- Dial indicator
- Gauge blocks
- Tool makers microscope
- Digital instruments
- Coordinate measuring machines
- ISO tables of fits and tolerance
- Measurement tools

0715-M&MT-70. Measure Threads and Gears

Overview: This competency standard covers the skills and knowledge required to Measure threads with thread gauges, Measure gear dimensions with gear tooth calliper and Measure gear dimensions with gear testing machine

Competency Units	Performance Criteria
CU1: Measure threads with thread gauges	**P1**. Place suitable sized wire in thread of work piece **P2.** Take the dimensions**.** **P3.** Note pitch of thread and calculate depth of thread by using formula**.**
CU2: Measure gear dimensions with gear tooth caliper	**P1**. Adjust the jaws of caliper into the tooth of gear work piece. **P2**. Measure the tooth thickness, cordials addendum and cordials thickness. **P3.** Compare the measured values with theoretical results.
CU3: Measure gear dimensions with gear testing machine	**P1.** Explain working principle of gear inspection machines and draw schematic. **P2.** Measurements of spur, bevel, helical with gear testing machine

Knowledge & understanding

K1. Threads and their types

K2. Measurement techniques

K3. Gears, terminologies related to gears and its types

Tools & equipment

- Thread gauge
- Gear tooth caliper
- Gear testing machine

0715-M&MT-71. Compare measurement with Comparators

Overview: This competency standard covers the skills and knowledge required to Exercise on Mechanical Comparator, Electronics Comparator and Electrical Comparator

Competency Units	Performance Criteria
CU1. Exercise on Mechanical Comparator	**P1**. Prepare the mechanical comparator setup for measurement **P2**. Set the dial at zero **P3**. Measure the results by comparing size of job with standard
CU2. Exercise on Electronics Comparator	**P1**. Prepare the electronic comparator setup for measurement **P2**. Set the dial at zero **P3**. Measure the results by comparing size of job with standard
CU3. Exercise on Electrical Comparator	**P1**. Prepare the electronic comparator setup for measurement **P2**. Set the dial at zero **P3**. Measure the results by comparing size of job with standard

Knowledge & understanding

K1. Measurement techniques

K2. Knowledge about Instrumentation

Tools & equipment

- Mechanical comparator
- Electronic comparator
- Electrical comparator

0715.10 Engineering Drawing

0715-M&MT-72. Perform Basic Manual Drawing

Overview: This competency standard covers the skills and knowledge required to Draw single stroke capital vertical lettering, Draw single stroke capital inclined lettering, Draw horizontal, vertical and inclined lines, Use of compass, circles, half circles, radius, Drawing Center lines, centers, curves, and crossing of lines, Construction of parallel-lines, perpendicular, bisects line, angles and equal division of lines, Draw round corners, circles elements, quadrilaterals inside and outside circle and Construction of angles and triangles.

Competency Units	Performance Criteria
CU1. Draw single stroke capital vertical 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 bar **P6.** Draw upper and lower lines for lettering according to standards. **P7.** Start Writing Vertical Lettering with different style like Gothic, Roman and free hand lettering.
CU2. Draw single stroke capital inclined lettering.	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Draw upper and lower lines for lettering according to standards. **P6.** Start Writing inclined Lettering with different style like Gothic, Roman and free hand lettering.
CU3. 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.
CU4. Draw circles, half circles, radius with compass,	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar

	P5. Divide the sheets in different equal parts. **P6.** Make different dia meters circles and half circles.
CU5. Draw Lines	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw Center lines, **P7.** Draw parallel-lines, **P8.** Draw perpendicular & bisects line, **P9.** Draw equal division of lines **P10.** Make different angle curves. **P11.** Draw crossing line
CU6. Draw round corners, circles elements, quadrilaterals inside and outside circle.	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Make different dia circles. **P7.** Make inside and outside different types of diagrams that touch the circles at the tangent points.
CU7. Construct angles and triangles	**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 Equilateral Triangle, Isosceles triangle, Scalene Triangle, Right Triangle, Obtuse Triangle, Acute Triangle.

Knowledge & Understanding

- **K1.** Importance of Technical Drawing.
- **K2.** Language of engineering terminology.
- **K3.** Uses of Technical Drawing
- **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. Introduction to geometry

K16. Introduction to sketching techniques.

K17. Techniques of sketching straight lines in different directions.

K18. Define Triangles, Quadrilateral, and Polygons.

Tool & Equipment

- Graph and drawing sheet.
- Drawing Board/Table.
- T-Square
- Set Square.
- Templets.
- Geometry Box.
- Tee-square and compass.

0715-M&MT-73. 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, Construct a parabola curve by Rectangle Method, Method of Tangents(Triangle Method) and Basic Locus Method, Construct a hyperbola curve, Construct a Archimedean Spiral curve, Construct a involutes curve of square rectangle hexagon and circle and Construct of cycloid, epicycloids, and hypocycloid.

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 bar **P5.** Divide the sheets in different equal parts. **P6.** Draw square, triangle and hexagon according to dimension.
CU2 Construct a pentagon, Hexagon and Octagon by circumscribe method.	**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 pentagon, Hexagon and Octagon .
CU3 Construct pentagon, Hexagon and Octagon by inscribe method	**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 pentagon, Hexagon and Octagon.
CU4 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
CU5 Construct Ellipse	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw an Ellipse by Concentric Circle. **P7.** Draw an Ellipse by Rectangle Method **P8.** Draw an Ellipse by Oblong Method **P9.** Draw an Ellipse by Arcs of Circle Method **P10.** Draw an Ellipse by Rhombus Method. **P11.** Draw an Ellipse by Basic Locus Method
CU6 Construct a parabola curve	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw a parabola curve by Rectangle **P7.** Draw a parabola curve by Method of Tangents(Triangle Method) **P8.** Draw a parabola curve by Basic Locus Method
CU7 Construct a hyperbola curve	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw a hyperbola curve.
CU8 Construct a Archimedean Spiral curve	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw spiral curve.
CU9 Construct involute curve	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar

	P5. Divide the sheets in different equal parts. **P6.** Draw involute curve by square **P7.** Draw involute curve by rectangle **P8.** Draw involute curve by hexagon **P9.** Draw involute curve by circle.
CU10 Construct of cycloid, epicycloid, and hypocycloid	**P1.** Prepare Drawing sheet. **P2.** Select the tools. **P3.** Draw Boundaries lines as per standards. **P4.** Make title bar **P5.** Divide the sheets in different equal parts. **P6.** Draw the generating circle and the base line equal to the circumference of the generating circle **P7.** Divide the circle and the base line in to equal number of parts **P8.** Complete the cycloid, epicycloids, and hypocycloid.

Knowledge & Understanding

- **K1.** Techniques of sketching straight lines in different directions
- **K2.** Define Triangles, Quadrilateral and Polygons
- **K3.** Describe circular arc using different line method
- **K4.** Describe circular arc
- **K5.** Types of Geometric Shape
- **K6.** Two-dimensional shapes
- **K7.** Three-dimensional shapes
- **K8.** Types of Geometric Shape
- **K9.** Regular Polyhedrons
- **K10.** Methods of drawing Tangents & Normal
- **K11.** Describe ellipse
- **K12.** Describe different methods of sketching ellipse
- **K13.** Describe parabola
- **K14.** Describe different methods of parabola
- **K15.** Describe hyperbola curve
- **K16.** Describe different methods of hyperbola curve.
- **K17.** Describe spiral curve
- **K18.** Describe involute curve
- **K19.** Describe cycloid
- **K20.** Describe epicycloids
- **K21.** Describe hypocycloid

Tool and Equipment

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

0715-M&MT-74. Construct multi-view drawings

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

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

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

Knowledge & Understanding

K1. Explain Orthographic projection 1st angle.

K2. Explain Orthographic projection 3rd angle.

K3. Explain Oblique Drawing.

K4. Explain Multi view drawing of Simple Bearing.

K5. Explain Prism, Cone and pyramid

Tool and Equipment

- Graph and drawing sheet.

- Drawing Board/Table.
- Tea-Square
- Set Square.
- Templets.
- Geometry Box.

0715-M&MT-75. Manage display in AutoCAD software

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

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

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

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

Tool & Equipment

- Computer with all accessories
- AutoCAD software disk
- Models

0715-M&MT-76. Develop 2D drawings

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

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

Knowledge & Understanding

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

Tool and Equipment

- Computer with all accessories
- AutoCAD software disk
- Models

0715-M&MT-77. Develop 3D drawing

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

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

Knowledge & Understanding

K1. 3D modeling in AutoCAD

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

K2. 3D face and Edges

- Boolean operation concepts
- Subtraction
- Intersection
- Union

K3. 3D Navigate control

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

K4. Material and light control

K5. Planner mapping

K6. Texture map

K7. Opacity control

K8. Render context

K9. Render sampling

Tool and Equipment

- Computer with all accessories
- AutoCAD software disk
- Models

0715.11 Heat Treatment and Material Testing

0715-M&MT-78. Perform Metallography of Metallic Materials

Overview: This competency standard covers the skills and knowledge required to Perform Metallography of Metallic materials and observing a prepared specimen under metallurgical microscope to reveal its microstructure.

Competency Units	Performance Criteria
CU1. Preparation of specimen	P-1. Select the material to perform metallography P-2. Cut the specimen according to specifications P-3. Mount the specimen by ensuring level P-4. Obtain flat specimen surface P-5. Rough polish the specimen with round grinder P-6. Fine polish the specimen using emery paper from low mesh number to high mesh number P-7. use cloth polishing as final polishing step P-8. Etch the polished specimen using advised etchant P-9. Observe the work piece under metallurgical microscope
CU2. Demonstrate the working of metallurgical microscope	P-1. Prepare the metallic specimen according to metallographic procedures P-2. Put the specimen on the mechanical stage of microscope P-3. Use plasticine to level its surface P-4. use various magnifications to observe the microstructure of specimen P-5. throw light on the surface of metallic specimen to see its microstructures P-6. observe the light throwing procedure in the microscope P-7. observe a bright refection of the work piece through eye piece P-8. observe the microstructure through eye piece P-9. Note the results P-10. Repeat the procedure using various specimen

Knowledge & Understanding

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

K7. Reason the proper handling of the equipment of microscope

Tools & Equipment

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

0715-M&MT-79. Perform Heat Treatment of Metallic Materials

Overview: This competency standard covers the skills and knowledge required to Perform hardening treatment on carbon steel and observe its micro structure, Perform tempering of hardened carbon steel, Perform annealing treatment on steel and observe its microstructure, Perform normalizing treatment of steel and observe microstructure, Perform carburizing treatment of steel and observe microstructure and Perform stress relieving of Aluminium

Competency Units	Performance Criteria
CU1. Perform hardening treatment on carbon steel and observe its micro structure	**P1**. Prepare the samples of appropriate size. **P2**. Place the sample in the furnace **P3**. Adjust the temperature of furnace and soaking time of the furnace according to steel grade. **P4**. Select a suitable quenching media. **P5**. Quench the samples in quenching media. **P6**. Prepare the sample according to standard metallographic techniques **P7**. Examine the microstructure **P8**. Interpret the results
CU2. Perform tempering of hardened carbon steel	**P1**. Take hardened sample (as prepared in above experiment). **P2**. Place the sample in the furnace **P3**. Adjust the tempering temperature of furnace and soaking time of the furnace according to require microstructure. **P4**. Cool the specimen in air **P5**. Prepare the sample according to standard metallographic techniques. **P6**. Examine the microstructure. **P7**. Interpret the results.
CU3. Perform annealing treatment on steel and observe its microstructure	**P1**. Prepare the samples of appropriate size. **P2**. Place the sample in the furnace **P3**. Adjust the temperature and soaking time of the furnace according to steel grade. **P4**. Turn of the furnace and let the samples to cool in the furnace. **P5**. Remove the samples from furnace once the temperature drops to near room temperature. **P6**. Prepare the sample according to standard metallographic techniques **P7**. Examine the microstructure **P8**. Interpret the results.
CU4. Perform normalizing	**P1**. Prepare the samples of appropriate size. **P2**. Place the sample in the furnace

treatment of steel and observe microstructure	**P3**. Adjust the temperature and soaking time of the furnace according to steel grade. **P4**. Turn off the furnace **P5**. Remove the samples from furnace and let them to cool in the air. **P6**. Prepare the sample according to standard metallographic techniques **P7**. Examine the microstructure **P8**. Interpret the results.
CU5. Perform carburizing treatment of steel and observe microstructure	**P1**. Cut and prepare the samples of appropriate sizes. **P2**. Pack the samples in carbonaceous material in steel box and seal the boxes by suitable method. **P3**. Place the boxes in the furnace **P4**. Heat the samples for suitable time and temperature. **P5**. Turn off the furnace and remove the steel boxes from furnace and recover the specimen. **P6**. Prepare the sample according to standard metallographic techniques **P7**. Check hardness of the sample's core and case. **P8**. Examine the microstructure of case and core. **P9**. Interpret the results of hardness and microstructure.
CU6. Perform stress relieving of Aluminum	**P1**. Prepare the samples of appropriate size. **P2**. Place the sample in the furnace. P3. Adjust the temperature and soaking time of the furnace according P4. Turn off the furnace and let the sample to cool in the furnace. P5. Remove the samples from furnace once the temperature reaches near room temperature. P6. Prepare the sample according to standard metallographic techniques P7. Determine the strength of annealed and un-annealed specimen. P8. Interpret the results.

Knowledge & Understanding

K1. Heat treatment of steels

K2. Microstructure of common metallic materials

K3. Metallography technique

K4. Sample preparation techniques

Tools & Equipment

- Heating furnace

- Long tongue
- Quenching bath
- Mounting press
- Grinder
- Polisher
- Beaker
- Optical microscope

0715-M&MT-80. Perform hardness tests for different metallic materials

Overview: This competency standard covers the skills and knowledge required to Measure hardness of specimen on brinnel hardness tester, Measure hardness of specimen on Rockwell hardness tester B-scale and Measure hardness of specimen on Rockwell hardness tester C-scale hardness

Competency Units	Performance Criteria
CU1. Measure hardness of specimen on brinnel hardness tester	**P1.** Prepare the sample according to standard requirements. **P2.** Flat and clean the specimen surface with file or emry paper **P3.** Colour/Etch the indent ball to make the indentation diameter visible **P4.** Apply the load /pressure for specific time according to material requirement. **P5**. Note the load /pressure. **P6**. Measure the diameter of indent with microscope and calculate the average diameter **P7**. Calculate the hardness with the help of Brinnel Hardness Number formula. **P8**. Record the results.
CU2- Measure hardness of specimen on Rockwell hardness tester B-scale	**P1.** Install the required indenter according to B-scale. **P2**. Set the anvil of the Rockwell tester. **P3.** Prepare the sample by performing filling, cleaning and drying operations. **P4**. Place the sample on anvil. **P5**. Apply the minor load. **P6**. Apply the major load. **P7**. Note the reading from B-scale of the dial indicated by red color. **P8**. Record the results.
CU3- Measure hardness of specimen on Rockwell hardness tester C-scale hardness	**P1**. Install the required indenter according to C-scale. **P2**. Set the anvil of the Rockwell tester **P3.** Prepare the sample by performing filling, drying and cleaning operations **P4**. Place the sample on anvil and lift the sample with handle **P5**. Apply minor load. **P6**. Apply the major load. **P7**. Note the reading from C-scale of the dial indicated by black color. **P8**. Record the results.

Knowledge & Understanding

K1. Brinnel hardness tester

K2. Properties of common engineering materials

K3. ASTM E 10, Standard test method for Brinnel hardness of metallic materials.

K4. ISO 6506-1 Metallic materials-Brinnel Hardness Test.

K5. Rockwell hardness tester

K6. ASTM E-18

Tool and Equipment

- Brinnel hardness tester
- Optical Microscope
- Filer
- Rockwell Hardness Tester
- Spirit Level

0715-M&MT-81. Perform Impact testing of metallic materials

Overview: This competency standard covers the skills and knowledge required to calculate impact resistance of aluminium and cast iron specimen using izod impact tester and Calculate impact resistance of metallic specimen using Charpy tester

Competency Units	Performance Criteria
CU1- Calculate impact resistance of aluminum and cast iron specimen using izod impact tester	**P1.** Prepare sample according to standard requirement. **P2**. Create the V-notch in the sample as per standard requirements **P3**. Set the pendulum in its position and attach the activator knob with pendulum arm **P4**. Perform the test without the specimen to check zero error and note the difference, if any. **P5**. Hold the sample in the clamp as per requirement of Izod impact test. **P6**. Release the pendulum. **P7**. Note the reading from the dial. **P8**. Calculate the impact resistance according to formula. **P8**. Record the results.
CU2. Calculate impact resistance of metallic specimen using Charpy tester	**P1.** Prepare sample according to standard requirement. **P2**. Create the V-notch in the sample as per standard requirements **P3**. Set the pendulum in its position and attach the activator knob with pendulum arm P4. Perform the test without the specimen to check zero error and note the difference, if any. **P5**. Hold the sample in the clamp as per requirement of Charpy impact test. **P6**. Release the pendulum **P7**. Note the reading from the dial. **P8**. Calculate the impact resistance according to formula. **P9**. Record the results.

Knowledge & Understanding

K1. ASTM E-23 18 Standard test methods for notched bar impact testing of metallic materials

K2. Materials properties of common engineering materials

Tool and Equipment

- Izod Impact Tester
- Vernier Caliper
- Tongs
- Charpy Impact Tester
- Holder for sample centering

0715-M&MT-82. Perform Mechanical Testing on Universal Testing Machine

Overview: This competency standard covers the skills and knowledge required to Measure tensile properties of standard specimen using universal testing machine, Measure compression strength of brick using universal testing machine, Measure bend strength of material using universal testing machine and Measure shear strength of material using universal testing machine

Competency Units	Performance Criteria
CU1. Measure tensile properties of standard specimen using universal testing machine	**P1**. Prepare sample as per standard requirement. **P2**. Measure the dimensions and mark gauge length according to standard **P3**. Prepare the machine for testing. **P4**. Install the fixture of tensile test specimen according to sample dimension and shape. **P5**. Perform tearing of the main scale. **P6**. Clamp the samples in the grips properly. **P7**. Clamp the extensometer on the sample **P8**. Set the machine speed according to sample. **P9**. Note the yield force and maximum force at break. **P10**. Draw stress/strain curve from data. **P11**. Calculate % elongation and % area reduction, yield strength, tensile strength and modulus of elasticity **P12**. Record the results.
CU2. Measure compression strength of brick using universal testing machine	**P1**. Measure the dimensions of concrete sample. **P3**. Prepare the machine for test. **P4**. Install the fixture of compression test. **P5**. Perform tearing of the main scale. **P6**. Place the sample within the fixture **P7**. Set the machine speed according to sample. **P8**. Note the maximum/breaking force **P9**. Calculate compression strength **P10**. Record the results.
CU3. Measure bend strength of material using universal testing machine	**P1**. Prepare sample as per ASTM standard. **P2**. Measure the dimensions. **P3**. Power on the machine control panel, grip panel and move machine stroke upward and downward. **P4**. Install and adjust the fixture of bending test specimen according to sample

	dimension. **P5**. Perform tearing of the main scale. **P6**. Place the sample in the fixture. **P7**. Set the machine speed according to sample. **P8**. Observe the specimen for marks or cracks. **P9**. Measure the bend strength / modulus of elasticity by calculating deflection from formula
CU4. Measure shear strength of material using universal testing machine	**P1**. Prepare the specimen according to requirements of standards. **P2**. Measure the dimensions of specimen. **P3**. Prepare the machine for test. **P4**. Install the fixture of shear test **P5**. Perform tearing of the main scale. **P6**. Place the sample within the fixture **P7**. Set the machine speed according to sample. **P8**. Note the maximum/breaking force **P9**. Calculate shear strength **P10.** Record the results.

Knowledge & Understanding

- **K1.** Material properties of common engineering materials.
- **K2.** Operation and maintenance of Universal testing machine.
- **K3.** ASTM A 370
- **K4.** ASTM C-39, C-67
- **K5.** ASTM 370
- **K6.** ASTM B-565

Tool and Equipment

- Universal Testing Machine
- Vernier Caliper
- Steel rule

0715-M&MT-83. Perform Torque and Fatigue test.

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

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

Knowledge & Understanding

- **K1.** Materials properties of common engineering materials.
- **K2.** Torsion test
- **K3.** Operation of torsion testing machine
- **K4.** ASTM A 260, ASTM A 0938
- **K5.** Fatigue test
- **K6.** Operation of fatigue testing and machine

Tool and Equipment

- ❖ Torsion test machine
- ❖ Vernier caliper
- ❖ Steel rule
- ❖ Fatigue test machine
- ❖ Vernier caliper
- ❖ Steel rule

0715-M&MT-84. Perform non-destructive test

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

Competency Units	Performance Criteria
CU1. Determine the flaws in specimen using dye penetrant technique	**P1.** Perform pre-cleaning of samples. **P2.** Apply dye penetrant. **P3.** Remove the excess dye penetrant. **P4**. Apply the developer. **P5.** Inspect the specimen for defects. **P6.** Interpret the results.
CU2. Determine the flaws /wall thickness of provided metallic specimen	**P1.** Install the ultrasonic probe according to requirement of specimen. **P2.** Calibrate the ultrasonic equipment with respect to calibration block **P3**. Apply couplant on the given specimen **P4.** Test the given specimen **P5.** Observe the peaks. **P6.** Interpret the peaks and record the results
CU3. Determine the flaws of given specimen using magnetic particle testing equipment	**P1**. Prepare the surface of specimen to be examined. **P2**. Apply magnetic field is to the specimen **P3**. Apply ferromagnetic medium **P4**. Remove the excess ferromagnetic medium. **P5**. Interpret the indications. **P6**. Evaluated the results.

Knowledge & Understanding

K1. Non-destructive testing

K2. Dye penetrant test

K3. E 165-02

K4. Ultrasonic flaw detector.

K5. Magnetic particle test

Tool and Equipment

- Dye penetrant accessories
- Ultrasonic flaw detector

0715.12 Designing of Mechanical Members

0715-M&MT-85. Calculate Stresses in Machine Parts

Overview: This competency standard covers the skills and knowledge required to Calculate Tensile Loads, Calculate Compressive load and Calculate Shear load

Competency Units	Performance Criteria
CU1. Calculate Tensile loads	**P1.** Select attachments for tensile load. **P2.** Select specimen as per machine manual description and capacity. **P3.** Calculate Dimensions of the specimen. **P4**. Mount specimen properly. **P5**. Perform tensile load test. **P6**. Prepare dimensions table with loaded and unloaded part. **P7**. Calculate Stresses, strain, modulus of elasticity, %age elongation, %age reduction in area and factor of safety.
CU2. Calculate Compressive load	**P1**. Select attachments for compressive load. **P2.** Select specimen as per machine manual description and capacity. **P3.** Calculate Dimensions of the specimen. **P4**. Mount specimen properly. **P5**. Perform compressive load test. **P6**. Prepare dimensions table with loaded and unloaded part. **P7**. Calculate Stresses, strain, modulus of elasticity, %age elongation, %age reduction in area and factor of safety.
CU3. Calculate Shear load	**P1**. Select attachments for shear load. **P2.** Select specimen as per machine manual description and capacity. **P3.** Calculate Dimensions of the specimen. **P4**. Mount specimen properly. **P5**. Perform shear load test. **P6**. Prepare dimensions table. **P7**. Calculate Stresses, strain, modulus of elasticity, %age elongation, %age reduction in area and factor of safety.

Knowledge & Understanding

- **K1.** Understanding of stress and strain,
- **K2.** Calculate modulus of elasticity,
- **K3.** Derive relationship of %age elongation,
- **K4.** Derive relationship of %age reduction in area,
- **K5.** Calculate factor of safety for simple machine parts.

K6. Knowing about Stress-Strain Diagram

Tool and Equipment

- UTM
- Specimen for tensile load
- Micrometer Screw gauge
- Vernier-Caliper
- Specimen for compressive load

0715-M&MT-86. Calculator diameter of cylinder for hoop and longitudinal stresses

Overview: This competency standard covers the skills and knowledge required to Differentiate between thin and thick shells, Identify Hoop and longitudinal stress in cylindrical shells and Calculate Transverse and longitudinal failure of pressure vessel

Competency Units	Performance Criteria
CU1. Differentiate between thin and thick shells.	**P1**. Select work-piece **P2**. Calculate thickness and diameter **P3.** Apply thin and thick criteria.
CU2. Identify Hoop and longitudinal stress in cylindrical shells	**P1.** Select thin wall pressure vessel **P2.** Apply air testing **P3.** Calculate hoop stresses and longitudinal stresses
CU3. Calculate Transverse and longitudinal failure of pressure vessel	**P1**. Select thin wall pressure vessel **P2.** Apply air testing **P3.** Calculate hoop stresses and longitudinal stresses **P4.** Apply failure criteria

Knowledge & Understanding

- **K1.** Understanding of cylindrical part.
- **K2.** Describe basic measurements
- **K3.** Know thin and thick cylinders relationships.
- **K4.** Understanding of hoop and longitudinal stress analysis
- **K5.** Relationship of hoop and longitudinal stresses
- **K6.** Know about strain gauges and pressure gauges
- **K7.** Proper knowledge to use air compressor
- **K8.** Apply relationship of failure criteria for pressure vessel

Tool and Equipment

- Micrometer Screw gauge
- Vernier-Caliper
- Measuring Gauges
- Pressure Gauges
- Air compressor with safety valve
- Strain Gauges (for hoop and longitudinal strains and stresses)
- Pressure Gauges

0715-M&MT-87. Calculate thickness and diameter of spherical shell for circumferential stresses

Overview: This competency standard covers the skills and knowledge required to Calculate Lame's equations for brittle materials and Calculate Different cases of thickness of thick shells of brittle material, Measure thickness of spherical shell for circumferential stresses and Measure diameter of spherical shell for circumferential stresses

Competency Units	Performance Criteria
CU1. Calculate Lame's equations for brittle materials	**P1**. Select thick wall pressure vessel **P2.** Apply air testing **P3.** Calculate hoop stresses and longitudinal stresses **P4.** Apply failure criteria
CU2. Calculate Different cases of thickness of thick shells of brittle material	**P1.** Select pressure vessel part **P2.** Choose measurement tool **P3.** Measure dimensions of the cylindrical part **P4.** Solve distributed load profiles.
CU3. Measure thickness of spherical shell for circumferential stresses	**P1**. Identify thick wall pressure vessel **P2.** Measure thickness of spherical part **P3.** Calculate Stresses on thick spherical shells
CU4. Measure diameter of spherical shell for circumferential stresses	**P1**. Identify thick wall pressure vessel **P2.** Measure diameter of spherical part **P3.** Calculate Stresses on inner side of spherical shells

Knowledge & Understanding

- **K1.** Thick cylinder derivations
- **K2.** Measuring techniques
- **K3.** Basic knowledge of stresses inside the thick wall
- **K4.** Understanding about Lame's equation
- **K5.** Knowledge of geometric
- **K6.** Analyze Stresses in thick wall cylinder

Tool and Equipment

- Measuring tools (Micrometer Screw gauge, Vernier-Caliper Measuring Gauges)
- Cylindrical part of thick cylinder of the brittle materials
- Thick cylinder catalogues
- Basic measuring tools
- Formulae catalogues

0715-M&MT-88. Design welded joints for transverse and parallel fillet under static and fatigue loading

Overview: This competency standard covers the skills and knowledge required to Produce transverse fillet weld, Produce parallel fillet weld, Calculate Tensile stresses in transverse fillet weld, Calculate Shear stresses in transverse fillet weld, Calculate Tensile stresses in parallel fillet weld, Calculate Shear stresses in parallel fillet weld, Calculate Transverse fillet weld under static loadings, Calculate Parallel fillet weld under fatigue loading, Calculate Parallel fillet weld under static loadings and Calculate Parallel fillet weld under fatigue loadings

Competency Units	Performance Criteria
CU1. Produce Transverse fillet weld	**P1**.Identify weld types **P2.** Select Electrode, weld machine as per material requirement **P3.** Perform transverse fillet Weld **P4.** Observe tensile and shear stresses in transverse fillet weld.
CU2. Produce Parallel fillet weld	**P1**. Identify weld types **P2.** Select Electrode, weld machine as per material requirement **P3.** Perform parallel fillet Weld **P4.** Observe tensile and shear stresses in transverse fillet weld.
CU3. Calculate Tensile stresses in transverse fillet weld.	**P1**. Identify weld types **P2.** Select Electrode, weld machine as per material requirement **P3.** Perform transverse fillet Weld **P4.** Analyze tensile and transverse fillet weld.
CU4. Calculate Shear stresses in transverse fillet weld.	**P1**. Identify weld types **P2.** Select Electrode, weld machine as per material requirement **P3.** Perform transverse fillet Weld **P4.** Analyze shear stresses in transverse fillet weld.
CU5. Calculate Tensile stresses in parallel fillet weld.	**P1**. Identify weld types **P2.** Select Electrode, weld machine as per material requirement **P3.** Perform parallel fillet Weld **P4.** Observe tensile stresses in parallel fillet weld.
CU6. Calculate Shear stresses in parallel fillet weld.	**P1.** Identify weld types **P2.** Select Electrode, weld machine as per material requirement **P3.** Perform parallel fillet Weld **P4.** Observe shear stresses in parallel fillet weld.
CU7. Calculate transverse fillet weld under static loadings	**P1.** Identify weld types **P2.** Select Electrode, weld machine as per material requirement **P3.** Perform transverse fillet Weld

	P4. Identify load types **P5**. Observe transverse fillet weld under static loadings.
CU8. Calculate parallel fillet weld under fatigue loading	**P1.** Identify weld types **P2.** Select Electrode, weld machine as per material requirement **P3.** Perform parallel fillet Weld **P4.** Identify load types **P5**. Observe parallel fillet weld under fatigue loading
CU9. Calculate parallel fillet weld under static loadings	**P1.** Identify weld types **P2.** Select Electrode, weld machine as per material requirement **P3.** Perform transverse fillet Weld **P4.** Identify load types **P5**. Observe parallel fillet weld under static loadings
CU10. Calculate parallel fillet weld under fatigue loadings	**P1.** Identify weld types **P2.** Select Electrode, weld machine as per material requirement **P3.** Perform transverse fillet Weld **P4.** Identify load types **P5**. Observe parallel fillet weld under fatigue loadings

Knowledge & Understanding

- **K1.** Understanding of various welding types
- **K2.** Recognize material types as per requirements.
- **K3.** Know about the current and voltage knowledge of welding transformers.
- **K4.** Familiar with the types of loads.

Tools and Equipment

- ❖ Welding transformers
- ❖ Welding Table and accessories
- ❖ Fixture and hand vice
- ❖ Welding Safety Equipment
- ❖ Chipping hammer
- ❖ Power supply
- ❖ Measuring Tools as per requirement.
- ❖ Cutting equipment and accessories

0715-M&MT-89. Calculate stresses due to initial tightening and external load on screws

Overview: this competency standard covers the skills and knowledge required to measure stress area of a screw, develop relation with core diameter and nominal diameter of a screw thread, perform initial tightening and its specific values and calculate different cases of external load raised by different bolts

Competency Units	Performance Criteria
CU1. Measure Stress area of a screw	**P1**. Choose bolt **P2.** Select bolt types w.r.t. threads categories **P3.** Comparison of Nut with bolt thread **P4.** Calculate stresses on the threaded part by using mathematical relationships **P5.** Compare stresses with as per given standard tables.
CU2. Develop relation with core dia. and nominal dia. of a screw thread	**P1**. Choose bolt **P2.** Select bolt types w.r.t. threads categories **P3.** Measure core and nominal diameters of the bolt. **P4.** Develop mathematical relationships between the diameters. **P5.** Compare stresses with given standard tables.
CU3. Perform Initial tightening and its specific values	**P1**. Measure tensile stresses due to stretching of the bolt **P2.** Calculate torsional shear stress due to frictional resistance at the threads. **P3.** Identify shear stress across threads **P4.** Identify compressive or crushing stress on the threads **P5.** Identify bending stress
CU4. Calculate different cases of external load raised by different bolts	**P1**. Measure stresses due to stretching of the bolt **P2.** Calculate torsional shear stress due to frictional resistance at the threads. **P3.** Identify shear stress across threads **P4.** Identify compressive or crushing stress on the threads **P5.** Identify bending stress **P6.** Perform same procedure for different cases.

Knowledge & Understanding

- **K1.** Difference between nut and bolts
- **K2.** Know about the thread types
- **K3.** Calculations of the stresses inside the bolts
- **K4.** Differentiate between the weak areas of the screw
- **K5.** Measurements of the diameters core and nominal
- **K6.** Knowledge of the failure criteria of the screw w.r.t. diameters
- **K7.** Knowledge of the various types of loads

K8. Analyze the stresses

K9. Understanding of torque theory and calibration

K10. Knowledge of tables and graphs for the specific values

K11. Understanding about different cases of external load

K12. Knowledge of bolts

K13. Recognize material of bolts

Tools & Equipment

- Measuring tools (Scales, Micrometer Screw Gauges)
- Thread pitch gauge
- Safety gloves
- Nut bolt assembly
- Torque wrench

0715-M&MT-90. Design dimension of square and rectangular keys

Overview: This competency standard covers the skills and knowledge required to Recognise all types of sunk keys, Understand sizes of keys proportional to the shaft diameter, Select length of a sunk key for same material with shaft and equal strength with shaft, Check torque transmitted by rectangular and square keys against shearing as well as crushing and Calculate length of a sunk key when torque transmitted dia. of shaft, stress (shear & compressive) and width of key is given,

Competency Units	Performance Criteria
CU.1 Recognise all types of sunk keys	**P1.** Select any key **P2.** Measure thickness of the key **P3.** Measure width of the key **P4.**Identify the type of the key
CU2. Understand sizes of keys proportional to the shaft diameter	**P1.** Select shaft and key according to the shaft requirement **P2.** Identify the type of the key **P3.** Perform shaft and key integration
CU3. Select length of a sunk key for same material with shaft and equal strength with shaft	**P1.** Select sunk key **P2.** Measure thickness of the key **P3.** Measure width of the key **P4.** Measure width of the key-way inside the shaft **P5.** Measure Length of the key-way inside the shaft **P6.** Measure depth of the key-way inside the shaft
CU4. Check torque transmitted by rectangular and square keys against shearing as well as crushing	**P1.** Select rectangular key **P2.** Measure thickness of the key **P3.** Measure width of the key **P4.** Measure width of the key-way inside the shaft **P5.** Measure Length of the key-way inside the shaft **P6.** Measure depth of the key-way inside the shaft **P7.** Apply torque as per given condition **P8.** Analyze the stresses on different condition **P9.** Perform the same procedure for square key

CU5. Calculate length of a sunk key when torque transmitted dia. of shaft, stress (shear & compressive) and width of key is given	**P1.** Select sunk key **P2.** Measure thickness of the key **P3.** Measure width of the key **P4.** Measure width of the key-way inside the shaft **P5.** Measure Length of the key-way inside the shaft **P6.** Measure depth of the key-way inside the shaft **P7.** Apply torque as per given condition **P8.** Analyze the stresses on different condition **P9.** Calculate tangential forces inside the key **P10.** Apply failure criteria to find out the torsional, shear and compression stresses.

Knowledge & Understanding

- **K1.** Understanding of the key's theory
- **K2.** Measurement techniques
- **K3.** Know about the categories of the keys
- **K4.** Measure key dimensions
- **K5.** Measure shaft slot dimension
- **K6.** Assemble both parts properly.
- **K7.** Understand the coupling mechanism
- **K8.** Knowing about the material strength
- **K9.** Understand the coupling mechanism
- **K10.** Understand the torque transmission
- **K11.** Calculate the shearing and crushing stresses
- **K12.** Calculate the shearing, torsional and crushing stresses

Tools and Equipment

- Various types of sunk keys
- Measuring instruments
- Various slotted shafts
- Various type of keys
- Measuring tools

0715-M&MT-91. Design hollow and solid shaft subjected to twisting moment only

Overview: This competency standard covers the skills and knowledge required to understand twisting and bending moment on solid shaft, Perform torsion and bending equation for strength of shaft, calculate diameters of shaft under torsion when torque to be transmitted and torsional shear stress is given, calculate diameter of shafts subjected to combine bending and twisting moments Understand twisting moment and bending moment on hollow shaft, Know torsion and bending equation and Calculate dia. of hollow shaft (inside & outside dia.) when bending moment, twisting moment and stresses are given

Competency Units	Performance Criteria
CU1. Perform twisting and bending moment on solid shaft	**P1**. Select required solid shaft **P2**. Measure dimensions of the shaft **P3**. Recognize the reaction forces which produce bending moment and twisting.
CU2. Perform torsion and bending equation for strength of shaft	**P1**. Select required solid shaft **P2**. Measure dimensions of the shaft **P3**. Measure the force to produce moment along the dia. **P4**. Calculate the reaction forces which produce bending moment. **P5.** Calculate the moment of inertia of shaft **P6.** Produce the relationship to find-out the strength of the shaft
CU3. Calculate diameters of shaft under torsion when torque to be transmitted and torsional shear stress is given	**P1**. Select required solid shaft **P2.** Identify the type of shaft **P3**. Measure dimensions of the shaft **P4**. Apply torque to produce torsion along the dia. **P5**. Calculate the reaction forces which produce shear moment. **P6.** Calculate the moment of inertia of the shaft **P7.** Produce the relationship to find-out the diameter of the shaft under torsional loading
CU4. Calculate diameter of shafts subjected to combine bending and twisting moments	**P1.** Identify the type of shaft **P2**. Measure dimensions of the shaft **P3**. Apply torque to produce torsion along the dia. **P4**. Calculate the reaction forces which produce bending moment. **P5.** Calculate the reaction forces which produce twisting moment. **P6.** Calculate the moment of inertia of the shaft **P7.** Produce the relationship to find-out the diameter of the shaft under torsional loading

	P8. Calculate the max. normal stress in the shaft **P9.** Calculate Min. normal stress in the shaft **P10.** Bending stress induce in the shaft in the bending moment **P11.** Calculate the shear stress induced in the shaft due to twisting moment **P12.** Calculate the equivalent bending moment **P13.** Calculate the max. shear stress
CU 5. Understand twisting moment and bending moment on hollow shaft	**P1**. Select required hollow shaft **P2**. Measure dimensions of the shaft **P3**. Observe bending and twisting moment of the hollow shaft
CU 6. Know torsion and bending equation	**P1.** Select required hollow shaft **P2**. Measure dimensions of the shaft **P3**. Observe bending and twisting moment of the hollow shaft
CU 7. Calculate dia. of hollow shaft (inside & outside dia.) when bending moment, twisting moment and stresses are given	**P1**. Select required hollow shaft **P2**. Measure dimensions of the shaft **P3**. Observe bending and twisting moment of the hollow shaft

Knowledge and Understanding

- **K1.** Measure the diameter and length of the solid shaft
- **K2.** Knowing about the moment types.
- **K3.** Differentiate between the twisting moment and bending moment.
- **K4.** Understanding twisting behavior of the shaft
- **K5.** Identify the bending moment of the shaft
- **K6.** Knowledge to deal with stiffness of the solid shaft
- **K7.** Identify the shearing moment of the shaft
- **K8.** Knowledge to deal with the modulus of the elasticity of the solid shaft
- **K9.** Understanding to measure the diameters (Inner, outer or thickness.)
- **K10.** Able to recognize twisting and bending.

Tools and Equipment

- Solid shaft
- Measuring instruments
- Safety equipment

0715-M&MT-92. Design flange coupling for specific torque

Overview: This competency standard covers the skills and knowledge required to un-protected flange coupling, know empirical size of flange coupling and design assembly (hub, keys, flange and bolts) of unprotected type flange coupling

Competency Units	Performance Criteria
CU1. Un protected flange coupling	**P1**.Identify flange from the different machine parts like Hub, keys. Flywheel, bolts etc. **P2.** Differentiate type of the flange from Marine, Unprotected and Protected flange coupling
CU2. Know empirical size of flange coupling	**P1**. Choose the flange coupling **P2**. Measure diameter of the shaft **P3**. Measure outside diameter of the shaft **P4.** Measure Length of hub/ Effective length of key **P5.** Measure Thickness of output flange **P6.** Measure Pitch circular diameter **P7.** Measure Thickness of Protective rim **P8.** Measure Diameter of pin **P9.** Measure Number of pins
CU3. Design assembly (hub, keys, flange and bolts) of unprotected type flange coupling	**P1.** Measure and select hub as per requirement **P2.** Identify keys and measure dimensions for required unprotected type flange coupling **P3.** Identify un-protected flange type **P4.** Select bolts as per requirements **P5.** Assemble shaft inside the flange **P6.** Insert key and check fitting **P7.** Assemble bolt and tight nuts **P8.** Check the torque of the nut bolt assembly

Knowledge and Understanding

- **K1.** Understanding of the machine parts
- **K2.** Measurement techniques
- **K3.** Knowledge about the sizes of flange
- **K4.** Knowledge about all the parts of the flange assembly
- **K5.** Knowing about the unprotected flange application.
- **K6.** Able to check the errors in fitting.

Tools and Equipment

- Flange

- Bolts

- Keys

- Hubs

- Flywheels

- Measuring instruments

- Leveling instruments

0715-M&MT-93. Design the dimensions of helical spring

Overview: This competency standard covers the skills and knowledge required to design helical springs of circular wire, design terms used in helical springs, calculate deflection in helical spring and solve problems on calculation of dimensions of helical springs

Competency Units	Performance Criteria
CU1: Design helical springs of circular wire	**P1**. Identify spring type (helical, leaf) **P2**. Show closely coiled helical spring **P3**. Perform assembly of the spring on hanger **P4**. Measure the circular pitch diameter of the spring
CU2: Design terms used in helical springs	**P1**. Identify spring type (helical, leaf) **P2**. Show closely coiled helical spring **P3**. Perform assembly of the spring on hanger **P4**. Measure the circular pitch diameter of the spring **P5.** Identify the uses of the helical spring
CU3: Calculate deflection in helical spring	**P1.** Identify spring type (helical, leaf) **P2**. Show closely coiled helical spring **P3**. Perform assembly of the spring on hanger **P4**. Measure the circular pitch diameter of the spring **P5.** Identify the uses of the helical spring **P6.** Adjust the helical spring as per procedure instructions **P7.** Measure the deflection inside the helical spring
CU4: Solve problems on calculation of dimensions of helical springs	**P1.** Identify spring type (helical, leaf) **P2**. Show closely coiled helical spring **P3**. Perform assembly of the spring on hanger **P4**. Measure the circular pitch diameter of the spring **P5.** Identify the uses of the helical spring **P6.** Adjust the helical spring as per procedure instructions **P7.** Measure the deflection inside the helical spring **P8.** Measure all the possible measurements of the helical spring

Knowledge and Understanding

- **K1.** Types of springs
- **K2.** Material of the spring
- **K3.** Measurements of the spring
- **K4.** Understand to assembly of all the helical spring parts
- **K5.** Record the reading as per requirements

K6. Understanding about the dimensional analysis of the helical spring

Tools and Equipment

- Springs
- Spring stand
- Table
- Circular wire
- Various hangers

0715-M&MT-94. Design bearings, speed, lubrication, pressure, viscosity and coefficient of friction

Overview: This competency standard covers the skills and knowledge required to verify length of journal bearing, Measure the viscosity of lubricants, calculate the bearing modulus and apply the coefficient of friction in the design of journal bearings

Competency Units	Performance Criteria
CU1: Verify length of journal bearing	**P1**. Identify the types of bearings **P2**. Choose required bearing **P3**. Measurements of the bearings and clearance **P4**. Verify measurements with the given details
CU2: Know the viscosity of lubricants	**P1**. Identify the types of bearings **P2**. Choose required bearing **P3**. Take sample of the lubricant **P4**. Identify the quality of lubricant by using piezometer/Lubricant meter
CU3: Calculate the bearing modulus	**P1.** Identify the types of bearings **P2**. Choose required bearing **P3.** Identify the modulus of the bearing **P4.** Calculate the factor of safety
CU4: Apply the coefficient of friction in the design of journal bearings	**P1.** Identify the types of bearings **P2.** Choose required bearing **P3.** Identify the modulus of the bearing **P4.** Calculate the factor of safety **P5.** Measure co-efficient of friction **P6.** Compare results with the ideal bearing case and check the efficiency

Knowledge and Understanding

- **K1.** Measurement techniques
- **K2.** Understanding of the bearings
- **K3.** Knowledge of the viscosity
- **K4.** Recognize the lubricant viscosity meter
- **K5.** Understanding of the quality
- **K6.** Knowledge about the working principle
- **K7.** Understanding of the coefficient of friction
- **K8.** Comparison with the given standard

Tools and Equipment

Measuring tools
Various types of bearings

0715-M&MT-95. Design and draw the CAM profile

Overview: This competency standard covers the skills and knowledge required to Design of knife edge follower, Sketch Displacement, velocity and acceleration diagram when knife edge Follower, Perform movement of follower with Simple Harmonic Motion (S.H.M), Perform movement of follower with Simple Harmonic Motion (S.H.M), Sketch Displacement, velocity and acceleration diagram when knife edge follower moves with uniform velocity and Draw CAM profile as given data

Competency Units	Performance Criteria
CU1: Design of knife edge follower	**P1**. Differentiate between the cam and follower **P2**. Choose required type of follower **P3.** Identify the modulus of the follower **P4.** Measure the dimensions of the follower
CU2: Sketch Displacement, velocity and acceleration diagram when knife edge Follower	**P1**. Differentiate between the cam and follower **P2**. Choose required type of follower **P3.** Identify the modulus of the follower **P4.** Measure the dimensions of the follower **P5.** Measure the displacement of the knife edge follower **P6.** Calculate the velocity of the knife edge follower **P7.** Calculate the acceleration of the knife edge follower
CU3: Perform movement of follower with Simple Harmonic Motion (S.H.M)	**P1.** Measure the dimensions of the follower **P2.** Calculate the displacement of the knife edge follower **P3.** Calculate the velocity of the knife edge follower **P4.** Calculate the acceleration of the knife edge follower **P5.** Observe the movement of the follower and compare its motion with simple harmonic motion
CU4: Sketch Displacement, velocity and acceleration diagram when knife edge follower moves with uniform velocity	**P1**. Differentiate between the cam and follower **P2**. Choose required type of follower **P3.** Identify the modulus of the follower **P4.** Measure the dimensions of the follower **P5.** Calculate the displacement of the knife edge follower with uniform velocity **P6.** Calculate the velocity of the knife edge follower with uniform velocity **P7.** Calculate the acceleration of the knife edge follower with uniform velocity
CU5. Draw CAM profile as given data	**P1.** Measure the dimensions of the follower **P2.** Calculate the displacement of the knife edge follower **P3.** Calculate the velocity of the knife edge follower **P4.** Calculate the acceleration of the knife edge follower

	P5. Observe the movement of the follower and draw cam profile as per given requirement

Knowledge and Understanding

K1. Knowing follower and cam theory

K2. Understanding of the knife edge follower

K3. Understanding about the follower types

K4. Knowledge about the modulus of the follower

K5. Understanding the K.E and P.E concepts

K6. Understanding about the follower displacement behaviour

K7. Calculate the velocity and acceleration behaviour

K8. Calculate the velocity and acceleration behaviour at uniform velocity

K9. Sketch CAM profile with the help of available data.

Tools and Equipment

- Cam and follower
- Various types of followers
- Measuring instruments
- Complete mechanism with displacement finder
- Blank graph paper

0715.13 Industrial Management

0715-M&MT-96. Paraphrase Industrial Planning

Overview: This competency standard covers the skills and knowledge required to define and explain need of Industrial Planning and explaining Phases of Industrial Planning.

Competency Units	Performance Criteria
CU-1: Identify the Need of Industrial Planning	**P1.** Enlist Planning Principles **P2.** Mention Industrial Planning Requirements **P3.** Identify the resources and data required for industrial planning **P4.** Draw a flow chart diagram for industrial planning process
CU-2: Identify Phases of Industrial Planning	**P1.** Identify Assets and Liabilities in Financial Planning **P2.** Prepare reports based on financial planning **P3.** Analyse the reports and mention the feasibility **P4.** Identify the Product and Raw Materials in Product Planning Phase **P5.** Draw Product Life Cycle **P6.** Identify all stages of the product life cycle **P7.** Report marketing analysis of the product **P8.** Estimate the unit cost of manufacturing in Process Planning **P9.** Select the right equipment required for production **P10.** Select the manufacturing process **P11.** Estimate the quantity envisaged

Knowledge & Understanding

- **K1.** Define Planning
- **K2.** Describe Industry
- **K3.** Describe Industrial Planning
- **K4.** Distinguish between simple planning and industrial planning
- **K5.** Explain various phases of Industrial Planning
- **K6.** Describe the importance of Report writing
- **K7.** Explain Life Cycle
- **K8.** Describe market Analysis importance

0715-M&MT-97. Carry out Site Selection for an Industry

Overview: This competency standard covers the skills and knowledge required to explain Economic and Technical factors of Site Selection.

Competency Units	Performance Criteria
CU-1: Highlight Economic Factors of Site selection	**P1.** Highlight the importance of site selection **P2.** Compare the Land cost of optional areas **P3.** Create surveys based on appropriate geography, cost of utilities, road network, community facilities etc. **P4.** Prepare a selection criteria **P5.** Analyse the results of surveys **P6.** Choose the site based on the selection criteria
CU-2: Highlight Technical Factors of Site selection	**P1.** Create product focused surveys based on Skilled man power, Raw material availability, Finished product transportation, spares and servicing **P2.** Prepare a selection criteria **P3.** Analyse the results of surveys **P4.** Choose the site based on the selection criteria

Knowledge & Understanding

K1. Explain the potential factors important for an industrial site

K2. Describe the methods required to analyses a potential site

K3. Describe difference between economic and technical factors of site selection

K4. Explain results presentation method

0715-M&MT-98. Develop Plant Layout

Overview: This competency standard covers the skills and knowledge required to define plant layout, objectives of layout, types of layout, criteria of good layout, advantages of good layout and factors in preparation of layout.

Competency Units	Performance Criteria
CU-1: Paraphrase Plant Layout Importance	**P1.** Highlight the relation between operational cost and material handling **P2.** Identify the importance of access to equipment for quick maintenance and reduction of downtime **P3.** Identify the importance of flexibility of Layout **P4.** Identify the safety requirements for smooth operation
CU-2: Mention Objectives of Layout	**P1.** Identify material handling, material control, and good house keeping **P2.** Identify effective utilization of people, equipment, space and energy **P3.** Ensure minimum capital investment **P4.** Ensure route flexible **P5.** Promote ease of maintenance **P6.** Provide employee safety and job satisfaction
CU-3: Mention Types of Layout	**P1.** Enlist details of fixed position layout **P2.** Enlist details of Process Layout **P3.** Enlist details of Product layout **P4.** Enlist details of Mixed Layout
CU-4: Identify the Criteria of a good layout	**P1.** Highlight the arrangement of machines, equipment and work areas that material is moved smoothly **P2.** Elimination of all possible delays **P3.** Unique flow pattern of each product **P4.** Optimum utilisation of cubic space **P5.** Safe working conditions **P6.** Reducing Investment **P7.** Allow flexibility
CU-5: Identify the Advantages of a good layout	**P1.** Highlight the Labour Cost factor **P2.** Highlight the Production Control benefits **P3.** Highlight the benefits of good layout in Supervision **P4.** Mark other manufacturing Costs **P5.** Paraphrase the advantages to the Worker
CU-6: Identify the Factors in Preparation of a Layout	**P1.** Paraphrase the Material factor **P2.** Paraphrase the Machine factor **P3.** Paraphrase the Man factor

	P4. Paraphrase the Movement Factor **P5.** Paraphrase the Waiting Factor **P6.** Paraphrase the Service Factor **P7.** Paraphrase the Building Factor **P8.** Paraphrase the Change Factor

Knowledge & Understanding

K1. Describe plant Layout

K2. Describe the elements that must be considered while designing a plant layout

K3. Describe a floor Layout

K4. Describe the important attributes of good layout

K5. Compare between various types of layouts

K6. Give examples specific to each layout type

K7. Differentiate a good layout from a bad layout

K8. Differentiate flexible layout from fixed layout

K9. Describe the indirect advantages of a good layout

K10. Describe indirect cost saving benefits

K11. Describe time and motion study

K12. Describe synchronization

0715-M&MT-99. Demonstrate Production Method

Overview: This competency standard covers the skills and knowledge required to define production and explain types of production.

Competency Units	Performance Criteria
CU-1: Paraphrase Production	**P1.** Enlist important activities involved in production **P2.** Highlight Need for Production
CU-2: Explain Types of Production	**P1.** Enlist all types of production **P2.** Paraphrase the Intermittent or Batch Production **P3.** Paraphrase the Continuous production **P4.** Paraphrase the Group Technology **P5.** Paraphrase the Mass Production **P6.** Paraphrase the Just-in-time **P7.** Paraphrase the applications of each production methods

Knowledge & Understanding

K1. Define production

K2. Describe importance of production

K3. Describe production types

K4. Differentiate between production and service industry

0715-M&MT-100. Carry out Job Analysis

Overview: This competency standard covers the skills and knowledge required to explain motion study and explain time study.

Competency Units	Performance Criteria
CU-1: Demonstrate Motion Study	**P1.** Identify the task to be observed **P2.** Prepare Process chart with columns for to and from destinations **P3.** Perform activity and note all the movements during the process **P4.** Mark time required for each movement **P5.** Analyse the important and non-important activities and the activities that took maximum **P6.** Devise method to improve activity completion time and movement reduction **P7.** Perform any activity according to the principles of motion study
CU-2: Demonstrate Time Study	**P1.** Identify the task to be analysed **P2.** Ensure equipment required to carry out the Time and Motion study e.g. Time Study Form, Timing Device, Pen/Pencil, Safety equipment, Clipboard **P3.** Prepare Process charts **P3.** Perform activity and note all the movements during the process **P4.** Mark time required for each movement **P5.** Analyse the important and non-important activities and the activities that took maximum time **P6.** Devise method to improve activity completion time and movements reduction **P7.** Perform any activity according to the principles of Time study

Knowledge & Understanding

K1. Explain the time and motion study process

K2. Explain the importance of time and motion study

K3. Identify an area in your knowledge where this study would be relevant

0715-M&MT-101. Carryout Production Planning and Control

Overview: This competency standard covers the skills and knowledge required to define production planning and control (PPC), describe objectives of PPC, explain functions of production control, explain routing, scheduling and loading, explain packaging and dispatching.

Competency Units	Performance Criteria
CU-1: Paraphrase Production Planning and Control	**P1.** Highlight the defining points of Production Planning and Control **P2.** Highlight the activities important for Production Planning and Control **P3.** Highlight the data required for a good Production Planning and Control process completion **P4.** Develop a Complete Manufacturing plan for any identified product
CU-2: Enlist Objectives of Production Planning and Control	**P1.** Highlight the sequence of operation **P2.** Highlight the issue coordinated work schedule **P3.** Highlight the plan plant facility **P4.** Highlight and maintain sufficient inventories **P5.** Highlight and maintain production and employment level
CU-3: Enlist and explain Functions of Production Control	**P1.** Identify Pre-Planning Functions including Product Design, Process Design, Flow Design and Forecast Demand **P2.** Identify Planning Functions including Planning Resources, Process Planning, Scheduling and Estimation **P3.** Identify Control Function including Dispatching, Inspection, Expediting and Evaluation
CU-4: Explain Routing, Scheduling and Loading	**P1.** Paraphrase Routing **P2.** Identify the specification of flow or sequence of operation and the process to be followed in producing a particular manufacturing lot. **P3.** Enlist the Factors of routing **P4.** Paraphrase Scheduling **P5.** Prepare Time-table of production functioning **P6.** Enlist the Objectives of scheduling **P7.** Enlist factors affecting the scheduling **P8.** Paraphrase Loading
CU-5: Explain Packaging and Dispatching	**P1.** Paraphrase Packaging **P2.** Enlist activities involved in Packaging **P3.** Identify the release of resources along with the necessary instruction for the production function

Knowledge & Understanding

K1. Describe Production Planning and Control

K2. Describe Objectives of Production Planning and Control

K3. Describe functions of Production Planning and Control

K4. Describe routing, scheduling and loading

K5. Differentiate between routing, scheduling and loading

K6. Describe Packaging process

K7. Describe Dispatching process

0715-M&MT-102. Analyse Quality control and Quality Assurance

Overview: This competency standard covers the skills and knowledge required to explain inspection and its types as well as quality control and assurance.

Competency Units	Performance Criteria
CU-1: Explain Inspection and its Types	**P1.** Carryout Pre-production inspection **P2.** Carryout During production inspection **P3.** Carryout Final random inspection **P4.** Carryout Container loading inspection
CU-2: Explain Quality Control and Assurance	**P1.** Highlight important aspects of quality **P2.** Enlist quality traits of a product **P3.** Enlist the techniques involved in quality control **P4.** Enlist the tools and techniques involved in quality assurance

Knowledge & Understanding

K1. Describe the importance of inspection

K2. Describe various inspection methods

K3. Identify various national and international standards of Quality

K4. Differentiate between quality control and quality assurance

0715-M&MT-103. Carry out Maintenance Activities

Overview: This competency standard covers the skills and knowledge required to explain duties of maintenance department, types of maintenance and replacement studies.

Competency Units	Performance Criteria
CU-1: Identify Duties of Maintenance Department	**P1.** Carry out Repair of equipment in shortest possible time **P2.** Ensure Minimum breakdown equipment **P3.** Ensure Existing equipment maintenance **P4.** Carry out Equipment inspection, lubrication and cleaning **P5.** Perform Alteration of Existing equipment **P6.** Ensure Protection of Equipment waste, disposal, overhaul **P7.** Develop Repair/maintenance Schedule **P8.** Perform Preventive maintenance **P9.** Develop Facilities of erection and maintenance of machinery
CU-2: Identify Types of Maintenance	**P1.** Demonstrate Breakdown Maintenance **P2.** Demonstrate Preventive Maintenance **P3.** Demonstrate Predictive Maintenance **P4.** Demonstrate Corrective Maintenance
CU-3: Demonstrate Replacement Studies	**P1.** Locate the trouble **P2.** Stop the operation **P3.** Carry out trouble shooting **P4.** Carry out trade-off between the need of replacement or repair **P5.** Perform replacement if necessary

Knowledge & Understanding

K1. Define maintenance

K2. Highlight benefits of maintenance

K3. Describe and explain various types of maintenance

K4. Explain trade-off procedure

0715-M&MT-104. Carry out Cost Determination and Control

Overview: This competency standard covers the skills and knowledge required to explain cost calculation of industrial products and describe cost control.

Competency Units	Performance Criteria
CU-1: Demonstrate Cost Calculation of Industrial Products	**P1.** Procure data from Production Planning Department **P2.** Identify Material Cost **P3.** Identify Standard Time **P4.** Identify Labour Cost **P5.** Identify Prime Cost **P6.** Identify Factory Overheads **P7.** Identify Administrative overheads **P8.** Identify Packaging and delivery charges **P9.** Determine Total cost **P10.** Determine Sale Price **P11.** Identify Discount Allowed **P12.** Decide Delivery Time
CU-2: paraphrase Cost Control	**P1.** Analyse the external factors like market supply and demand competition etc. **P2.** Demonstrate that Cost is internal to the organisation

Knowledge & Understanding

K1. Describe cost calculation procedure and benefits

K2. Describe supply-demand relationship

0715-M&MT-105. Carry out Store Operation in Industry

Overview: This competency standard covers the skills and knowledge required to explain procedure of receipt items, describe forms in store operation and issuance procedure of store items.

Competency Units	Performance Criteria
CU-1: Explain procedure adopted by the store on receipt of store items	**P1.** Ensure Materials Report at Central Receiving section **P2.** Unload the goods **P3.** Verify the consignment **P4.** Record on goods receive note **P5.** Use gauges to inspect the material
CU-2: Describe forms used in store operation	**P1.** Check the Stores in-ward Receipt **P2.** Read the Inspection Report **P3.** Inspect the Rejection Memo
CU-3: Explain the procedure of issuance of store items	**P1.** Check the form and identify date, requisition number, name, department, and job number, material specifications, and quality, place of delivery, unit cost, total cost, and signature of the person making requisition. **P2. Issue** the Materials against the materials requisition **P3.** Keep Records

Knowledge & Understanding

K1. Describe store keeping in an industry

K2. Describe store keepers duties and operations

K3. Describe the importance of record keeping

K4. Describe various methods of store keeping

K5. Describe various methods of material Handling in a store

0715.14 CAD CAM

0715-M&MT-106. Draw A Simple Drawing of Die for Given Objects

Overview: This competency standard covers the skills and knowledge required to draw die of V-Block and Draw Die of Gear

Competency Units	Performance Criteria
CU1. Draw die of V-Block	P1. Setup drawing interface for required specifications P2. Setup user interface settings for required specifications P3. Save AutoCAD drawing files in different file formats (DWG, PDF, and JPG). P4. Create 2D Object of V-Block with given measurements P5. Edit 2D Object of V-Block to meet set standards P6. Use appropriate command and tools to develop 2D Drawing P7. Develop 2D Drawing with given project specifications and measurements P8. Setup & save 3D drawing interface for required specifications. P9. Setup 3D user interface settings for required specifications. P10. Create 3D objects with given measurements
CU2 . Draw Die Of Gear	P1. Setup drawing interface for required specifications P2. Setup user interface settings for required specifications P3. Save AutoCAD drawing files in different file formats (DWG, PDF, and JPG). P4. Create 2D Object of Gear with given measurements P5. Edit 2D Object of Gear to meet set standards P6. Use appropriate command and tools to develop 2D Drawing P7. Develop 2D Drawing with given project specifications and measurements P8. Setup & save 3D drawing interface for required specifications. P9. Setup 3D user interface settings for required specifications. P10. Create 3D objects with given measurements

Knowledge & Understanding

- **K1.** Define basic measurement
- **K2.** Describe Modules in 3D CAD
- **K3.** Describe Toolbars in 3D CAD
- **K4.** Explain Perpendicular Constraint
- **K5.** Explain Parallel Constraint
- **K6.** Explain Tangent Constraint

K7. Explain Coincident Constraint

K8. Explain Concentric Constraint

0715-M&MT-107. Perform Part Modelling

Overview: This competency standard covers the skills and knowledge required to Use of Line Command in Sketching, Use Of Circle Command In Sketching, Use Of Rectangle Command In Sketching, Perform Extude In Modeling, Perform Revolve In Modeling, Perform Hole In Modeling, Perform Chamfer In Modeling

Competency Units	Performance Criteria
CU1. Use Of Line Command In Sketching	P1. Start new Part Drawing in Auto Desk Inventor P2. Select sketching plane as per drawing P3. Select origin on plane selected P4. Select Line command from command menu P5. Draw multiple lines as per drawing P6. Finish sketch and save the drawing
CU2. Use Of Circle Command In Sketching	P1. Start new Part Drawing in Auto Desk Inventor P2. Select sketching plane as per drawing P3. Select origin on plane selected P4. Select Line command from command menu P5. Draw a line as per drawing P6. Select Circle command from command menu P7. Draw circle of given diameter on both ends of line P8. Finish sketch and save the drawing
CU3. Use Of Rectangle Command In Sketching	P1. Start new Part Drawing in Auto Desk Inventor P2. Select sketching plane as per drawing P3. Select origin on plane selected P4. Select Rectangle command from command menu P5. Draw a rectangle as per given drawing P6. Finish sketch and save the drawing
CU4. Perform Extude In Modeling	P1. Start new Part Drawing in Auto Desk Inventor P2. Select sketching plane as per drawing P3. Select origin on plane selected P4. Select Rectangle command from command menu P5. Draw a rectangle as per given drawing P6. Finish sketch and select Extude command P7. Select the drawn rectangle P8. Select the dimension of extude and its axis

	P9. Finish sketch and save the drawing
CU5. Perform Revolve In Modeling	P1. Start new Part Drawing in Auto Desk Inventor P2. Select sketching plane as per drawing P3. Select origin on plane selected P4. Select circle command from command menu P5. Draw a circle as per given drawing P6. Finish sketch and select Revolve command P7. Select the drawn Circle P8. Select the Degree of Revolve and its axis P9. Finish sketch and save the drawing
CU6. Perform Hole In Modeling	P1. Start new Part Drawing in Auto Desk Inventor P2. Select sketching plane as per drawing P3. Select origin on plane selected P4. Select Rectangle command from command menu P5. Draw a rectangle as per given drawing P6. Finish sketch and select Extude command P7. Select the drawn rectangle P8. Select the dimension of extude and its axis P9. Select Hole command P10. Select one side of object where hole is required P11. Select the diameter and depth of hole P12. Finish sketch and save the drawing
CU7. Perform Chamfer In Modeling	P1. Start new Part Drawing in Auto Desk Inventor P2. Select sketching plane as per drawing P3. Select origin on plane selected P4. Select Rectangle command from command menu P5. Draw a rectangle as per given drawing P6. Finish sketch and select Extude command P7. Select the drawn rectangle P8. Select the dimension of extude and its axis P9. Select Chamfer command P10. Select the corners of object to chamfer as per drawing P11. Finish sketch and save the drawing

Knowledge & Understanding

K1. Describe shortcut key for line

K2. Describe shortcut key to open a new file
K3. Describe Extrude Feature
K4. Describe Revolve Feature
K5. Describe methods of drawing circle in sketching
K6. Describe shortcut key to save a file
K7. Describe Fillets Feature
K8. Describe Chamfers Feature
K9. Describe Ribs Feature
K10. Describe Thicken and Offset Feature
K11. Describe Holes Feature
K12. Describe Sweep Feature
K13. Describe Lofted Feature
K14. Describe Coil Feature
K15. Describe Thread Feature
K16. Describe Shell Feature
K17. Describe Face Draft Feature
K18. Describe Replacing Face Feature
K19. Describe Boundary Patch Feature
K20. Describe Stitching Surfaces Feature
K21. Describe Sculpt Feature

0715-M&MT-108. Carry Out Assembly Modelling

Overview: This competency standard covers the skills and knowledge required to Perform Top down Assembly, Perform Bottom up Assembly, Perform Assemble Parts with Mate Constraint and Perform Assemble Parts with Angle Constraint

Competency Units	Performance Criteria
CU1. Perform Top Down Assembly	P1. Start new Assembly Drawing in Auto Desk Inventor P2. Select Assembly Modelling and set parameters as per standard P3. Select PLACE command P4. Draw largest assembling part using sketch module P5. Import other assembling part from saved location P6. Join both parts using Constraint as per standard P7. Finish sketch and save the drawing
CU2. Perform Bottom Up Assembly	P1. Start new Assembly Drawing in Auto Desk Inventor P2. Select Assembly Modelling and set parameters as per standard

	P3. Select CREATE command P4. Draw largest assembling part using sketch module P5. Draw other assembling part in same drawing P6. Join both parts using Constraint as per standard P7. Finish sketch and save the drawing
CU3. Perform Assemble Parts With Mate Constraint	P1. Start new Assembly Drawing in Auto Desk Inventor P2. Select sketching plane as per drawing P3. Select origin on plane selected P4. Draw 2D objects as per given drawing P5. Finish sketch and select Modelling commands (Extude, Revolve) to convert into 3D P6. Select the Constrain Command P7. Select Assembly tab in dialogue box appears P8. Select MATE in Place Constrain menu P9. Select faces of both objects as per drawing P10. Select Apply P11. Finish sketch and save the drawing
CU4. Perform Assemble Parts With Angle Constraint	P1. Start new Assembly Drawing in Auto Desk Inventor P2. Select sketching plane as per drawing P3. Select origin on plane selected P4. Draw two Rectangles as per given drawing P5. Finish sketch and select Modelling command Extude to convert into 3D P6. Select the Constrain Command P7. Select Assembly tab in dialogue box appears P8. Select ANGLE in Place Constrain menu P9. Select faces of both objects as per drawing P10. Select Apply P11. Finish sketch and save the drawing

Knowledge & Understanding

K1. Describe Types of Assembly

K2. Describe Assembly Component

K3. Explain Mate Constraint

K4. Explain Angle Constraint

K5. Explain Tangent Constraint

K6. Explain Insert Constraint

K7. Explain Rotation Constraint

K8. Explain Rotation-Translation Constraint

K9. Explain Transitional Constraint

0715-M&MT-109. Perform CAM Operations

Overview: This competency standard covers the skills and knowledge required to perform holes drilling in cam milling, perform holes drilling in cam milling, perform turning in cam turning, and perform facing in cam turning.

Competency Units	Performance Criteria
CU1. Perform Holes Drilling in CAM Milling	P1. Start new part document in Feature CAM P2. Select Milling Setup P3. Select Block stock and give dimensions as per standard P4. Select stock material as per standard P5. Select axis of milling as per drawing P6. Select part program Zero location on stock P7. Select off-set if required as per job P8. Select finish P9. Select Feature in Tool box menu P10. Select Hole P11. Give dimensions of hole in dialogue box P12. Identify the position of hole on stock P13. Select finish to complete operation
CU2. Perform Holes Drilling in CAM Milling	P1. Start new part document in Feature CAM P2. Select Milling Setup P3. Select Block stock and give dimensions as per standard P4. Select stock material as per standard P5. Select axis of milling as per drawing P6. Select part program Zero location on stock P7. Select off-set if required as per job P8. Select finish P9. Select Feature in Tool box menu P10. Select Pocket P11. Give dimensions of Pocket in dialogue box P12. Identify the Distance of Pocket on stock from corners P13. Select finish to complete operation
CU3. Perform Turning in CAM Turning	P1. Start new part document in Feature CAM P2. Select Turning Setup P3. Select Round stock and give dimensions as per standard

	P4. Select stock material as per standard P5. Select axis of milling as per drawing P6. Draw geometry/profile on stock as per drawing P7. Select finish P8. Select Feature in Tool box menu P9. Select Turn P10. Select the geometry/profile drawn P11. Set cutting parameters as per standard P12. Select finish to complete operation P13. Run simulation and check for errors
CU4. Perform Facing in CAM Turning	P1. Start new part document in Feature CAM P2. Select Turning Setup P3. Select Round stock and give dimensions as per standard P4. Select stock material as per standard P5. Select axis of milling as per drawing P6. Draw geometry/profile on stock as per drawing P7. Select finish P8. Select Feature in Tool box menu P9. Select Face P10. Select the geometry/profile drawn P11. Set cutting parameters as per standard P12. Select finish to complete operation P13. Run simulation and check for errors

Knowledge & Understanding

K1. Describe Holes Drilling
K2. Describe Face cutting
K3. Describe Side cutting
K4. Describe Pocket cutting
K5. Describe Slot cutting
K6. Explain Facing
K7. Explain Boring
K8. Explain Grooving
K9. Explain Inside Threading
K10. Explain Outside Threading
K11. Explain Cut off

0715.15 Boiler Operator

0715-M&MT-110. Perform Boiler Operations

Overview: This competency standard covers the skills and knowledge required to inspect boiler & accessories for safe operation, Check and operate boiler mountings & burner, Operate feed water pumps / Injector, Check fuel system, Fire the burner, Check control panels and Inspect openings and Shutdown burner.

Competency Units	Performance Criteria
CU1. Inspect boiler & accessories for safe operation	**P1.** Inspect openings & refractory linings **P2.** Inspect furnace and tube nest **P3.** Check Boiler utilities **P4.** Check exhaust system
CU2. Check and operate boiler mountings & burner	**P1.** Check water gauge column, water level and steam pressure controls **P2.** Check pressure gauges **P3.** Check safety valves **P4.** Check main valve **P5.** Check feed water and stop valves **P6.** Operate blow down valves **P7.** Operate air vent valve
CU3. Operate feed water pumps / Injector	**P1.** Maintain all supply and delivery valves in proper open position. **P2.** Check Feed water pumps to ensure that they are in proper operating condition, after powering on. **P3.** Check Feed water injector to ensure that they are in proper operating conditions. **P4.** Clean Strainers cleaned if necessary
CU4. Check fuel system	P1. Maintain all valves in fuel supply line in open position. P2. Check Fuel pump to ensure that it is building up proper pressure. P3. Check fuel pump and fuel filter checked to ensure proper fuel supply. P4. Maintain Temperature and final pressure in fuel oil system/s.
CU5. Fire the burner	**P1.** Control Furnace purged to prevent possible backfire following recommended procedure. **P2.** Open Fuel and air lines for pilot burner prior to operation. **P3.** Inspect Sight glass and magic eye and clean to observe boiler operations. **P4.** Inspect Burner flame through sight glass to ensure proper operation.

	P5. Check Chimney outlet checked for abnormal/excessive smoke.
CU6. Check control panels and **Inspect openings**	**P1.** Check Indicator lamps to ensure that all are in proper working order. **P2.** Check Alarms to ensure that they are in working order. **P3.** Inspect Manholes, hand holes and joints **P4.** inspect for leaks and result entered correctly in the check list
CU7. Shutdown burner	**P1.** Switch Burner switched off as instruction given by the authorized person **P2.** Close Inlets & outlets valves closed appropriately **P3.** Cool down the boiler to atmospheric condition ensured as specified **P4.** Open Air vent

Knowledge & Understanding

- **K1.** Principles of boiler operation
- **K2.** Preventive & corrective maintenance
- **K3.** Reading and understanding instructions
- **K4.** Safety rules and regulations
- **K5.** Safety procedures to be followed.
- **K6.** Factories Ordinance
- **K7.** Proper operation of valves and pumps
- **K8.** Material Safety Data Sheet (MSDS)
- **K9.** Technical terms in English language
- **K10.** Ability to understand engineering drawings and flow charts

Tool and Equipment

- Personal protective equipment
- Packing and gaskets
- General mechanic's tools and electricians basic tools
- Tube brush
- General mechanic's tools • Gauge glass, rubber cones
- Set of gaskets
- Gland packing
- Dial thermometer 0-600° C • Oil pressure gauge 0-600 psi
- Personal protective equipment • Pyrometer

0715-M&MT-111. Operate boiler auxiliaries

Overview: This competency standard covers the skills and knowledge required to check water softener, Check chemical dosing system, Check make-up water tank and Check day oil tank and Inspect main header and oil storage tank.

Competency Units	Performance Criteria

CU1. Check water softener	**P1.** Monitor operation of water softener system. **P2.** Check level of brine tank to ensure adequate supply.
CU2. Check chemical dosing system	**P1.** Check Chemical storage tank levels to ensure adequate chemical supply. **P2.** Check Chemical dosing pump for proper functioning
CU3. Check make-up water tank and Check day oil tank	**P1.** Check Make-up water tank to ensure that sufficient water level is maintained. **P2.** Check Feed and outlet valves to ensure proper supply of water. **P3.** Ensure required quality of make-up water by testing Check day oil tank to ensure that oil level is sufficient. **P4.** Drain Water and sludge from the oil tank as and when necessary. **P5.** Check Temperature of day oil tank, record and report as required.
CU4. Inspect main header and oil storage tank	**P1. Check** Safety valve, pressure gauge and steam trap c for proper operation. **P2.** Check Steam valves checked for leaks. **P3.** Check Fuel oil level, fuel transfer pump, fuel oil filter/s and valves to ensure proper operation. **P4.** Drain Water/sludge drained when required. **P5.** Monitor Fuel stock and inform to superior if necessary for required action.

Tool and Equipment

- General mechanic's tools
  - Gauge glass, rubber cones
  - Chemicals (for testing & softening)
  - Bucket
  - Sets of gaskets
  - Cotton waste
  - Gland packing
  - Personal protective equipment
  - Cleaning agents
  - Boiler water testing kits

0715-M&MT-112. Set and adjust burners

Overview: This competency standard covers the skills and knowledge required to Carry out basic startup of burner and maintain burner system.

Competency Units	Performance Criteria
CU1. Carry out basic startup of burner	**P1.** Check Electrode setting and adjust /replace if necessary. **P2.** Check Nozzle tips and clean / replace if necessary.

	P3. Check Photocell / UV scanner / flame rod and replace if necessary. **P4.** Check Heater thermostats and set / replace if necessary.
CU2. Maintain burner system	**P1.** Check Nozzle closure and replace if necessary. **P2.** Check Nozzle head and adjust if necessary. **P3.** Air dampers position checked and adjusted if necessary. **P4.** Check/ adjust Atomizer (air / fuel) checked **P5.** Check Oxygen & carbon dioxide content and temperature of flue gas, if gas analyzer available and air/fuel ratio adjust if necessary. **P6.** Check Solenoid valve checked / adjusted / replaced as required.

Knowledge & Understanding

K1. Principles of combustion.

K2. Types of burners and their mode of operation

K3. Methods of analyzing flue gases

K4. Methods of adjusting air/fuel ratio

K5. Types of fuels and their characteristics

K6. Basic principles of electricity and electronics

K7. Safety rules and regulations

K8. Relevant ISO/ ASME/ BS codes

K9. Fire safety

K10. Safety procedures to be followed

K11. Factories ordinance

K12. Testing instruments

K13. Technical terms in English language

K14. Ability to understand engineering drawings and flow charts

Tool and Equipment

- General mechanic's tools
- Gauge glass, rubber cones
- Set of nozzles and cleaning kit
- Pair of electrodes
- Sets of gaskets
- Photo cell
- Gland packings
- Personal protective equipment
- Smoke analyzing test kit
- Flame rod

- UV Scanner

- Solenoid valve

- Thermostats

0715-M&MT-113. Maintain Boiler house Record

Overview: This competency standard covers the skills and knowledge required to maintain record book & log book and maintain boiler tools
& emergency spares.

Competency Units	Performance Criteria
CU1. Maintain record book & log book	**P6.** Entries made regularly in check lists records & log books. **P7.** Arrangements made for statutory annual inspection of boiler as per factories ordinance.
CU2. Maintain boiler tools & emergency spares	**P1.** Necessary tools and essential spares for the boiler stocked in a suitable storage facility. **P2.** Appropriate firefighting equipment correctly located and maintained regularly. **P3.** Maintain Cleanliness and tidiness of the boiler house by following good housekeeping practices.

Knowledge & Understanding

- **K1.** Principles of boiler operation
- **K2.** Statutory requirements regarding boiler operation
- **K3.** English Technical Terms
- **K4.** Basic stock management
- **K5.** Fire safety and firefighting equipment
- **K6.** Safety procedures to be followed

Tool and Equipment

- General mechanic's tools
- Fire extinguishers
- Sand buckets
- Cleaning tools
- Record books
- Commonly used boiler spares
- Personal protective equipment

0715-M&MT-114. Perform Maintenance of Boiler

Overview: This competency standard covers the skills and knowledge required to Carry out routine maintenance and Carry out basic maintenance operations.

Competency Units	Performance Criteria
CU1. Carry out routine maintenance	**P1.** Regenerate water softener plant **P2.** Clean / Replace air filters **P3.** Clean / Replace oil filters **P4.** Clean / Replace ignition electrodes **P5.** Clean diffuser plates **P6.** Clean/replace burner and sight glass **P7.** Clean carbon deposits in smoke box & chimney
CU2. Carry out basic maintenance operations	**P1.** Clean atomizer and damper **P2.** Clean/replace burner nozzle **P3.** Clean fire tubes **P4.** Clean chamber of the boiler

Knowledge & Understanding

K1. Types of maintenance

Tool and Equipment

- oil filters
- air filters
- water softener plant
- ignition electrodes
- diffuser plates
- burner and sight glass

0715.16 Plastic machine processes

0715-M&MT-115. Operate Injection Moulding Machine

Overview: This competency standard covers the skills and knowledge required to Select the mould and the machine required for making the product, Inspect the injection moulding machine and carry out necessary adjustments, prior to operation, Set injection-moulding machine for operation, Carry out safety checks prior to operation, Perform sample inspection and Finish and deliver product.

Competency Units	Performance Criteria
CU1. Select the mould and the machine required for making the product	**P1.** Identify Size of the mould and the machine to fit the mould. **P2.** Measure parameters like the specifications, finish of the product required, cycle times and estimated total time for making the order etc. **P3.** Identify production plan.
CU2. Inspect the injection moulding machine and carry out necessary adjustments, prior to operation.	**P1.** Control the following system: • Electrical • hydraulic • pneumatic • and water circulation systems **P2.** Identify necessary corrections and carry out lubrication to make the injection moulding machine operational. **P3.** Control safety doors and other safety devices, are functioning properly. **P4.** Inspect Abnormalities of the machine if any, and take the corrective action taken recorded in the logbook.
CU3. Set injection-moulding machine for operation	**P1.** Identify Job order read and material required for production noted, material, tools and equipment **P2.** prepare/arrange the storage of finished product **P3.** Change Mould according to the requirement of the job following safety procedures **P4.** Set Processing parameters according to the data sheet and to suit the quality of the product.
CU4. Carry out safety checks prior to operation	**P1.** Select and feed all raw materials **P2.** Prepare Safety checklist for all safety points as per the checklist, and take corrective action where necessary, before starting. **P3.** Use Personal Protective Equipment, to suit production process

	P4. Switch on Machine and set adjustments as necessary, by listening to any unusual noises and feeling for any undue vibrations, and by checking each crucial point of the machine. **P5.** Keep informed relevant authorities for any abnormalities.
CU5. Perform sample inspection.	**P1.** Sample each production according to company policy and product specification. **P2.** Check Sample physically for quality inspection. **P3.** Take Necessary steps to fine-tune the process based on sample checked. **P4.** Maintain Quality assurance approval prior to production
CU6. Finish and deliver product.	**P1.** Produce required number of products as per the job card switch off and machine. **P2.** Check Quality as per sampling plan, packed and store as planned for easy retrieval preventing any damage or contamination. **P3.** Make Necessary entries in production documents. **P4.** Store runners and sprues and any rejected items separately for reprocessing. **P5.** Transfer the last shot attached to the mould for cleaning and storage.

Knowledge & Understanding

K1. Basic literacy and knowledge of arithmetic for simple counting and additions.

- The process of production with injection moulding
- Product quality expected
- Interpretation of production instructions
- Different moulds used in production.
- Faults in products and methods of identification and rectification.
- Safety procedures to be followed.
- Chemical raw material usage, safe storage and care with reference to Material Safety Data Sheets (MSDS)
- Pre-conditioning and drying
- Basic properties of polymers

Tool and Equipment

- Measuring tape
- Personal Protective Equipment.
- Vernier calliper of appropriate range

- Injection moulding machine,
- Mould and ancillary equipment
- Mould lifting equipment
- Machine setting instruments
- Copper rod
- Cutter to separate the items
- Toolbox or tool car containing all necessary tools
- Computer with an installed / designed
- Mould heater package for recording production
- Hot runner nozzle controller (optional)
- Temperature measuring instrument.

0715-M&MT-116. Operate Blow Molding Machine

Overview: This competency standard covers the skills and knowledge required to Select the mould and the machine required for making the product, Carry out pre inspections and prepare / set the blow-moulding machine for operation, Select and feed raw material, Operate the machine and perform sample production and inspections, Carry out mass (commercial) production as necessary, deliver product and finish the job.

Competency Units	Performance Criteria
CU1. Select the mould and the machine required for making the product.	**P1.** Identify Size of the mould and the machine to fit the mould. **P2.** Measure parameters like the specifications, finish of the product required, cycle times and estimated total time for making the order etc. **P3.** Identify production plan.
CU2. Carry out pre inspections and prepare / set the blow-moulding machine for operation.	**P1.** Carry out to make the blow moulding machine operational. **P2.** Check the Individual components movement before running the machine with material in normal practice. **P3.** Make the Machine safe for operation, by ensuring safety doors and other safety devices, are functioning properly. **P4.** Take the Abnormalities of the machine if any, and the corrective recorded in the logbook. **P5.** Prepare and Arrange Necessary tools and gauges and accessories such as mould temperature controller, air ejector etc. **P6.** Check the Parison profile with parison controller
CU3. Select and feed raw material	**P1.** Select and Check required raw material for making the product, in correct quantity as appropriate. **P2.** Make Arrangements for, preheating where necessary, and facilities for mixing of any fillers and additives and supply of raw material ensured for continuous operation.
CU4. Operate the machine and perform sample production and inspections.	P1. Check all safety points before starting the machine, and operator safety ensured by wearing of the appropriate Personal Protective Equipment. P2. Do Necessary adjustments to the machine and sample production commenced, according to company policy and product specifications. P3. Check the required product specifications verified by either physically the samples or sending for quality checks.

	P4. Carry out Any corrections needed to fine tune the process, and exact requirements of the product obtained.
CU5. Carry out mass (commercial) production as necessary, deliver product and finish the Job.	**P1.** Check the Mass production commenced, performance of machine and feeding of the raw material continued, in process inspection done, and adjustments made so as to ensure required quality of the product. Required number of products as per the production plan (job card) produced, machine stopped. **P2.** Check Quality as per sampling plan, packed and stored as planned for easy retrieval. **P3.** Make Necessary entries in production documents. **P4.** Separate the Rejects and off-cuts properly segregated and stored for re-processing. **P5.** Transfer the last shot attached to the mould after proper lubrication and for cleaning and storage to avoid corrosion

Knowledge & Understanding

K1. Basic literacy and knowledge of arithmetic for simple counting and additions.
K2. Material Safety Data Sheet (MSDS)
K3. Basic knowledge and function of Melt Flow
K4. Index (MFI) and density of raw materials
K5. Melt pressure and temperature
K6. The process of production with blow moulding
K7. Chemical raw material usage, safe storage and care.
K8. Product quality expected
K9. Safety procedures to be followed with blow moulding machine
K10. Planning of production based on the capacity and output of the machine
K11. Basic Properties of Polymers
K12. Quality testing method and identification of faults
K13. Basic First aid with respect to handling of accidents.
K14. Basic firefighting methods & equipment
K15. Operational capability of a blow moulding machine
K16. Safe working with chemicals and machinery
K17. Selection and feeding of raw materials at appropriate times in correct quantities
K18. Maintenance of product quality through adjustment of machine and raw material input
K19. Care and observation of good housekeeping habits in working area
K20. Recording of product output and any remarks as necessary
K21. Purging of machine

K22. Optimizing output

K23. Preventive maintenance of machine

K24. Control melt temperature and pressure

K25. Identification of design defect and abnormalities

K26. Effective communication and coordination

K27. Use of basic firefighting equipment.

K28. The assembly and disassembly of moulds and other parts and components.

K29. Feeding of raw materials on to blow moulding machine preconditioning if necessary

K30. Identification of faults in products and methods of rectification

K31. Ensuring output rate based on production plan.

K32. Shut down machine

K33. Flow properties & Thermal properties

Tool and Equipment

- Pocket measuring tape (3m)
- Pre-heaters
- Chiller and cooling towers
- Water pumps
- Air compressors
- Material mixers
- A computer with an installed / designed
- Personal Protective Equipment.
- Package for recording production
- Tool box or Tool car containing all necessary tool
- Parison controller

0715-M&MT-117. Operate Plastic Film Extrusion machines (Blown/Cast)

Overview: This competency standard covers the skills and knowledge required to Carry out pre inspections and prepare the plastic film extrusion machine for operation, Set extrusion machine for operation, operate the machine and commence production, Perform sample inspections of product, Finish and transfer product for storage

Competency Units	Performance Criteria
CU1. Carry out pre inspections and prepare the plastic film extrusion machine for operation.	**P1.** Identify any corrections or adjustments to the extrusion machine after inspecting the machine. **P2.** Take Abnormalities of the machine if any and the corrective action recorded in the log book along with remarks for the day.
CU2. Set extrusion machine for operation	**P1.** Verify the Job requirements and priority from production plan. **P2.** Identify Material tools and equipment required for production, from job order and a location arranged for storage of finished product. **P3.** Make the Die change where necessary according to the requirement of the job and adjustments on the machine. **P4.** Clean the Web rollers and contact arms etc. For safety of machine ensured. **P5.** Refer the Process parameters set to the product data sheet
CU3. Operate the machine and commence production	**P1.** Obtain the Quantities of raw material with the quality as specified for the product and sufficient for the work shift. **P2.** Check the Selected material as appropriate. **P3.** Check all safety points before starting the machine using a checklist. **P4.** Total time required to complete the production estimated. **P5.** Make Machine switched on and adjustments as necessary by checking each crucial point/function of the machine and by making finer adjustments. Relevant authority informed of any defects. **P6.** Produce Production commenced, and sample according to company policy and product specification.
CU4. Perform sample inspections of product	**P1.** Forward Samples physically for quality and/or for such inspections. **P2.** Any corrections necessary to fine tune the production identified. **P3.** Adjustments made on machine and / or raw material checked to get the exact requirement of the product.

	P4. Obtain the Quality assurance approval to prior to production **P5.** Performance of machine checked prior to commencing mass production. **P6.** Check raw material fed, to continue mass production. **P7.** Carry out In- process inspection and necessary adjustments made to produce a product to the required quality standards. **P8.** Revise the process parameters recorded for future reference.
CU5. Finish and transfer product for storage	**P1.** Identify the Required quantity of the product according to the job card. **P2.** Check Quality as per sampling plan. **P3.** Check the Output and machine stopped / job changed, when required quantity is produced. **P4.** Keep Product packed and stacked, similar items together at the appropriate place for easy retrieval prevent any damage or contamination **P5.** Make Entries in production documents as necessary. **P6.** Store All remaining material accounted and returned to where applicable

Knowledge & Understanding

K1. The extrusion process
K2. Product quality expected
K3. Extrusion Dies
K4. Optimization of output
K5. Functions of Melt flow index (MFI) and density of Raw Materials.
K6. Material handling
K7. Mixing, melting, conveying and pressure generation of raw material in the extruder
K8. Screw characteristics
K9. Identification of faults in products and methods of rectification
K10. Extruder output calculations
K11. Basic Quality testing methods
K12. Safety procedures to be followed with extrusion machine
K13. Safety in handling chemicals with reference to Material Safety Data Sheet (MSDS).
K14. Basic Fire Fighting methods
K15. Basic polymer rheological and thermal properties
K16. Zonal distribution and functions of the screw.
K17. Basic First aid with respect to handling of accidents.

K18. Basic firefighting methods & equipment

K19. Production quality based on the capacity and output of the machine

K20. Effects of environmental conditions on the extrusion process

K21. Preventive maintenance of machine or equipment

Tool & Equipment

- Pocket measuring tape
- A computer with an installed / designed package for recording production
- Thickness gauge and feeler gauge
- Precision weighing scale (lab scale) for sample weighing
- Platform scale for product weighing
- Suitable material handling equipment
- Surface treatment test pen.
- Marker pen and adhesive tape,
- Personal Protective Equipment.
- Appropriate tools
- Surface treating equipment (optional)
- Die lifting equipment.
- Knife

0715-M&MT-118. Operate Pipe & Profile Extrusion Machines

Overview: This competency standard covers the skills and knowledge required to set extrusion machine for operation, operate the machine and commence production, Perform sample inspections of product and Finish and deliver product

Competency Units	Performance Criteria
CU1. Set extrusion machine for operation	**P1.** Carryout pre inspections and prepare the pipe or profile extrusion machine for operation **P2.** Verify Job requirements and priority from production plan. **P3.** Identify Material tools & equipment required for production, from job order and a location for storage of finished product arranged. **P4.** Change Dies where necessary according to the requirement of the job as per job card and adjustments made on the machine. **P5.** Pre-check of the machine performed to verify whether the cooling though cutter, printing and the haul off are working correctly **P6.** Set Processing parameters by referring to the product data sheet
CU2. Operate the machine and commence production	**P1.** Select and feed all raw material **P2.** Check All safety points before starting the machine using a checklist. **P3.** Total time required to complete the production set. **P4.** Make Machine switched on and adjustments as necessary by checking each crucial point /function of the machine and by making finer adjustments. Relevant authority informed of any defects. **P5.** Produce Production commenced, and sample according to company policy and product specifications..
CU3. Perform sample inspections of product	**P1.** Check Samples physically for quality and/or forwarded for such inspections. **P2.** Carry out Any corrections necessary to fine tune the process identified. **P3.** Check Adjustments made on machine and / or raw material to get the exact requirement of the product. **P4.** Carryout mass production as necessary
CU4. Finish and deliver product	**P1.** Identify required quantity of the product according to the job card/production plan. **P2.** Make Product inspected and any further adjustments as necessary. **P3.** Keep Product packed and stacked, similar items together at the appropriate place for easy retrieval. **P4.** Make Entries in production documents as necessary.

	P5. Check Output and machine stopped / job changed, when required quantity is produced. **P6.** Store Rejected items and off-cuts separately for re-processing.

Knowledge & Understanding

- **K1.** Operational capability of pipe and profile extrusion machine.
- **K2.** The process of production
- **K3.** Knowledge of raw material
- **K4.** Product quality expected and basic Quality testing methods
- **K5.** Safety procedures to be followed
- **K6.** Chemical raw material usage, safe storage and care, including Material Safety Data Sheet (MSDS)
- **K7.** Basic properties of polymers
- **K8.** Knowledge of functions of Melt flow index (MFI) and density of Raw Materials.
- **K9.** Material handling
- **K10.** Conveying, melting, mixing and pressure generation
- **K11.** Identification of faults in products and methods of rectification
- **K12.** Purging and shutdown methods
- **K13.** Pipe/profile calibration technique
- **K14.** Sharpening of circular saw
- **K15.** Basic knowledge on quality checking parameters
- **K16.** Safe working with chemicals and machinery
- **K17.** The assembly and disassembly of parts and components of machine.
- **K18.** Controlling of melt temperature and pressures according to the process parameters
- **K19.** Operation and maintenance of pipe & profile printing machinery
- **K20.** Maintenance of product quality through adjustment of machine and raw material input
- **K21.** Use of Personal Protective Equipment (PPE)

Tool and Equipment

- Extrusion Machine, dies
- Measuring tape
- Computer with installed / package for
- Trimming Knife recording production
- Platform scale for product weighing
- Thickness gauge and feeler gauge
- General hand tools
- Material handling equipment
- Die lifting equipment

- Circumference tape

- Personal Protective Equipment

- Vernier Calliper

0715-M&MT-119. Operate Rotational Molding Machines

Overview: This competency standard covers the skills and knowledge required to Set Rotational Moulding machine for operation, operate the machine and commence production and Finish the product and Prepare mould for next cycle

Competency Units	Performance Criteria
CU1. Set Rotational Molding machine for operation	**P1.** Carryout pre inspections and prepare/ Rotational Molding Machine for operation **P2.** Verify Job requirements and priority from production plan. **P3.** Identify Material required for production, tools & equipment required, from job order and a location for storage of finished product arranged. **P4.** Change Molds where necessary according to the requirement of the job as per job card and instructions from Superior Officer. **P5.** Carry out Final check on mold mounting. **P6.** Apply Mold release agent and baked. **P7.** Set Processing parameters by referring to the product data sheet and adjustment made on the machine as necessary.
CU2. Operate the machine and commence production	**P1.** Select and feed all raw material **P2.** Check All safety points before starting the machine using a checklist. **P3.** Set total cycle time required for finishing the product according to product requirement. **P4.** Activate and adjust Machine by checking each crucial point /function of the machine and by making finer adjustments. **P5.** Commence Production and Check product according to specifications and quality requirements.
CU3. Finish the product and Prepare mold for next cycle	**P1.** Obtain Finished product by trimming flash, punching holes and application of stickers **P2.** Attach basic Accessories where required. **P3.** Check required quantity against job card Transfer Product to storage area safely. **P4.** Make production documents as necessary. **P5.** Clean Mold and release mold agent if necessary. **P6.** Store Rejected items separately for re-processing

Knowledge & Understanding

K1. The process of production with rotational molding machines

K2. Expected product quality

K3. Safety procedures to be followed with rotational molding machine

K4. Chemical raw material usage, safe storage and care including Material Safety Data Sheet (MSDS)

K5. Functions of Melt flow index (MFI) and density of Raw Materials.

K6. Material handling

K7. Basic First aid with respect to handling of accidents.

K8. Basic firefighting equipment and methods.

Tool and Equipment

- Measuring tape
- Rotational molding machine tools & equipment
- Computer with an installed / designed package
- Thickness measuring equipment for recording production
- Trimming Knife
- Mold lifting equipment
- Platform scale for product weighing
- Personal Protective Equipment.
- Material handling equipment.
- General hand tools

0715-M&MT-120. Operate Foam Processing Machines

Overview: This competency standard covers the skills and knowledge required to Set foam processing machine for operation, Operate the machine and commence production and Check and transfer product for further processing

Competency Units	Performance Criteria
CU1. Set foam processing machine for operation	**P1.** Carryout pre inspections on the foam processing machine and mold. **P2.** Verify Job requirements and priority from production plan. Identify Material, tools & equipment required for production from job order **P3.** Arrange a location for storage of finished product arranged. Change Mold where necessary according to the requirement of the job as per job card and adjustments made on the machine. **P4.** Set Process parameters by referring to the product data sheet and to suit product, production speed quality and standard wastage.
CU2. Operate the machine and commence production	**P1.** Select and feed all raw material **P2.** Check all safety points before starting the machine using a checklist. **P3.** Set Total time required for finishing the product **P4.** Switch on Machine and adjustments made as necessary **P5.** Check each crucial point /function of the machine and by making finer adjustments. **P6.** Commence Production and intermediate product of “foam - bun” checked as for specification. **P7.** Adjust machine and / or check raw material to get the exact requirement of the product by analyzing the quality requirement of final product.
CU3. Check and transfer product for further processing	**P1.** Identify required quantity of the product according to the job card. **P2.** Inspect Product and any further adjustments made as necessary. **P3.** Make Entries in production documents as necessary. **P4.** Check Output and stop machine /job, when required quantity is produced, following correct shut down procedure. **P5.** Transfer Product to storage area for curing.

Knowledge & Understanding

- **K1.** The process of production with rotational molding machines
- **K2.** Expected product quality
- **K3.** Safety procedures to be followed with rotational molding machine
- **K4.** Chemical raw material usage, safe storage and care including Material Safety Data Sheet (MSDS)
- **K5.** Functions of Melt flow index (MFI) and density of Raw Materials.
- **K6.** Material handling

Tool and Equipment

- Measuring tape
- Foam processing machine
- A computer for recording production
- Precision weighing scale for sample weighing
- Material handling equipment
- Personal Protective Equipment.
- General hand tools
- Relevant test equipment.

0715-M&MT-121. Operate Compression/Transfer Molding Machines

Overview: This competency standard covers the skills and knowledge required to set compression/transfer moulding machine for operation, operate the machine and commence production and Finish and transfer product

Competency Units	Performance Criteria
CU1. Set compression/ transfer molding machine for operation	**P1.** Carryout pre inspections on the compression/transfer molding machine and molds. **P2.** Verify requirements and priority verified from production plan. **P3.** Material required for production, tools & equipment required, identify from job order and a location for storage of finished product arranged. **P4.** Change mold where necessary according to the requirement of the job as per job card and adjustments made on the machine. **P5.** Set Processing Parameters by referring to the product data sheet and to suit product, production speed, quality and standard wastage.
CU2. Operate the machine and commence production	**P1.** Select and feed all raw materials **P2.** All safety points checked before starting the machine using a check-list. **P3.** Set Total time required for finishing the product **P4.** Switched on Machine adjustments made as necessary by checking each crucial point /function of the machine and by making finer adjustments. Relevant authority informed of any defects. **P5.** Commence Production and sample produced according to company policy.
CU3. Finish and transfer product	**P1.** Perform sample product inspections **P2.** Carryout mass production as necessary required quantity of the product identified according to the job card. **P3.** Inspect Product and any further adjustments made as necessary. **P4.** Pack and stack Products keeping similar items together at the appropriate place for easy retrieval. **P5.** Make Entries in production documents as necessary.

Knowledge & Understanding

K1. The process of production with rotational molding machines

K2. Expected product quality

K3. Safety procedures to be followed with rotational molding machine

K4. Chemical raw material usage, safe storage and care including Material Safety Data Sheet (MSDS)

K5. Functions of Melt flow index (MFI) and density of Raw Materials.

K6. Material handling

K7. Basic First aid with respect to handling of accidents.

K8. Basic firefighting equipment and methods.

Tool and Equipment

- Pocket measuring tape (3m)
- Compression molding machine,
- Production record sheets
- Compression molding machine tools & equipment
- Pen or pencil for noting records
- Computer for recording productions package for recording production
- Personal Protective Equipment.
- Precision weighing scale for sample weighing.

0715-M&MT-122. Operate Multi-Color Printing Machines (Rotogravure)

Overview: This competency standard covers the skills and knowledge required to Set printing machine for operation, operate the machine and commence production and Finish and transfer product for storage

Competency Units	Performance Criteria
CU1. Set printing machine for operation	**P1.** Carryout pre-inspections on the printing machine. **P2.** Verify job requirements and priority from production plan. **P3.** Clean All web rollers as per given instruction. **P4.** Identify Material, tools & equipment required for production, from job order and a location for storage of finished product arranged. **P5.** Make Adjustments on the machine and printing cylinders changed where necessary according to requirement of the job. **P6.** Set Processing parameters by referring to the product data sheet. **P7.** Plan Production according to total time allocated for the job as per job card taking in to consideration the setting up time.
CU2. Operate the machine and commence production	**P1.** Select and feed all raw material **P2.** All safety points checked before starting the machine using a checklist. **P3.** Switch on Machine and adjustments made as necessary by checking each crucial point / function of the machine and by making finer adjustments. Relevant authority informed of any defects. **P4.** Perform Test run prior to commencing production. **P5.** Check Compliance of the color/ registration/ positioning / perforation and alignment with the sample provided for guidance and production commenced by making finer adjustments.
CU3. Finish and transfer product for storage	**P1.** Product inspected and any further adjustments made as necessary. **P2.** Pack and Stack Products, keeping similar items together at the appropriate place for easy retrieval and for quality check and to prevent any damage or contamination. **P3.** Check Output and machine stopped / job changed, when required quantity is produced, following correct shut down procedure where necessary. **P4.** Make Entries in production documents as necessary. **P5.** Account All remaining material and returned to store where applicable

Knowledge & Understanding

K1. The process of production with rotational molding machines

K2. Expected product quality

K3. Safety procedures to be followed with rotational molding machine

K4. Chemical raw material usage, safe storage and care including Material Safety Data Sheet (MSDS)

K5. Functions of Melt flow index (MFI) and density of Raw Materials.

K6. Material handling

K7. Basic First aid with respect to handling of accidents.

K8. Basic firefighting equipment and methods.

0715-M&MT-123. Operate Multi-Color Printing Machine (Flexographic)

Overview: This competency standard covers the skills and knowledge required to Set printing machine for operation, Select design and feed material required for printing, Operate the machine and commence printing and Finish and transfer product for storage

Competency Units	Performance Criteria
CU1. Set printing machine for operation	**P1.** Carry out pre-inspections of the Printing machine. **P2.** Job requirements and priority verified from production plan. **P3.** Clean All web rollers as per given instructions. **P4.** Identify Material, tools & equipment required for production, from job order and a location for storage of finished product arranged. **P5.** Make Adjustments on the machine and printing cylinders and printing plates changed where necessary according to requirement of the job. **P6.** Set Processing parameters by referring to the product data sheet. **P7.** Plan Production according to total time allocated for the job as per Job instruction ticket taking into consideration the setting up time.
CU2. Select design and feed material required for printing	**P1.** Quantities of material with the quality as specified for the product and sufficient for the work shift, obtained. **P2.** Check selected material including inks and solvents as appropriate. **P3.** Arranged Continuous supply of material to complete job/for the work shift. **P4.** Mount Printing plates with the correct design as per job ticket on the machine. **P5.** Install Appropriate tooling (Anilox Rollers/ Cutters / Perforation units) required for the given design.
CU3. Operate the machine and commence printing	**P1.** All safety points checked before starting the machine using a checklist. **P2.** Switch on Machine and adjustments made as necessary by checking each crucial point /function of the machine and by making finer adjustments. Relevant authority informed of any defects. **P3.** Perform Test run prior to commencing production. **P4.** Check Compliance of the color/ registration/ positioning/ perforation and alignment, with the sample provided for guidance and production commenced by making finer adjustments.
CU4. Finish and transfer product for storage	**P1.** Product inspected and any further adjustments made as necessary. **P2.** Pack and Stack Products, keeping similar items together at the appropriate place for easy retrieval for quality checks and to prevent any damage or contamination.

	P3. Check Output and machine stopped / job changed, when required quantity is produced, following correct shut down procedure where necessary. **P4.** Make Entries in production documents as necessary. **P5.** Account all remaining material and returned to stores where applicable.

Knowledge & Understanding

- **K1.** Testing with viscosity cups
- **K2.** Mayer rod testing
- **K3.** Proper use of auto viscosity controllers
- **K4.** Selecting, sharpening, mounting, positioning and use of doctor blades
- **K5.** Surface treatment of printing substrates
- **K6.** Printing plates
- **K7.** Print drying requirements
- **K8.** Knowledge of print defects, how to recognize them, the probable causes and remedies.
- **K9.** Storage of inks
- **K10.** Formulation of colors
- **K11.** Register control
- **K12.** Knowledge of color sequence
- **K13.** Quality testing methods
- **K14.** Effects of environmental conditions
- **K15.** Firefighting equipment and methods.
- **K16.** First aid treatment especially in the event of injury from harmful chemical.

Tool and Equipment

- Pocket measuring tape (3m) • Viscosity cup
- Printing machine tools & equipment • A computer with an installed / designed package
- Personal Protective Equipment. for recording production
- Platform scale
- Mixing rod
- Mayer rod
- Thickness gauge
- Knife
- Material handling equipment
- Dyne test marker pen scotch tape to treat
- Marker pen surface treatment level or ink
- General tools
- Compass

- Printing cylinder mounting tables & tools

- Magnifying glass

0715.17 HVAC

0715-M&MT-124. Maintain Safe Work Environment

Overview: This Competency Standard identifies the competencies required to apply occupational safety and health at workplace in accordance with the organization's approved guidelines and procedures. You will be expected to identify and use Personnel Protective Equipment (PPE) according to the job requirement and potential hazards at workplace. The underpinning knowledge regarding OSH will be sufficient to provide the basis for your work.

Competency Units	Performance Criteria
CU 1: Identify Hazards at Workplace	**P1.** Recognize engineering processes, tools, equipment and consumable materials that have the potential to cause harm **P2.** Identify any potential hazards and take appropriate action to minimize the risk
CU 2: Observe Occupational Safety and Health (OSH)	**P1.** Identify health and safety hazards in the workplace, so that the potential for personal injury, damage to equipment or workplace is prevented, and corrective action is taken **P2.** Deal with problems which are within your control, and report those that cannot be resolved to safety officer **P3.** Wear, adjust, and maintain Personal Protective Equipment to ensure correct fit and optimum protection in compliance with company procedures **P4.** Keep work area clean and clear of obstructions, and storing tools or equipment, so that the potential for accident or injury is prevented

Knowledge & Understanding

K1. Read and interpret work processes and procedures correctly to identify risk of hazards at workplace

K2. Work safely while complying with health and safety precautions, regulations and other relevant guidelines

K3. Types of hazards that are most likely to cause harm to health and safety

K4. Health and safety precautions

K5. Health and safety signs and symbols

K6. Techniques and methods to identify the risks of hazards at workplace

K7. Dealing with hazards to avoid any accident or injury

K8. Safety reporting procedures and documentation

K9. Use of Personal Protective Equipment

K10. First aid treatment methods including methods of resuscitation

K11. Fire-fighting methods

Tool and Equipment

- User Manual
- Health & Safety Manuals
- Safety Kit
- Fire safety equipment

0715-M&MT-125. Carry out Calculations and Prepare Estimates

Overview: This competency standard identifies the competencies required to prepare estimates/cooling load calculations in accordance with client's guidelines. You will be expected to estimate, ensuring cost effectiveness, conforming to standards and regulations. Your underpinning knowledge regarding estimation skills will be sufficient to provide the basis for your work.

Competency Units	Performance Criteria
CU 1: Develop Basic Drawing/Cooling Load Calculation	**P1.** Calculate the cooling load for conditioned space **P2.** Calculate the electric load for circuit distribution **P3.** Develop drawing according to requirement **P3.** Negotiate any alteration to the job specifications with clients
CU 2: Perform Estimation of Materials	**P1.** Take measurements as per drawing **P2.** Quantify the material as per drawing **P3.** Calculate cost of material and accessories in accordance with current market prices **P4.** Make the cost estimate of material **P5.** Incorporate the agreed alteration in Job specifications for estimation
CU 3: Prepare Costing for the Work	**P1.** Calculate man-hours for work as per drawing **P2.** Make the cost estimate of labor as per requirement

Knowledge & Understanding

K1. Cooling load calculations terminologies and formulas along with charts & Tables

K2. Basic electrical terminologies

K3. Electrical Circuit Characteristics

K4. Basic electric formulas & numeracy

K5. Norms in interacting & negotiating with customers/clients

K6. Interpretation of layout plans/wiring diagrams, service manuals and manufacturer specifications, technical Sketches, graphic symbols etc.

K7. Types of electrical control and protective switchgear and accessories used in electrical circuits

K8. Types of electrical wires and cables and their ratings

K9. Types of electrical conduits, casing & capping etc.; their applications and their cutting/jointing/fixing methods

K10. Types of insulation material used in electrical installations

K11. Types of earth electrodes and their applications

K12. Method of calculating labor Cost/overheads/profit margin etc.

K13. Norms and standard formats of preparing estimates/BOQ

K14. Make Rate analysis according to market Rates.

K15. Record keeping and reporting

0715-M&MT-126. Install Residential Air Conditioner

Overview: This Competency Standard identifies the competencies required to install different types of Window type / Split type residential Air conditioners skills at workplace in accordance with the organization's / client's guidelines. This unit covers the knowledge regarding safety rules, Personal Protective Equipment (PPE), and international standards for installing Residential Air conditioners to provide you the basis for your work.

Competency Units	Performance Criteria
CU 1: Install Window Air-Conditioner	**P1.** Select tools, equipment and related accessories according to job requirements **P2.** Mark the location on the wall where Window Air Conditioner to be installed according to Unit specifications and client requirements **P3.** Make opening at the marked area on the wall **P4.** Fix Iron / wooden frame in the opening firmly and insert in it the Air Conditioner cover according to the instructional manual and standards **P5.** Install the Air conditioner in the framed opening with standard slope so that condensate water drops outside **P6.** Cover / Seal side air gaps of opening with insulation material **P7.** Fix the fancy wooden border around the Air conditioner grill as per client's requirement **P8.** Fix the Air Conditioner condensate drain pipe and put it into main sewerage line **P9.** Arrange power supply with circuit breaker near the Air Conditioner **P10.** Make sure that all packing materials - Cardboard, Styrofoam, Tape and Plastic Film, have been removed from the site after installation **P11.** Switch on the Air Conditioner and check Air Conditioner performance as per capacity and specifications
CU 2: Install Split Air Conditioner	**P1.** Select tools, equipment and related accessories according to job requirements **P2.** Select and mark the area on the wall where Indoor and Outdoor units are to be installed according to **P3.** Perform physical inspection of indoor and outdoor unit according to unit specifications **P4.** Make opening for the refrigerant pipes, condensate pipe and control wires to pass through

	P5. Mount the Indoor unit wall mounting plate according to manufacturer specifications and install the Indoor unit on it **P6.** Prepare base for the fixing of Outdoor unit according to manufacturer specifications and fix the Outdoor unit there **P7.** Connect the refrigerant pipes amongst both indoor and outdoor units, supply and control wires according to manufacturer manual **P8.** Add additional refrigerant for additional piping according to manufacturer recommendations **P9.** Make oil trap in copper pipe as per site requirement **P10.** Perform leak test, evacuation procedure, charge refrigerant and open the service valves **P11.** Insulate the joints and refrigerant pipes according to standards and manufacturer installation manual **P12.** Make sure that all packing materials - Cardboard, Styrofoam, Tape and Plastic film, have been removed **P13.** Switch on the Air Conditioner and check performance as per capacity and specifications

Knowledge & Understanding

K1. Basic load calculation for cooling / heating

K2. Fundamental knowledge of HVACR, Electric and Electronics

K3. Techniques for installation of Window / Split (DC Inverter)

K4. Technical Operations of all types of Split Air Conditioners

K5. Electrical / HVAC layout plans/wiring diagrams

K6. Type of Electrical wires and cables including underground cables, their ratings and applications

K7. Methods of Copper Tube Cutting / Reaming / Bending / Swaging / Flaring / Brazing / Jointing / Fixing

K8. Basic masonry and carpentry applications

K9. Gas welding (Soldering and Brazing)

K10. Types of insulation and their applications

K11. Compressor types and applications

K12. Methods of Pressurizing / Evacuations / Purging / Refrigerant Charging

K13. Types of Refrigerant, its properties, recycling, recovery and reclaiming

Tools and Equipment

- Windows Air-conditioning Unit to be installed.
- Air-conditioning Kit
- Gas Cylinder

- Safety kit
- Split Air-conditioning Unit to be installed.
- Air-conditioning Kit
- Gas Cylinder
- Safety kit
- Copper Pipe
- Hammers
- Chisel
- Teflon Tape
- Tachometer
- Multi meter
- Drill Machine
- Wire Tape
- Heavy Wire

0715-M&MT-127. Repair/Service Residential Air-Conditioner

Overview: This Competency Standard covers the competencies required to diagnose / repair / service residential Air Conditioners at workplace in accordance with the manufacturer specifications / guidelines. This unit covers the knowledge regarding safety rules, Personal Protective Equipment, and international standards for repairing / servicing of Residential Air Conditioners to provide you the basis for your work.

Competency Units	Performance Criteria
CU1: Diagnose Faults In Residential Air Conditioner	**P1.** Check for obvious problem to determine which component or system is causing the problem **P2.** Select tools, equipment and related accessories according to requirements and standards **P3.** Check power supply, electric wiring, electric / electronic components and refrigerant pressure to determine the exact problem by using AVO meter / Gauge manifold / flow chart as recommended by manufacturer, and record the results **P4.** Eliminate the causes of the problem according to the manufacturer manual and standards **P5.** Isolate and recheck the causes of the problem and rectify the fault **P6.** Start the Air Conditioner and recheck the unit as specified in the manufacturer manual and record the results
CU 2: Repair Window / Split Air Conditioner	**P1.** Select tools, equipment and related accessories according to job requirements **P2.** Disconnect the Air Conditioner from electric supply and follow the manual instructions for rectification **P3.** Rectify the diagnosed faults; repair / replace the components, as necessary **P4.** Switch on the Air Conditioner to check the performance of electrical/ electronic and mechanical components as specified in the manufacturer manual and record the results
CU 3: Service Window Air Conditioner	**P1.** Select tools, equipment and related accessories according to job requirements **P2.** Start the Air Conditioner, check and record performance by using specified test instruments **P3.** Disconnect the Air Conditioner from

	electric supply
	and remove Air Conditioner from the cover **P4.** Secure the electric / electronic components with polythene sheet **P5.** Clean / wash all mechanical parts of Window Air conditioner with specified cleaning agents / detergent by using pressure pump **P6.** Fix the Air conditioner in the cover, connect with electric supply, check and record performance
CU 4: Service Split Air Conditioner	**P1.** Select tools, equipment and related accessories according to job requirements **P2.** Start the Air Conditioner, check and record performance by using specified test instruments **P3.** Pump down the split Air Conditioner and dismantle both indoor unit and condensing unit **P4.** Clean the components of Air conditioner with specified cleaning agents/tools and material **P5.** Re-Install the indoor and outdoor unit; connect with refrigerant pipes, control wires and evacuation; open the service valves and leak testing **P6.** Switch on the Air Conditioner, check and record performance

Knowledge & Understanding

K1. Knowledge of American Society of Heating, Refrigeration, And Air Conditioning Engineers (ASHRAE)

K2. Knowledge of Ozone Protection and Synthetic Greenhouse Gas Management Act 1989

K3. Basic load calculation for cooling /heating

K4. Fundamental knowledge of HVACR, Electric and Electronics

K5. Techniques for repairing of Window /Split Air Conditioners

K6. Technical Operations of Split Air Conditioners

K7. Electrical / copper piping layout plans/wiring diagrams

K8. Type of Electrical wires and cables including underground cables, their ratings and applications

K9. Techniques of diagnosing and troubleshooting of Residential Air Conditioners

K10. Familiarity with Residential Air Conditioner error codes and solution

K11. Types of motors used in Residential Air Conditioners

K12. Types of lubricants and their properties

K13. Compressor types / Specifications and applications

K14. Methods of Copper Tube cutting / Bending/Swaging / Flaring /Brazing / Jointing /fixing

K15. Gas welding (Soldering and Brazing)

K16. Types of Insulation and their applications

K17. Methods of Pressurizing / Evacuation /Purging / Refrigerant Charging

K18. Types of Refrigerant, its properties, recovery and reclaiming

K19. Read all the relevant data regarding the unit very carefully and then start servicing.

Tools and Equipment

- Personal Protective Equipment
- Allen Key Set
- Bench Vice
- Center Punch
- File Set
- Hand Hacksaw Frame with Blade
- Metal Drill Bit Set
- Hammer Set
- Mallet Set
- Diagonal Side Cutter
- Combination Plier
- Nose Plier Set
- Locking Plier
- Rivet Gun / Plier
- Adjustable Screw Wrench
- Adjustable Pipe Wrench
- Ratchet Wrench
- Box Spanner Set
- Socket Set
- Open Ended Spanner Set
- Box Spanner Screw Drivers
- Steel Ruler
- Scissors
- Scriber
- Tap and Die Set
- Try Square
- Chisel Set
- Pulley Wheel Puller
- Gas Welding Set with All Accessories
- Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
- Pipe Cutter

- Pipe Vice
- Manual Screw Driver Set
- Electric Screw Driver Set
- Electric Hand Grinder
- Soldering Iron
- Crimping Tool
- Insulation Remover
- Wire Stripper
- Digital Multi Meter
- Digital Clamp-On Ampere Meter
- Electric Hand Drills
- Hot Air Gun
- Digital Capacitor Analyzer
- Hand Electric Blower
- Digital Humidity Meter
- Digital Psychrometric (Hygrometer)
- Tube Cutter
- Digital Optical Tachometer
- Micron Pressure Gauge
- Digital Pressure Gauges Set (High &Combine)
- Pinch-Off Plier
- Flaring and Swaging Tool Kit
- Vacuum Pump 2-Stage, 6cfm
- Tube Benders (Spring Type and Pulley Bender Type)
- ohm meter (0 - 1000 Volts)
- Laser Temperature Measuring Device
- Electronic Leak Detector
- Water Pressure Gun for Service
- Digital Air Flow / Velocity Meter
- Portable Refrigerant Charging Station

0715-M&MT-128. Repair / Service Residential Refrigeration Units

Overview: This Competency Standard covers the competencies required to diagnose / repair / service residential refrigeration units at workplace in accordance with the manufacturer specifications / guidelines.

This unit covers the knowledge regarding safety rules, Personal Protective Equipment, and international standards for repairing / servicing of residential refrigeration units to provide you the basis for your work.

Competency Units	Performance Criteria
CU 1: Diagnose Faults in Residential Refrigeration Units	**P1.** Check for obvious problem to determine which component or system is causing the problem **P2.** Select tools, equipment and related accessories according to requirements and standards **P3.** Check power supply, electric wiring, electric / electronic components and refrigerant pressure to determine the exact problem by using AVO Meter / Gauge manifold as recommended by manufacturer and record the results **P4.** Eliminate the causes of the problem according to the manufacturer manual and standards **P5.** Isolate and recheck the causes of the problem and rectify the fault **P6.** Start the refrigeration unit and recheck as specified in the manufacturer manual and record the results
CU 2: Repair / Service Residential Refrigerator / Freezer	**P1.** Select tools, equipment and related accessories according to job requirements **P2.** Disconnect the Refrigerator / Freezer from electric supply and follow the instructions in manufacture manual for rectification **P3.** Rectify the diagnosed faults; repair / replace the components, as necessary **P4.** Check, wash and restore to the actual condition Refrigerator / Freezer Body / Cabinets **P5.** Check, service, and replace if necessary, the proper functioning of Thermostat / Door Gasket / Heaters **P6.** Switch on the Refrigerator / Freezer to check the performance of electrical/ electronic and mechanical components as specified in the manufacturer manual and record the results
CU 3: Repair / Service Residential Electric Water Cooler / Water Dispenser	**P1.** Select tools, equipment and related accessories according to job requirements **P2.** Disconnect the water cooler / dispenser from electric supply and follow the manual instructions for rectification **P3.** Rectify the diagnosed faults; repair / replace the components, as necessary **P4.** Check, wash and restore to actual condition Water Cooler / Dispenser

	Body / Mounts **P5.** Switch on water cooler / dispenser to check the performance of electrical/ electronic and mechanical components as specified in the manufacturer manual and record the results

Knowledge & Understanding

K1. Knowledge of Ozone Protection and Synthetic Greenhouse Gas Management Act 1989
K2. Fundamental knowledge of HVACR, Electric and Electronics
K3. Techniques for repairing of Refrigerators /Freezers / Water Coolers and Water Dispensers
K4. Technical Operations of Non-Frost refrigerators
K5. Types of electrical wires and cables, their ratings and applications
K6. Techniques for Diagnosing and Troubleshooting of Residential Refrigerators /Freezers / Water Coolers and Water Dispensers
K7. Types of Lubricants and their properties
K8. Capable to replace PCB Card
K9. Compressor types/ Specifications and applications
K10. Methods of Copper Tube Cutting /Bending /Swaging / Flaring / Brazing /Jointing / Fixing
K11. Gas welding (Soldering and Brazing)
K12. Methods of Pressurizing/ Evacuation /Purging / Refrigerant Charging
K13. Types of Refrigerant, its properties, recovery and reclaiming
K14. Record keeping and reporting
K15. Capable to replace PCB Card

Tools & Equipment

Air-Conditioning Kit

0715-M&MT-129. Install Commercial Refrigeration Units

Overview: This Competency Standard covers the competencies required to install different types and sizes of walk in coolers / freezers / ice making machines / chilled water tanks at work place in accordance with the organization guidelines. This unit covers the knowledge regarding safety rules, personal protective equipment, and international standards for installing Commercial refrigeration units to provide you the basis for your work.

Competency Units	Performance Criteria
CU 1: Install Walk in Cooler / Freezer	**P1.** Select tools, equipment and related accessories according to job requirements **P2.** Prepare insulated room for preserving the food on lowest temperature as

	per drawing and requirements **P3.** Prepare steel / concrete foundation / frame for installation of condensing unit following manufacturer specifications **P4.** Prepare and level the place to fix the evaporator and condensing unit firmly, according to manufacturer specifications **P5.** Layout piping and control wiring from indoor to outdoor unit according to instructional manual **P6.** Perform leak test, evacuation and charge the refrigerant according to unit specifications and standards **P7.** Connect the electric supply and operate the unit to check the performance according to unit specifications

CU 2: Install Ice Making Machine	**P1.** Select tools, equipment and related accessories according to job requirements **P2.** Fix the machine on potable water supply by following manufacturer specifications **P3.** Measure the clearance on each side to be sure it meets the standards set by the manufacturer **P4.** Make water drain connections in order to empty purged and melt water as per manual instructions and client requirements **P5.** Install shut of valve on water supply near the machine according to unit specifications **P6.** Make electric supply switched on and check performance according to machine specification by using specific instruments

CU 3: Install Chilled Water Tank	**P1.** Select tools, equipment and related accessories according to job requirements **P2.** Fix the cooler / tank on potable water supply by following manufacturer specifications and client requirements **P3.** Measure the clearance on each side to be sure it meets the standards set by the manufacturer **P4.** Make water drain connections adjacent to water supply as per instructions manual **P5.** Install shut off valve and no return valve at water supply line **P6.** Fix minimum water level protection and interlocking with refrigeration unit to prevent empty freezing **P7.** Make power supply as per manual instructions

Knowledge & Understanding

K1. Knowledge of Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

K2. Ozone Protection and Synthetic Greenhouse Gas Management Act 1989

K3. Methods of Pipe Cutting /Welding / Jointing / Fixing /Sealing

K4. Preparation of hanging supportive structures for piping

K5. Types of insulation and their application

K6. Techniques for installation of Pipes by using specified test instruments

K7. Types of electrical wires and cables, including underground cables, their ratings and applications

K8. Techniques for installation of refrigeration units

Tools and Equipment

- Personal Protective Equipment
- Allen Key Set
- Bench Vice
- Center Punch
- Pedestal Drill Machine
- Digital Vernier Caliper
- Metal Drill Bit Set
- Masonry Drill Set
- File Set
- Hand Hacksaw Frame
- Hammer Set
- Mallet Set
- Diagonal Side Cutter

- Combination Plier
- Nose Plier Set
- Locking Plier
- Measuring Tape
- Rivet Gun / Plier
- Adjustable Screw Wrench
- Adjustable Pipe Wrench
- Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
- Pipe Cutter
- Pipe Vice
- Bearing Puller
- Manual Screw Driver Set
- Electric Screw Driver Set
- Spirit Level
- Electric Hand Grinder
- Wire Stripper
- Digital Multi Meter
- Digital Clamp-On Ampere Meter
- Electric Hand Drills
- Hot Air Gun
- HILTI Drill Machine (Piston Type)
- Swaging Tool Kit
- Vacuum Pump 2-Stage, 6cfm
- Tube Benders (Spring Type and Pulley Bender Type)
- Laser Distance Measuring Device
- Electronic Leak Detector
- Manometer
- Digital Air Flow / Velocity Meter
- Portable Refrigerant Charging Station
- Fins Straightening Comb Set

0715-M&MT-130. Repair/Service Commercial Refrigeration Units

Overview: This Competency Standard covers the competencies required to diagnose / repair / service residential refrigeration units at workplace in accordance with the manufacturer specifications / guidelines. This unit covers the knowledge regarding safety rules, Personal Protective Equipment, and international standards for repairing / servicing of refrigeration units to provide you the basis for your work.

Competency Units	Performance Criteria
CU 1: Diagnose Faults in Commercial Refrigeration Units	**P1.** Check for obvious problem to determine which component or system is causing problem **P2.** Select tools, equipment and related accessories according to requirements and standards **P3.** Check the power supply, electric wiring, electric / electronic components and refrigerant pressure to determine the exact problem by using flow chart as recommended by manufacturer and record the results **P4.** Eliminate the causes of the problem according to the manufacturer manual and standards **P5.** Isolate and recheck the causes of the problem and correct the fault **P6.** Start the refrigeration unit and recheck the unit as specified in the manufacturer manual and record the results
2. Repair Commercial Refrigeration Units	**P1.** Select tools, equipment and related accessories according to requirements and standards **P2.** Disconnect the unit from electric supply and follow the manual instructions for rectification **P3.** Rectify the diagnosed fault by repairing / replacing the components **P4.** Switch on the unit to check the performance of electrical/ electronic and mechanical components as specified in the manufacturer manual and record the results

Knowledge & Understanding

K1. Techniques for Diagnosing and Troubleshooting of Residential Refrigeration Units

K2. Familiarity with Refrigeration Units error codes and solution

K3. Types of Lubricants and their properties

K4. Types of Refrigerant and its properties

K5. Methods of Pressurizing/ Evacuation / Purging / Refrigerant Charging

K6. Repair leak in refrigeration unit

K7. Replace the compressor

K8. Replace the thermostat

K9. Repair replace PCB Card

Tools and Equipment

- Digital Vernier Caliper
- Metal Drill Bit Set
- Masonry Drill Set
- File Set
- Hand Hacksaw Frame
- Hammer Set
- Mallet Set
- Digital Micro Meter
- Diagonal Side Cutter
- Combination Plier
- Nose Plier Set
- Locking Plier
- Measuring Tape
- Rivet Gun / Plier
- Adjustable Screw Wrench
- Adjustable Pipe Wrench
- Ratchet Wrench
- Box Spanner Set
- Socket Set
- Open Ended Spanner Set
- Box Spanner Screw Drivers
- Steel Ruler
- Scissors
- Scriber
- Tap and Die Set
- Try Square
- Chisel Set
- Pulley Wheel Puller
- Gas Welding Set with All Accessories
- Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
- Pipe Cutter

- Pipe Vice
- Bearing Puller
- Manual Screw Driver Set
- Electric Screw Driver Set
- Spirit Level
- Electric Hand Grinder
- De-Soldering Tool
- Lcr Meter
- Soldering Iron
- Crimping Tool
- Insulation Remover
- Wire Stripper
- Digital Multi Meter
- Digital Clamp-On Ampere Meter
- Electric Hand Drills
- Hot Air Gun
- Digital Optical Tachometer
- Meg ohmmeter (0 - 1000 Volts)
- Water Pressure Gun for Service
- Digital Capacitor Analyzer
- Hand Electric Blower
- Tube Cutter
- Micron Pressure Gauge
- Digital Pressure Gauges Set (High & Combine)
- Pinch-Off Plier
- Flaring and Swaging Tool Kit
- Vacuum Pump 2-Stage, 6cfm
- Tube Benders (Spring Type and Pulley Bender Type)
- Laser Temperature Measuring Device
- Electronic Leak Detector
- Manometer
- Digital Air Flow / Velocity Meter
- Portable Refrigerant Charging Station
- Fins Straightening Comb Set

Overview: This Competency Standard identifies the competencies required to fabricate different types of Ducts and Pipes at workplace in accordance with the international HVAC standards. Your underpinning knowledge regarding safety rules, Personal Protective Equipment, and international standards for fabricating and installing of Duct and Piping will be sufficient to provide the basis for your work.

Competency Units	Performance Criteria
CU1. Fabricate Ducts	**P1.** Select tools, machines, equipment, sheet materials and related accessories according to requirements and standards **P2.** Take measurements, mark proper location and select Duct fittings as specified in the layout plan/ diagram **P3.** Prepare different types of Edges / Joints / Seams / Bends and Notches used to join Sheet Metal work **P4.** Prepare flexible connections between Duct sections and unit fittings (Air Handling Units / Fan Coil Units) **P5.** Prepare duct in required size, shape and pieces and connect with each other according to Duct route drawing **P6.** Seal Duct joints with good mastic material, to avoid air leakage, according to SMACNA /ASHRAE standards **P7.** Fabricate cladding to protect insulation
CU2. Fabricate Pipes	**P1.** Select tools, machines, equipment, pipe materials and related accessories according to requirements and standards **P2.** Prepare joints (Elbow / Reducer / Tees / Offset / Couplings / Flanges etc.) for jointing of Pipes as per layout plan / requirements **P3.** Prepare and clean Pipe joints for smooth Welding / Threading work according to layout plan / diagram **P4.** Carry out Jointing using Welding or Threading methods to ensure proper fitting according to international standards

CU3. Install Ducts and Piping	**P1.** Follow International standards of ASHRAE or SMACNA while installing ducts and piping **P2.** Select tools, equipment, Pipe materials and related accessories according to requirements and standards **P3.** Mark location for Duct and Pipes installations according to drawing specifications **P4.** Mount Hangers, Angle rails, threaded rods / Studs and Straps according to standards **P5.** Install the Ducts and Pipes on angle rails and ensure the straps are fabricated into one unit according to layout plan/ diagram **P6.** Seal all the joints with good mastic material to avoid leakage according to standards **P7.** Install Grills/Diffusers/Dampers and Flexible Duct according to drawing / layout plan **P8.** Install the valves in pipes as per drawing **P9.** Perform leak testing of piping and duct system as per standards
CU4. Insulate Piping Ducts	**P1.** Select tools, equipment, pipe materials and related accessories according to requirements and standards **P2.** Prepare insulation material / Sound liner according to manufacturer specifications **P3.** Insulate water / steam pipes with specified insulation according to ASHRAE or SMACNA standards **P4.** Apply vapor barrier paper, cotton cloth wrapping and sheet metal cladding firmly on the ducts / pipes according to manufacturer specifications

Knowledge & Understanding

- **K1.** Knowledge of Sheet Metal& Air Conditioning Contractors' National Association (SMACNA)
- **K2.** Layout plans, drawing and manufacturer specifications, and HVAC symbols etc.
- **K3.** Working at heights and platforms
- **K4.** Use and transport of Ladders / Scaffolds safely
- **K5.** Type of Ducts, Duct fittings and their applications
- **K6.** Type of Pipes, Pipe fittings and their applications
- **K7.** Preparation of hanging supportive structures for Ducts and Piping
- **K8.** Fabricate Duct accessories

K9. Fabricate Pipe accessories

K10. Perform welding / Brazing on Pipe joints

K11. Insulate the Ducts / Pipes

K12. Perform Leakage test of Ducts and Pipes in accordance with standard HVAC procedures

K13. Types of Insulation and their application

K14. Techniques for installation of Ducts and Pipes by using specified test instruments

K15. Procedures of pressure testing of Pipes by using specified test instruments

K16. Procedures of leakage testing in Ducts by using light source

K17. Record keeping and reporting

Tools and Equipment

- Personal protective equipment
- Working tables
- Sheet metal tools
- Bench vice
- Pedestal drill machine
- Digital Vernier caliper
- Allen key set
- Center punch
- Metal Drill bit set
- Masonry drill set
- File set
- Hand Hacksaw frame
- Electric hand grinder
- Hammer set
- Mallet set
- Diagonal side cutter
- Combination plier
- Nose plier set
- Locking plier
- Measuring tape
- Rivet gun / plier
- Adjustable screw wrench
- Adjustable pipe wrench
- Ratchet wrench
- Box spanner set
- Socket set
- Open ended spanner set

- Box spanner screw drivers
- Steel ruler
- Scriber
- Tap and Die set
- Try square
- Chisel set
- Tin Cutter
- Gas welding set with all accessories
- Scissors
- Pipe cutter
- Pipe vice
- Electric hand drills
- Manual Screw driver set
- Electric Screw driver set
- Spirit level
- HILTI drill machine (Piston type)
- Laser distance measuring device
- Tube cutter

0715-M&MT-132. Install Central Air Conditioning Systems

Overview: This Competency Standard identifies the competencies required to install Package type unit / VRF / VRV / Absorption Chiller System at workplace in accordance with the organization / client guidelines under the supervision of HVAC Engineer. This unit covers the knowledge regarding safety rules, Personal Protective Equipment, and international standards for the installation of central air conditioning system to provide you the basis for your work.

Competency Units	Performance Criteria
CU1. Install Package Unit	**P1.** Select tools, equipment and related accessories according to job requirements **P2.** Mark the location and area according to layout plan and manufacturer specifications **P3.** Prepare foundation as per drawing, place, adjust and level the Package unit by giving attention to safety precautions **P4.** Connect Package unit with supply, return and fresh air duct through flexible connection as per drawing / unit specification **P5**. Insulate duct where required **P6.** Remove all packaging material from work place **P7.** Connect the power supply and control wire **P8.** Switch on the supply and check the performance according to manufacturer instructions and standards
CU2. Install Variable Refrigerant Flow (VRF) / Variable Refrigerant Volume (VRV) System	**P1**. Select tools, equipment and related accessories according to job requirements **P2.** Prepare foundation as per drawing, place, adjust and level the outdoor unit by giving attention to safety precautions **P3.** Prepare piping, weld / braze them according to unit specifications and layout drawings **P4.** Install indoor units according to layout diagrams, client requirements and manufacturer instruction manual **P5.** Fix Shut-off valves with service ports on every indoor unit **P6.** Check leaks by applying pressure method before the joints insulation; repair leaks, if any **P7.** Insulate the copper pipe joints according to manufacturer instructions and standards **P8.** Evacuate the system and charge the refrigerant as per requirement **P9.** Connect the power supply and control wires attached with central control / Building Management (BMS) system

	P10. Switch on the system and check performance
CU3. Install Water Chiller System	**P1.** Select tools, equipment and related accessories according to job requirements **P2.** Mark the location and area according to layout plan **P3.** Prepare foundation as per drawing, place, adjust and level the chiller by giving attention to safety precautions **P4.** Install Air Handling Units (AHU) / Fan Coil Unit (FCU) at different locations inside the building according to drawing **P5.** Install high pressure MS Pipe from chiller to Air Handling Units/ Fan Coil Unit inside the building **P6.** Fabricate and install G.I sheet ducting inside the building as per drawing **P7.** Install Cooling Tower and water pumps (Only for water cooling condenser) **P8.** Establish the electric power supply system for the chiller and air handling units and cooling tower as per Requirements and Standards
CU4. Carry out Commissioning	**P1.** Select tools, equipment and related accessories according to job requirements **P2.** Start the condenser and chilled water pump for water circulation in the system **P3.** Start the chiller and take reading of all parameters regarding temperature / pressure and electric power, check unusual vibrations / noises etc., if any **P4.** Perform Air Balancing and water balancing to check the air / water distribution according to design requirements **P5.** Check the system performance as per design criteria

Knowledge & Understanding

K1. Techniques for installation of central Air conditioners
K2. Fundamental and Technical Operations of VRF / VRV system
K3. Electrical / HVAC layout plans/wiring diagrams
K4. Types of electrical control wires, cables, including underground cables, their ratings and its applications
K5. Methods of Copper Tube Cutting / Bending /Swaging / Flaring / Brazing / Y-Jointing / Fixing
K6. Basic Masonry and Carpentry applications
K7. Types of Insulation and their applications
K8. Types of AHU, FCU, Chillers and Cooling Towers, Compressor, Condenser and pump types and their applications
K9. Types of Refrigerant, its properties, recovery and reclaiming
K10. Procedure regarding commissioning the central HVAC systems

K11. Record keeping and reporting

K12. Mark location according to specifications and standards

K13. Perform electric connections to joint indoor unit and outdoor unit

K14. Install the indoor / outdoor unit according to HVAC standards

K15. Balancing the system (Air / Water)

Tools and Equipment

- Personal Protective Equipment
- Allen Key Set
- Bench Vice
- Center Punch
- Pedestal Drill Machine
- Digital Vernier Caliper
- Metal Drill Bit Set
- Masonry Drill Set
- File Set
- Hand Hacksaw Frame
- Hammer Set
- Mallet Set
- Digital Micro Meter
- Diagonal Side Cutter
- Combination Plier
- Nose Plier Set
- Locking Plier
- Measuring Tape
- Rivet Gun / Plier
- Adjustable Screw Wrench
- Adjustable Pipe Wrench
- Ratchet Wrench
- Box Spanner Set
- Socket Set
- Open Ended Spanner Set
- Box Spanner Screw Drivers
- Steel Ruler
- Scissors
- Scriber
- Tap and Die Set
- Try Square

- Chisel Set
- Pulley Wheel Puller
- Gas Welding Set with All Accessories
- Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
- Pipe Cutter
- Pipe Vice
- Manual Screw Driver Set
- Electric Screw Driver Set
- Spirit Level
- Electric Hand Grinder
- Soldering Iron
- Crimping Tool
- Insulation Remover
- De-Soldering Tool
- LCR Meter
- Wire Stripper
- Digital Multi Meter
- Digital Clamp-On Ampere Meter
- Electric Hand Drills
- Hot Air Gun
- HILTI Drill Machine (Piston Type)
- Digital Optical Tachometer
- Meg ohmmeter (0 - 1000 Volts)
- Digital Capacitor Analyzer
- Hand Electric Blower
- Tube Cutter
- Micron Pressure Gauge
- Digital Pressure Gauges Set (High &Combine)
- Pinch-Off Plier
- Flaring and Swaging Tool Kit
- Vacuum Pump 2-Stage, 6cfm
- Tube Benders (Spring Type and Pulley Bender Type)
- Laser Distance Measuring Device
- Laser Temperature Measuring Device
- Electronic Leak Detector
- Manometer
- Digital Air Flow / Velocity Meter

- Portable Refrigerant Charging Station

- Fins Straightening Comb Set

- Digital Humidity Meter

- Digital Psychrometric (Hygrometer)

0715-M&MT-133. Repair/Service Central Air Conditioning System

Overview: This Competency Standard covers the competencies required to diagnose / repair / service central air conditioning system at workplace in accordance with the manufacturer specifications / guidelines. This unit covers the knowledge regarding safety rules, Personal Protective Equipment, and international standards for repairing / servicing of central air conditioning units to provide you the basis for your work.

Competency Units	Performance Criteria
CU1. Diagnose Fault in Central Air Conditioning System	**P1.** Check for obvious problem to determine which component or system is causing the problem **P2.** Select tools, equipment and related accessories according to requirements and standards **P3.** Arrange drawings and manuals of the equipment to be attended for diagnosing the fault **P4.** Check the power supply, electric wiring, electric / electronic components and refrigerant pressure to determine the exact problem and record the results **P5.** Start the air conditioning unit and recheck as specified in the manufacturer manual and record the results
CU2. Repairing of Chillers / Air Handling Unit (AHU) / Fan Coil Unit (FCU)	**P1.** Select tools, equipment and related accessories according to job requirements **P2.** System shut down and follow the instructions manual for rectification **P3.** Rectify the diagnosed faults; repair / replace the components, as necessary **P4.** Switch on the system to check the performance of electrical / mechanical components as specified in the manufacturer manual and record the results
CU3. Repair Pumps and Cooling Tower	**P1.** Select tools, equipment and related accessories according to job requirements **P2.** System shut down and follow the instructions manual for rectification **P3.** Check water level of cooling tower **P4.** Check the fan assembly, to check the bearings and motor abnormalities according to manufacturer specifications and HVAC standards **P5.** Check the float valves and strainers to maintain
CU3. Repair Pumps and Cooling Tower	**P1.** Select tools, equipment and related accessories according to job requirements **P2.** System shut down and follow the instructions manual for rectification **P3.** Check water level of cooling tower **P4.** Check the fan assembly, to check the bearings and motor abnormalities according to manufacturer specifications and HVAC standards **P5.** Check the float valves and strainers to maintain

	water level **P6.** Perform chemical treatment to prevent the sludge / scaling problems according to manufacturer specifications and HVAC standards **P7.** Condenser / chilled water pumps start and check their performance according to their specifications; service / repair, if necessary **P8.** Clean the sprinkler assembly water pan from leaves, mud, and scale, if any **P9.** Rectify the fault and restart the cooling tower and pumps
CU4. Repair Control System	**P1.** Select tools, equipment and related accessories according to job requirements **P2.** System shut down and follow the instructions manual for rectification **P3.** Arrange drawings and manuals of the equipment to be attended for diagnosing the fault **P4.** Check the details of fault / errors on computer screen to rectify the same **P5.** Eliminate the causes of the problem according to the manufacturer manual and standards **P6.** Isolate and recheck the causes of the problem and correct the fault **P7.** Start the air conditioning unit and recheck as specified in the manufacturer manual and record the results

Knowledge & Understanding

- **K1.** Technical Operations of Chillers, Cooling Tower, Pumps, AHUs & FCUs
- **K2.** Techniques for Diagnosing and Troubleshooting of central Air conditioning systems
- **K3.** Capability to replace the PCB Cards and controls
- **K4.** Familiarity with central Air conditioners error codes and solution
- **K5.** Types of Motors used in central Air conditioners
- **K6.** Types of controls and their functions used in central air conditioning systems
- **K7.** Capability to use and handle the micron gauge for deep vacuum measuring
- **K8.** Compressor, Condenser, Evaporator types and applications
- **K9.** Types of Refrigerant, its properties, recovery and reclaiming
- **K10.** Repair refrigerant leaks o Replace the Condenser motor o Replace the control
- **K11.** Replace water pump
- **K12.** Replace motorized actuators

Tool and Equipment

- Personal Protective Equipment
- Allen Key Set
- Bench Vice
- Center Punch
- Pedestal Drill Machine
- Digital Vernier Caliper
- Metal Drill Bit Set
- Masonry Drill Set
- File Set
- Hand Hacksaw Frame
- Hand Saw
- Hammer Set
- Mallet Set
- Digital Micro Meter
- Diagonal Side Cutter
- Combination Plier
- Nose Plier Set
- Locking Plier
- Measuring Tape
- Rivet Gun / Plier
- Adjustable Screw Wrench
- Adjustable Pipe Wrench
- Ratchet Wrench
- Box Spanner Set
- Socket Set
- Open Ended Spanner Set
- Box Spanner Screw Drivers
- Steel Ruler
- Scissors
- Scriber
- Tap and Die Set
- Try Square
- Chisel Set
- Pulley Wheel Puller
- Gas Welding Set with Table and All Accessories
- Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
- Pipe Cutter

- Pipe Vice
- Bearing Puller
- Manual Screw Driver Set
- Electric Screw Driver Set
- Spirit Level
- Electric Hand Grinder
- Soldering Iron
- Crimping Tool
- Insulation Remover
- De-Soldering Tool
- LCR Meter
- Wire Stripper
- Digital Multi Meter
- Digital Clamp-On Ampere Meter
- Electric Hand Drills
- Hot Air Gun
- HILTI Drill Machine (Piston Type)
- Digital Optical Tachometer
- Meg ohmmeter (0 - 1000 Volts)
- Digital Capacitor Analyzer
- Hand Electric Blower
- Tube Cutter
- Micron Pressure Gauge
- Digital Pressure Gauges Set (High &Combine)
- Pinch-Off Plier
- Flaring and Swaging Tool Kit
- Vacuum Pump 2-Stage, 6cfm
- Tube Benders (Spring Type and Pulley Bender Type)
- Laser Distance Measuring Device
- Laser Temperature Measuring Device
- Electronic Leak Detector
- Manometer
- Digital Air Flow / Velocity Meter
- Portable Refrigerant Charging Station
- Fins Straightening Comb Set
- Digital Humidity Meter
- Digital Psychrometer (Hygrometer)

- Water Pressure Gun for Service

0715-M&MT-134. Perform Preventive Maintenance

Overview: This Competency Standard covers the competencies required to calibrate and carry out maintenance of refrigeration / air conditioning system skills at workplace in accordance with the manufacturer specifications / guidelines. This unit covers the knowledge regarding safety rules, Personal Protective Equipment, and international standards for calibrating / maintenance of refrigeration / air conditioning units to provide you the basis for your work.

Competency Units	Performance Criteria
CU1. Calibrate / Replace Measuring Instruments	**P1.** Shut down the system if necessary and dismantle measuring instruments **P2.** Select and arrange tools, equipment and related accessories according to job requirements / sequence of operation **P3.** Calibrate / replace the instruments following the manufacturer instructions **P4.** Reinstall measuring instruments and start the system to check the performance of calibrated instrument as specified by the manufacturer manual **P5.** Record the output result of measuring instrument for future reference **P6.** Follow HVACR standards to complete the job
CU2. Carry out Maintenance	**P1.** Pump down / Shut down the system if necessary **P2.** Select and arrange tools, equipment and material according to job requirements / sequence of operation **P3.** Check different machines with measuring instruments for temperature, vibration and noise, etc. so as to operate the plant at desired efficiency **P4.** Carry out weekly / monthly / annual maintenance according to schedule **P5.** Check and record the performance of system after maintenance **P6.** Follow HVACR standards to complete the job

Knowledge & Understanding

K1. Technical Operations of Control

K2. Purpose / Advantages of preventive maintenance

K3. Techniques for Diagnosing and Troubleshooting of controls

K4. Controls error codes and solution

K5. Types of controls and their functions used in Central Air Conditioning Systems

K6. Procedure to replace PCB cards and controls

K7. Methods of calibration of different measurement instruments

K8. Record keeping and reporting

K9. Calibrate air temperature pressure gauge control device o Measure airflow / water flow difference

K10. Provide system log sheet and recommend repairs or replacement as necessary

Tool and Equipment

- Personal Protective Equipment
- Calibrating Tool Set
- Allen Key Set
- Bench Vice
- Centre Punch
- Pedestal Drill Machine
- Digital Vernier Calliper
- Metal Drill Bit Set
- Masonry Drill Set
- File Set
- Hand Hacksaw Frame
- Hammer Set
- Mallet Set
- Digital Micro Meter
- Diagonal Side Cutter
- Combination Plier
- Nose Plier Set
- Locking Plier
- Measuring Tape
- Rivet Gun / Plier
- Adjustable Screw Wrench
- Adjustable Pipe Wrench
- Ratchet Wrench
- Box Spanner Set
- Socket Set
- Open Ended Spanner Set
- Box Spanner Screw Drivers
- Steel Ruler
- Scissors
- Scriber
- Tap and Die Set
- Try Square
- Chisel Set

- Pulley Wheel Puller
- Gas Welding Set with All Accessories
- Nitrogen Gas Cylinder with Hose Pipe, Regulator and Back Arrestor
- Pipe Cutter
- Tube Cutter
- Pipe Vice
- Bearing Puller
- Manual Screw Driver Set
- Electric Screw Driver Set
- Spirit Level
- Electric Hand Grinder
- Soldering Iron
- De-Soldering Tool
- LCR Meter
- Crimping Tool
- Insulation Remover
- Wire Stripper
- Digital Multi Meter
- Digital Clamp-On Ampere Meter
- Electric Hand Drills
- Hot Air Gun
- HILTI Drill Machine (Piston Type)
- Digital Optical Tachometer
- Meg ohmmeter (0 - 1000 Volts)
- Digital Capacitor Analyser
- Hand Electric Blower
- Micron Pressure Gauge
- Digital Pressure Gauges Set (High &Combine)
- Pinch-Off Plier
- Flaring and Swaging Tool Kit
- Vacuum Pump 2-Stage, 6cfm
- Tube Benders (Spring Type and Pulley Bender Type)
- Laser Distance Measuring Device
- Laser Temperature Measuring Device
- Electronic Leak Detector
- Manometer
- Digital Air Flow / Velocity Meter

- Water Pressure Gun for Service

- Digital Humidity Meter

- Digital Psychrometer (Hygrometer)

- Portable Refrigerant Charging Station

- Fins Straightening Comb Set

0715.18 Mill Wright/ Industrial Mechanic

0715-M&MT-135. Apply basic Occupational Health & Safety

Overview: This competency standard covers the skills and knowledge required to Adopt Health & Safety regulations, Encourage primary safety program, Ensure Personal protective equipment (PPE), Ensure Safety documentation common to Machines, Assess Worksite hazards, Judge Dangerous Trees, Protect wildlife, Adopt Safety during fire season and Perform Map orientation.

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. Ensure Safety documentation common to Machines.	P1. Construct safety network flag person certification. P2. Ensure Workplace Hazardous Materials Information System.(WHMIS) P3. Prepare Material Safety Data Sheets (MSDS) P4. Ensure symbols identifying dangerous goods. P5. Follow safety while transporting dangerous goods.
CU4.Assess Worksite hazards	**P1**. Ensure safety during Steep terrain movement. **P2**. Ensure safe terrain stability **P3**. Evaluate overhead High voltage wires. **P4**. Estimate overhead obstacles, overhangs & demolition
CU5. Adopt Safety during fire	**P1.** Ensure designated fire equipment with the machine. **P2**. Ensure fire watch, fire trucks are ready to go. **P3**. Shut down the operation when humidity becoming lower than the temperature. **P4**. Calculate degree of hazards depends on the level of humidity versus temperature.

Knowledge & Understanding

The candidate must possess underpinning knowledge and understanding required to carry out tasks covered in this competency standard. Therefore he/she must be able to:

K1. Define Worksite hazards.

K2. Enlist various types of hazardous materials.

K3. Enlist various types of personal protective equipment.

K4. Define Material Safety Data Sheets (MSDS).

0715-M&MT-136. Perform general 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, Adopt Environmental Regulation, Adopt company policies and procedures, Follow federal, provincial/ territorial, and municipal legislation, Attain health & safety training, 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. Adopt Environmental Regulation	**P1.** Locate applicable permits on job site **P2.** Ensure work friendly environment **P3.** Adopt environmental regulations
CU7. Adopt company policies and procedures	**P1.** Ensure company policy and procedures **P2.** Adopt company procedures
CU8. Follow federal, provincial/ territorial, and municipal legislation	**P1.** Locate relevant section and legislation **P2.** Seek clarification of legislation **P3.** Adopt regulation of the area

CU9. Attain health & safety training	**P1.** Locate relevant section and legislation **P2.** Seek clarification of legislation **P3.** Adopt regulation of the area
CU10. Prepare for emergencies	**P1.** Take emergency response training **P2.** Ensure emergency response exercises **P3.** Adopt first aid, cardio for respiratory, resuscitation, and CPR
CU11. Respond to emergencies	**P1.** Follow emergency plan **P2.** Communicate instructions **P3.** Assess risk and determine course of action **P4.** Operate emergency equipment and supplies
CU12. 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
CU13. Investigate incident at workplace	**P1.** Identify incidents causes **P1.** Collect relevant data for evidences **P2.** Analyze the accident and plan a control measure 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 Occupational Health & Safety Regulations.

K5. Describe Typical worksite Hazards.

K6. Describe factors affecting Health & Safety in the workplace.

K7. Knowledge about First-Aid-Box.

K8. Usage of first aid box

K9. Accident history in different types of industries

K10. Environment safety.

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,

0715-M&MT-137. Perform Routine Trade Activity

Overview: This competency standard covers the skills and knowledge required to lubricate system and equipment, Perform levelling of components and system, Maintain fastening and retaining devices, Interpret mechanical drawing and specifications and Perform heat treatment of metal.

Competency Units	Performance Criteria
CU1. Lubricate system and equipment	**P4.** Identify attachments for lubrication process **P5.** Clean the surface of equipment **P6.** Select the correct lubricant for specific applications. **P7.** Maintain the safe use, storage and handling of lubricants.
CU2. Perform leveling of components and system	**P1.** Select and safely use fixed shop machines and equipment. **P2.** Maintain and repair fixed shop machines and equipment
CU3. Maintain fastening and retaining devices	**P1.** Identify, select and use fasteners and locking devices **P2.** Identify and use tools required for installation **P3.** set torque values **P4.** calculate strengths of fasteners

Knowledge & Understanding

K1. Describe types of lubrication.

K2. Describe various lubrication system

K3. Describe the properties and characteristics of lubricants.

K4. Describe layout of equipment

0715-M&MT-138. Perform Measuring and Layout of Work piece

Overview: This competency standard covers the skills and knowledge required to Prepare work area, tools and equipment, Layout and fabricate work piece and Maintains precision measuring of tools

Competency Units	Performance Criteria
CU1. Prepare work area, tools and equipment	**P1.** Identify tools and equipment as per job requirement **P2.** Select and use millwright's hand tools. **P3.** Clean and maintain millwright's hand tools **P4.** Select and safely use portable power tools Maintain and repair portable power tools
CU2. Layout and fabricate work piece	**P1.** Identify and use measuring tools and instruments. **P2.** Describe maintenance and storage procedures for measuring tools and instruments. **P3.** Identify and use layout tools and instruments **P4.** Maintain and store procedures for layout tools and instruments
CU3. Maintains precision measuring of tools	**P1.** Identify and describe tolerances, fits and fitting methods. **P2.** Apply fitting techniques and procedures associated with the assembly of equipment

Knowledge & Understanding

K1. Define terminology associated with measuring and layout

K2. Identify types of precision measuring tools and describe their applications and procedures for use.

- Micrometers
- Calipers
- Dial indicators
- Protractors
- Height gauges
- Feeler gauges
- Plug, ring and snap gauges
- Gauge blocks

K3. Identify types of layout tools and describe their applications and procedures for use.

- Straight edges
- Solid squares
- Combination sets
- Surface plate
- Scribers
- calipers
- Dividers
- Trammels
- Prick and center punches
- Angle plates
- Surface gauges
- n. Layout dye

Tool and Equipment

- Micrometers

- Calipers
- Dial indicators
- Protractors
- Height gauges
- Feeler gauges
- Plug, ring and snap gauges
- Gauge blocks

0715-M&MT-139. Perform Cutting and Welding Operation

Overview: This competency standard covers the skills and knowledge required to perform cutting operations on material as per requirements and Perform welding operations.

Competency Units	Performance Criteria
CU1. Perform cutting operations on material as per requirements	**P1**. Cut piece with manual cutting operations **P2.** Cut material with oxy-fuel and plasma arc cutting equipment
CU2. Perform welding operations	**P1.** Join material using oxy-fuel welding equipment **P2.** Weld material using shielded metal arc welding (SMAW) equipment **P3.** Weld material with gas metal arc welding (GMAW) equipment **P4.** Weld material with gas tungsten arc welding (GTAW) equipment **P5.** Maintain welding equipment

Knowledge & Understanding

K1. Describe cutting operations

K2. Describe different types of welding

0715-M&MT-140. Perform Rigging, Hoisting / Lifting and Moving

Overview: This competency standard covers the skills and knowledge required to Design a rigging plan, Select and use hoisting and lifting equipment, Set and use sling and rigging attachment and Service chain and belt drive system.

Competency Units	Performance Criteria
CU1. Design a rigging plan	**P1.** Determines load **P2.** Selects rigging equipment **P3.** Selects hoisting/lifting and moving equipment **P4.** Secures area
CU2. Selects and use hoisting and lifting equipment	**P1.** Identify and describe the use of mobile access equipment. **P2.** Perform routine inspection of lifting equipment **P3.** Use ladders and scaffolding.
CU3. Set and use sling and rigging attachment	**P1.** Identify wire and fiber rope. **P2.** Identify the types and use rigging attachments. **P3.** Identify and use hand rigging equipment and devices. **P4.** Select, inspect and use wire rope **P5.** Select, inspect and use slings **P6.** Select, inspect and use rigging attachments • Spreader bars • Eyebolts • Hoist rings • Shackles • Hooks • End terminations • Turnbuckles • Blocks and pulleys • Maintenance and Storage **P7.** Select, inspect and use hand rigging equipment
CU4. Service chain and belt drive system	**P1.** Identify and select gear system **P2.** Install, repair and maintain gear system

Knowledge & Understanding

K1. Describe the use of mobile access equipment.

K2. Describe the applicable Work Safe BC regulations pertaining to rigging equipment and procedures

K3. Describe the types and use wire and fiber rope

Tool and Equipment

- Spreader bars
- Eyebolts
- Hoist rings
- Shackles
- Hooks
- End terminations
- Turnbuckles
- Blocks and pulleys
- Ladders and scaffolding.

0715-M&MT-141. Service general mechanical equipment

Overview: This competency standard covers the skills and knowledge required to Service couplings, clutches and brake system, Service shaft, bearing seals and their alignment procedures ,Service gear systems , Service Pumps, Service fan and blowers, Service compressors, Service piping, tank and containers, Service hydraulic system, Service pneumatic and vacuum system, Service conveying system, Service prime movers, Perform preventive and predictive maintenance , Perform commissioning and decommissioning of equipment and Service mechanical robot and automated equipment

Competency Units	Performance Criteria
CU1. Service couplings, clutches and brake system	**P1.** Select, install and maintain coupling system **P2.** Select, install and maintain clutch system **P3.** Select, install and maintain brake system
CU2. Service shaft ,bearing seals and their alignment procedures	**P4.** Select, install and maintain shaft system **P5.** Select, install and maintain bearing system **P6.** Select, install and maintain seal system **P7.** Perform rough alignment procedures **P8.** Perform dial alignment procedure **P9.** Perform laser alignment procedure **P10.** Fit, mount and dismount friction and anti-friction bearings. **P11.** Inspect and maintain bearings and diagnose causes of bearing failures
CU3. Service gear systems	**P1.** Identify and select gear system **P2.** Install, repair and maintain gear system
CU4. Service Pumps	**P1.** Identify and select positive displacement pump **P2.** Install, repair and maintain positive displacement pump **P3.** Identify and select non-positive displacement pump **P4.** Install, repair and maintain non-positive displacement pump
CU5. Service fan and blowers	**P1.** Identify and select fan system **P2.** Install, repair and maintain fan system **P3.** Identify and select blower system **P4.** Install, repair and maintain blower system
CU6. Service compressors	**P1.** Identify and select compressor **P2.** Install, maintain and repair compressor
CU7. Service piping, tank and containers	**P1.** Select, install and repair tank and container system **P2.** Select, install and repair piping system
CU8. Service hydraulic	**P1.** Identify hydraulic system components

system	**P2.** Assemble hydraulic system components **P3.** Repair and maintain hydraulic system components **P4.** Test the hydraulic system
CU9. Service pneumatic and vacuum system	**P1.** Identify pneumatic and vacuum components **P2.** Assemble pneumatic and vacuum components **P3.** Maintain and repair pneumatic and vacuum components
CU10. Service conveying system	**P1.** Identify the conveying system components **P2.** Assemble conveying components as per manufacturer manual **P3.** Maintain and repair conveying system
CU11. Service prime movers	**P1.** Service electric motor **P2.** Service internal combustion engine **P3.** Service turbines
CU12. Perfrom preventive and predictive maintenance	**P1.** Identify the related maintenance type as per requirement **P2.** Perform vibration analysis procedures **P3.** Perform balancing procedures **P4.** Perform non-destructive evaluation procedures
CU13. Perform commissioning and decommissioning of equipment	**P1.** Identify reports and other data required for commissioning equipment **P2.** Commission the system and equipment **P3.** Recommend commissioning improvements where appropriate **P4.** Review test and trial schedules **P5.** Check equipment and systems • Fuel • Lube oil • Freedom of movement • Electricity • Test equipment **P6.** Perform test and trials • Specific performance standards • Comparison to specifications • Safety/guards/emergency stops • Maintenance arrangements • Nose levels • Defects **P7.** Identify and document required changes • Sumps • Drainage

	• Vibration • Pipe hangers • Insulation • Couplings **P8.** Report warranty and defects **P9.** Test results examination • Defects • Deficiencies **P10.** Decommission the system and equipment
CU14. Service mechanical robot and automated equipment	**P1.** Identify robotic and automated equipment **P2.** Identify defect and issue in system **P3.** Inspect the fault **P4.** Repair/replace the defective parts **P5.** Test the replacement of part in system **P6.** Perform finishing operations

Knowledge & Understanding

K1. Describe couplings, clutches and brake system
K2. Describe shaft, bearing seals and their alignment procedures
K3. Describe types of gear system.
K4. Describe pump system
K5. Describe fan and blowers
K6. Describe compressors
K7. Describe piping, tank and containers
K8. Describe hydraulic system
K9. Describe pneumatic and vacuum system
K10. Describe conveying system
K11. Describe prime movers
K12. Describe types of maintenance
K13. Describe commissioning and decommissioning of equipment
K14. Describe mechanical robot and automated equipment
K15. Describe various types of friction and load conditions associated with bearings.

Tool and Equipment

- couplings, clutches and brake system
- shaft ,bearing and seals

- gear systems

- positive displacement pump

- non-positive displacement pump fan and blowers

- compressors

0715.19 Tool design and tool making

0715-M&MT-142. Design and draw the CAM profile with knife edge follower for uniform velocity

Overview: This competency standard covers the skills and knowledge required to Movement of knife edge follower, Practice to sketch Displacement, velocity and acceleration diagram when knife edge Follower, Movement of follower with Simple Harmonic Motion (S.H.M), Practice to sketch Displacement, velocity and acceleration diagram when knife edge follower moves with uniform velocity and Practice to draw CAM profile as given data

Competency Units	Performance Criteria
CU1: Movement of knife edge follower	**P1**. Differentiate between the cam and follower **P2**. Choose required type of follower **P3.** Identify the modulus of the follower **P4.** Measure the dimensions of the follower
CU2: Practice to sketch Displacement, velocity and acceleration diagram when knife edge Follower.	**P1**. Differentiate between the cam and follower **P2**. Choose required type of follower **P3.** Identify the modulus of the follower **P4.** Measure the dimensions of the follower **P5.** Measure the displacement of the knife edge follower **P6.** Calculate the velocity of the knife edge follower **P7.** Calculate the acceleration of the knife edge follower
CU3: Movement of follower with Simple Harmonic Motion (S.H.M)	**P1.** Measure the dimensions of the follower **P2.** Calculate the displacement of the knife edge follower **P3.** Calculate the velocity of the knife edge follower **P4.** Calculate the acceleration of the knife edge follower **P5.** Observe the movement of the follower and compare its motion with simple harmonic motion
CU4: Practice to sketch Displacement, velocity and acceleration diagram when knife edge follower moves with uniform velocity	P1. Differentiate between the cam and follower P2. Choose required type of follower P3. Identify the modulus of the follower P4. Measure the dimensions of the follower P5. Calculate the displacement of the knife edge follower with uniform velocity P6. Calculate the velocity of the knife edge follower with uniform velocity P7. Calculate the acceleration of the knife edge follower with uniform velocity
CU5. Practice to draw CAM profile as given data	P1. Measure the dimensions of the follower P2. Calculate the displacement of the knife edge follower

	P3. Calculate the velocity of the knife edge follower P4. Calculate the acceleration of the knife edge follower P5. Observe the movement of the follower and draw cam profile as per given requirement

Knowledge and Understanding

K1. Knowing follower and cam theory

K2. Understanding of the knife edge follower

K3. Understanding about the follower types

K4. Knowledge about the modulus of the follower

K5. Understanding the K.E and P.E concepts

K6. Understanding about the follower displacement behavior

K7. Calculate the velocity and acceleration behavior

Tools and Equipment

- Cam and follower
- Various types of followers
- Measuring instruments
- Complete mechanism with displacement finder
- Blank graph paper

0715-M&MT-143. Draw standard parts of jigs & fixtures (manual drawing)

Overview: This competency standard covers the skills and knowledge required to Draw hex head nut, Draw hex head bolt, Draw wing nut, Draw knurling nut, Draw counter sinking head screw, Draw cap screw, Draw machine screw, Draw socket head screw, Draw plain washer, Draw spring washer and Draw c-type washer

Competency Units	Performance Criteria
CU1. Draw hex head nut	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw hex head nut as per requirement
CU2. Draw hex head bolt	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of a bolt **P7.** Draw a bolt head **P8.** Draw an end view of the head **P9.** Draw hex head bolt
CU3. Draw wing nut	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of nut **P9.** Draw wing nut according to the requirements
CU4. Draw knurling nut	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw knurling nut
CU5. Draw counter sinking head screw	**P1.** Select drawing sheet

	P2. Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6**. Draw counter sinking head screw
CU6.Draw cap screw	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw cap screw
CU7.Draw machine screw	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw machine screw
CU8.Draw socket head screw	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw socket head screw
CU9.Draw plain washer	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw plain washer
CU10.Draw spring washer	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw spring washer
Cu11.Draw c-type washer	**P1.** Select drawing sheet **P2.** Select drawing instruments

	P3. Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw c-type washer

Knowledge & Understanding

K1. Knowledge about drawing sheets

K2. Knowledge about drawing instruments

K3. Understanding about the lines and sketch phenomena

K4. Understanding about nut terminology

K5. Understanding about nut types

Tools and Equipment

- Drawing instruments and drawing sheet
- Drawing board
- Drawing sheet
- Drawing sheet holder
- Set squares
- Scale
- Divider
- T square
- Drawing pencils- H, 2H, HB
- Paper tape
- Pencil Sharpeners Eraser
- Protractor
- Drawing instruments and drawing sheet
- Drawing board
- Drawing sheet holder
- Set squares

0715-M&MT-144. Draw different types of clamps

Overview: This competency standard covers the skills and knowledge required to Draw hook clamp, Draw latch clamp, Draw cam clamp, Draw eye bolt, Draw strap clamps and Draw plain wedge clamp

Competency Units	Performance Criteria
CU1. Draw hook clamp	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of a clamp **P7.** Draw an end view of the clamp **P8.** Draw hook clamp
CU2. Draw latch clamp	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of a clamp **P7.** Draw a latch clamp
CU3. Draw cam clamp	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of a clamp **P7.** Draw cam clamp
CU4. Draw eye bolt	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of a bolt **P7.** Draw eye bolt
CU5. Draw strap clamps	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board

	P4. Set arm location **P5.** Choose starting position **P6.** Draw body of a clamp **P7.** Draw an end view of the clamp **P8.** Draw strap clamp
CU6. Draw plain wedge clamp	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of a clamp **P7.** Draw an end view of the clamp **P8.** Draw wedge clamp

Knowledge & Understanding

K1. Knowledge about drawing sheets

K2. Knowledge about drawing instruments

K3. Understanding about the lines and sketch phenomena

K4. Understanding about washer terminology

K5. Understanding about hook clamp

Tools and Equipment

- Drawing instruments and drawing sheet
- Drawing board
- Drawing sheet holder
- Set squares
- Scale
- Divider
- T square
- Drawing pencils H, 2H, HB
- Paper tape
- Pencil Sharpeners Eraser
- Protractor
- Drawing instruments and drawing sheet
- Drawing board
- Drawing sheet holder
- Set squares

0715-M&MT-145. Draw locators (Manual)

Overview: This competency standard covers the skills and knowledge required to Draw pin and button location, Draw rest pad and plates, Draw nest or cavity location and Draw jig feet (rest button, hex rest button, jig leg, flat jig feet)

Competency Units	Performance Criteria
CU1. Draw pin and button location	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of a pin **P7.** Draw an end view of the button **P8.** Draw pin and button location
CU2 Draw rest pad and plates	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of a pad **P7.** Draw an end view of the plates **P8.** Draw rest pad and plates
CU3.Draw nest or cavity location	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of nest **P7.** Draw an end view of the cavity **P8.** Draw nest or cavity location
CU4.Draw jig feet (rest button, hex rest button, jig leg, flat jig feet)	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of a jig feet **P7.** Draw an end view of the rest parts

Knowledge & Understanding

K1. Knowledge about drawing sheets

K2. Knowledge about drawing instruments

K3. Understanding about the lines and sketch phenomena

K4. Understanding about nut terminology

K5. Understanding about pin & button location

Tools and Equipment

- Drawing instruments and drawing sheet
- Drawing board
- Drawing sheet holder
- Set squares
- Scale
- Divider
- T square
- Drawing pencils- H, 2H, HB
- Paper tape
- Pencil Sharpeners Eraser
- Protractor

0715-M&MT-146. Draw template jig and plate type drill Jig

Overview: This competency standard covers the skills and knowledge required to Draw the work piece to be drilled, Draw the body of jig as per given job and Draw the template and plate drill jig as per given job

Competency Units	Performance Criteria
CU1. Draw the work piece to be drilled	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the work piece **P7.** Draw an end view of the drill **P8.** Draw the main drill hole
CU2. Draw the body of jig as per given job	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the jig **P7.** Draw an end view of the body of jig
CU3. Draw the template and plate drill jig as per given job	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the jig **P7.** Draw an end view of the body of jig **P8.** Draw the main plate drill jig

Knowledge & Understanding

K1. Knowledge about drawing sheets

K2. Knowledge about drawing instruments

K3. Understanding about the lines and sketch phenomena

K4. Understanding about drilling terminology

K5. Understanding about work piece

K4. Understanding about jig terminology

K5. Understanding about body of the jig

K5. Understanding about templates and jigs

Tools and Equipment

- Drawing instruments and drawing sheet
- Drawing board
- Drawing sheet holder
- Set squares
- scale
- Divider
- T square
- Drawing pencils- H, 2H, HB
- Paper tape
- Pencil Sharpeners Eraser
- Protractor

0715-M&MT-147. Draw swinging leaf jig

Overview: This competency standard covers the skills and knowledge required to Draw the work piece to be drill, Draw the body of jig as per given work piece, Draw clamps for accurate and easy clamping, Draw locators for accurate location, Draw proper drill bushings for guidance of twist drill and Draw suitable jig feet(flat jig feet)

Competency Units	Performance Criteria
CU1. Draw the work piece to be drill	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the work piece **P7.** Draw an end view of the drill **P8.** Draw the main drill hole
CU2. Draw the body of jig as per given work piece	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the jig **P7.** Draw an end view of the body of jig
CU3. Draw clamps for accurate and easy clamping	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the clamping place **P7.** Draw an end view of the clamp **P8.** Draw the main and accurate clamps for easy clamping
CU4. Draw locators for accurate location	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body locator **P7.** Draw an end view of the locator

	P8. Attach locator for accurate location
CU5.Draw proper drill bushings for guidance of twist drill	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the bush **P7.** Draw an end view of the drill **P8.** Draw proper drill bushings for guidance of twist drill
CU6.Draw suitable jig feet(flat jig feet)	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the jig **P7.** Draw an end view of the body of jig **P8.** Draw the main plate drill jig/ flat jig

Knowledge & Understanding

K1. Knowledge about Drawing sheets

K2. Knowledge about Drawing instruments

K3. Understanding about the lines and sketch phenomena

K4. Understanding about drilling terminology

K5. Understanding about jig terminology

K6. Understanding about body of the jig

K7. Understanding about clamps terminology

K8. Understanding about clamps

K9. Understanding about locators terminology

K10. Understanding about locators

K11. Understanding about drill bushings terminology

K12. Understanding about twist drill

K13. Understanding about flat jig terminology

K14. Understanding about suitable jig feet

Tools and Equipment

- Drawing instruments and drawing sheet
- Drawing board
- Drawing sheet holder

- Set squares

- Scale

- Divider

- T square

- Drawing pencils- H, 2H, HB

- Paper tape

- Pencil Sharpeners Eraser

- Protractor

0715-M&MT-148. Draw an indexing jig

Overview: This competency standard covers the skills and knowledge required to Draw the work piece to be drilled, Draw the body of work piece as per given w / p, Draw locators for accurate location, Draw clamps for accurate clamping, Draw drill bushing for guidance of twist drill and Draw indexing mechanism

Competency Units	Performance Criteria
CU1.Draw the work piece to be drilled	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the work piece **P7.** Draw an end view of the drill **P8.** Draw the main drill hole
CU2.Draw the body of work piece as per given w / p	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the work piece **P7.** Draw an end view of the drill **P8.** Draw the main drill hole as per given w/p
CU3.Draw locators for accurate location	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the locators **P7.** Draw an end view of the locators **P8.** Draw the main and accurate locators for accurate location
CU4 Draw clamps for accurate clamping	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body clamps

	P7. Draw an end view of the clamps **P8.** Attach locator for accurate clamping
CU5.Draw drill bushing for guidance of twist drill	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the bush **P7.** Draw an end view of the drill bush **P8.** Draw proper drill bushings for guidance of twist drill
CU5.Draw indexing mechanism	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the remaining parts **P7.** Draw an end view of the body of indexing mechanism **P8.** Draw the main indexing jig

Knowledge & Understanding

- **K1.** Knowledge about drawing sheets
- **K2.** Knowledge about drawing instruments
- **K3.** Understanding about the lines and sketch phenomena
- **K4.** Understanding about the work piece to be drilled
- **K5.** Understanding about work piece terminology
- **K6.** Understanding about w/p
- **K7.** Understanding about locator terminology
- **K8.** Understanding about accurate location
- **K9.** Understanding about clamps terminology
- **K10.** Understanding about accurate clamping
- **K11.** Understanding about drill bushing terminology
- **K12.** Understanding about twist drilling
- **K13.** Understanding about indexing terminology
- **K14.** Understanding about indexing mechanism

Tools and Equipment

- Drawing instruments and drawing sheet
- Drawing board
- Drawing sheet holder
- Set squares
- Scale
- Divider
- T square
- Drawing pencils- H, 2H, HB
- Paper tape
- Pencil Sharpeners Eraser
- Protractor

0715-M&MT-149. Draw an angle milling fixture

Overview: This competency standard covers the skills and knowledge required to Draw the work piece to be milled, Draw the main parts, the base, Draw Clamps, Draw Rest blocks or nest, Draw locating points, Draw gauging surfaces and Draw the assembled single piece milling fixture

Competency Units	Performance Criteria
CU1.Draw the work piece to be milled	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the work piece to be milled
CU2.Draw the main parts, the base	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the work piece **P7.** Draw an end view of the base
CU3.Draw Clamps	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the clamp
CU4.Draw Rest blocks or nest,	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the blocks/rest as per requirement
CU5. Draw locating points,	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position

	P6. Draw body of the locating points
CU 6. Draw gauging surfaces	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the gauge surfaces
CU7.Draw the assembled single piece milling fixture	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the single piece milling fixture

Knowledge & Understanding

- **K1.** Knowledge about drawing sheets
- **K2.** Knowledge about drawing instruments
- **K3.** Understanding about the lines and sketch phenomena
- **K4.** Understanding about milling terminology
- **K5.** Understanding about work piece to be milled
- **K6.** Understanding about the base terminology
- **K7.** Understanding about main parts
- **K8.** Understanding about clamps terminology
- **K9.** Understanding about rest blocks terminology
- **K10.** Understanding about nest
- **K11.** Understanding about locating point's terminology
- **K12.** Understanding about gauging terminology
- **K13.** Understanding about surfaces
- **K14.** Understanding about milling fixtures terminology
- **K15.** Understanding about single piece assembly

Tools and Equipment

- Drawing instruments and drawing sheet
- Drawing board
- Drawing sheet holder
- Set squares
- Scale
- Divider

- T square

- Drawing pencils- H, 2H, HB

- Paper tape

- Pencil Sharpeners Eraser

- Protractor

0715-M&MT-150. Draw lathe fixture for turning and boring operation

Overview: This competency standard covers the skills and knowledge required to draw the work piece to be turned or bored, Draw the turning fixture and Draw holding mechanism of fixture on lathe spindle

Competency Units	Performance Criteria
CU1.Draw the work piece to be turned or bored	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the work piece **P7.** Draw an end view of the drill **P8.** Draw the main drill hole
CU2.Draw the turning fixture	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw the turning fixture
CU3.Draw holding mechanism of fixture on lathe spindle	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw holding mechanism of fixture on lathe spindle

Knowledge & Understanding

- **K1.** Knowledge about drawing sheets
- **K2.** Knowledge about drawing instruments
- **K3.** Understanding about the lines and sketch phenomena
- **K4.** Understanding about turning terminology
- **K5.** Understanding about turning and boring
- **K6.** Understanding about turning fixture terminology
- **K7.** Understanding about fixture
- **K8.** Understanding about holding mechanism terminology
- **K9.** Understanding about fixture on lathe spindle

Tools and Equipment

- Drawing instruments and drawing sheet
- Drawing board
- Drawing sheet holder
- Set squares
- scale
- Divider
- T square
- Drawing pencils- H, 2H, HB
- Paper tape
- Pencil Sharpeners Eraser
- Protractor

0715-M&MT-151. Draw simple blanking die for making a blank

Overview: This competency standard covers the skills and knowledge required to Draw the blank position in the strip, Calculate the size of punch considering the elastic recovery of material, Calculate the size of die considering the elastic recovery of material, Draw the piercing die and punch, Draw the piercing punch and Draw the different types of punches to reduce the cutting forces

Competency Units	Performance Criteria
CU1.Draw the blank position in the strip	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the strips **P7.** Draw an end view of the blank position **P8.** Draw the blank position in the strip
CU2.Calculate the size of punch considering the elastic recovery of material	**P1.** Consider elastic recovery of material **P2.** Calculate the size of punch
CU3.Calculate the size of die considering the elastic recovery of material	**P1.** Select measuring tools **P2.** Consider elastic recovery of the material **P3.** Analyze the tolerance of the material
CU4.Draw the piercing die and punch	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the piercing die and punching
CU5. Draw the piercing punch	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the piercing punch
CU6. Draw the	**P1.** Select drawing sheet

different types of punches to reduce the cutting forces	**P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the punches which reduces the cutting forces

Knowledge & Understanding

- **K1.** Knowledge about drawing sheets
- **K2.** Knowledge about drawing instruments
- **K3.** Understanding about the lines and sketch phenomena
- **K4.** Understanding about strips terminology
- **K5.** Understanding about blank position in strips
- **K6.** Understanding about punching terminology
- **K7.** Understanding about elasticity
- **K8.** Understanding about dies terminology
- **K9.** Understanding about elasticity
- **K10.** Understanding about piercing terminology
- **K11.** Understanding about punching
- **K12.** Understanding about reduction terminology
- **K13.** Understanding about reduction of cutting forces in punching

Tools and Equipment

- Drawing instruments and drawing sheet
- Drawing board
- Drawing sheet holder
- Set squares
- Scale
- Divider
- T square
- Drawing pencils- H, 2H, HB
- Paper tape
- Pencil Sharpeners Eraser
- Protractor

0715-M&MT-152. Draw a progressive die for making a washer of inner diameter 20 and outer 40 mm

Overview: This competency standard covers the skills and knowledge required to Draw the piercing position in the strip inner dia 20 and outer dia 40mm, Draw the blanking position in the strip inner dia 20

and outer dia 40mm, Draw the die block and calculate the size of punch after considering the elastic recovery of Material, Draw the die block and calculate the size of die after considering the elastic recovery of Material and Draw the pilot punch used in progressive die

Competency Units	Performance Criteria
CU1.Draw the piercing position in the strip inner dia 20 and outer dia 40mm	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the piercing position as per given requirements
CU2.Draw the blanking position in the strip inner dia 20 and outer dia 40mm	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the blanking position as per given requirements
CU2. Draw the die block and calculate the size of punch after considering the elastic recovery of Material	**P1.** Select measuring tools **P2.** Consider elastic recovery of the material **P3.** Analyze the tolerance of the material **P4.** Select drawing sheet **P5.** Select drawing instruments **P6.** Set drawing sheet on drawing table/board **P7**. Set arm location **P8.** Choose starting position **P9.** Draw body of the die block
CU3. Draw the die block and calculate the size of die after considering the elastic recovery of Material	**P1.** Select measuring tools **P2.** Consider elastic recovery of the material **P3.** Analyze the tolerance of the material **P4.** Select drawing sheet **P5.** Select drawing instruments **P6.** Set drawing sheet on drawing table/board **P7**. Set arm location **P8.** Choose starting position **P9.** Draw body of the die block
CU4. Draw the pilot punch used in	**P1.** Select drawing sheet **P2.** Select drawing instruments

progressive die	**P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the pilot punch

Knowledge & Understanding

K1. Knowledge about drawing sheets

K2. Knowledge about drawing instruments

K3. Understanding about the lines and sketch phenomena

K4. Understanding about measurements of the piercing terminology

K5. Understanding about dimensional analysis

K6. Understanding about die block terminology

K7. Understanding about punching

K8. Understanding about elasticity

K9. Understanding about pilot punch terminology

K10. Understanding about progressive die

Tools and Equipment

- Drawing instruments and drawing sheet
- Drawing board
- Drawing sheet holder
- Set squares
- Scale
- Divider
- T square
- Drawing pencils- H, 2H, HB
- Paper tape
- Pencil Sharpeners Eraser
- Protractor

0715-M&MT-153. Draw a simple drawing die for a cup

Overview: This competency standard covers the skills and knowledge required to Draw the work piece to be draw, Draw the single action draw die with spring loaded knockout, Calculate the percent reduction and depth of draws, Calculate blank size for a cup of 40mm inner dia., 30mm depth and sheet thickness 1mm and Calculate the drawing forces

Competency Units	Performance Criteria
CU1. Draw the work piece to be draw	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the base lines **P7.** Draw an end view of the work piece
CU2. Draw the single action draw die with spring loaded knockout	**P1.** Select drawing sheet **P2.** Select drawing instruments **P3.** Set drawing sheet on drawing table/board **P4**. Set arm location **P5.** Choose starting position **P6.** Draw body of the spring **P7.** Draw an end view of the single action draw die
CU3. Calculate the percent reduction and depth of draws	**P1.** Select measuring tools **P2.** Calculate change I length **P3.** Develop relationship to get % reduction **P4.** Follow same procedure to calculate the depth of draws
CU4. Calculate blank size for a cup of 40mm inner dia., 30mm depth and sheet thickness 1mm	**P1.** Select measuring tools **P2.** Calculate change I length **P3.** Develop relationship to get % reduction as per given condition **P4.** Follow same procedure to calculate the depth of draws as per condition
CU5. Calculate the drawing forces	**P1.** Select measuring tools **P2.** Calculate change I length **P3.** Develop relationship to get % reduction as per given condition **P4.** Follow same procedure to calculate the depth of draws as per condition

Knowledge & Understanding

K1. Knowledge about drawing sheets

K2. Knowledge about drawing instruments

K3. Understanding about the lines and sketch phenomena

K4. Understanding about work piece terminology

K5. Understanding about drawing

K4. Understanding about single action drawing terminology

K5. Understanding about spring loading

K4. Understanding about % reduction terminology

K5. Understanding about % depth of draws

K4. Understanding about cup terminology

K5. Understanding about thickness

K5. Understanding about drawing forces

Tools & Equipment

- Drawing instruments and drawing sheet
- Drawing board
- Drawing sheet holder
- Set squares
- scale
- Divider
- T square
- Drawing pencils- H, 2H, HB
- Paper tape
- Pencil Sharpeners Eraser
- Protractor

0715.20 Entrepreneurial Skill

0715-M&MT-154. Develop Entrepreneurial Skills

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

Unit of Competency	Performance Criteria
1. Develop a business plan	P1 Conduct a market survey to collect following information ✓ Customer /demand ✓ Tools, equipment, machinery and furniture with rates ✓ Raw material ✓ Supplier ✓ Credit / funding sources ✓ Marketing strategy ✓ Market trends ✓ Overall expenses ✓ Profit margin P2 Select the best option in terms of cost, service, quality, sales, profit margin, overall expenses P3 Compile the information collected through the market survey, in the business plan format
2. Collect information regarding funding sources	P1 Identify the available funding sources based on their terms and conditions, maximum loan limit, payback time, interest rate P2 Choose the best available option according to investment requirement P3 Prepare documents according to the loan agreement requirement P4 Include the information of funding sources in the business plan
3. Develop a marketing plan	P1. Make a marketing plan for the business including product, price, placement, promotion, people, packaging and positioning P2. Include the information of marketing plan in the business plan
4. Develop basic business communication skills	P1. Communicate with internal customers e.g.: labor, partners and external customers e.g.: suppliers, customers etc., using effective communication skills

	P2. Use different modes of communication to communicate internally and externally e.g.: presentation, speaking, writing, listening, visual representation, reading etc. P3. Use specific business terms used in the market

Knowledge and Understanding

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

K1. Explain the 7ps of marketing including product, price, placement, promotion, people, packaging and positioning

K2. Describe 7Cs of business communication

K3. Define different modes of communication and their application in the industry

K4. Enlist specific business terms used in the industry

K5. Enlist the available funding sources

K6. Explain how to get loan to start a new business

K7. Explain market survey and its tools e.g: questionnaire, interview, observation etc

K8. Describe the market trends for specific product offering

K9. State the main elements of business plan

K10. Explain how to fill the business plan format

Critical Evidence(s) Required

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

0715-M&MT-155. Apply project information management and communications techniques

Overview:

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

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

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

K2. Explain importance of managing risk by treating information securely

K3. Outline methods of reviewing outcomes

K4. Identify organizational policies and procedures relevant to this role in a specific context.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to apply project information management and communications techniques. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- lead an effective team in planning and implementing all necessary communications for a workplace project
- Evaluate and review project communication outcomes and make recommendations for future improvements.
- Identify organizational policies and procedures relevant to this role in a specific context.
- summarize models and methods of communications management in context of project life cycle and other project management functions

0715-M&MT-156. Apply project human resources management approaches

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

Unit of Competency	Performance Criteria
1. Assist in determining human resource requirements	P1 Analyze work breakdown structure to determine human resource requirements P2 Prepare a skills analysis of project personnel against project task requirements P3 Assist in assigning responsibilities for achieving project deliverables
2. Contribute to establishing and maintaining productive team relationships	P1 Actively seek views and opinions of team members during task planning and implementation P2 Promote cooperation and effective activities, goals and relationships within team P3 Communicate with others using styles and methods appropriate to organizational standards, group expectations and desired outcomes P4 Communicate information and ideas to others in a logical, concise and understandable manner P5 Regularly seek feedback on nature and quality of work relationships, and use feedback as basis for own improvement and development
3. Assist with human resource monitoring	P1 Monitor work of project personnel against assigned roles and responsibilities within delegated authority levels P2 Monitor and control actual effort against project plan P3 Review skill levels against allocated tasks and recommend solutions, where required, to others P4 Advise others within delegated authority when assigned responsibilities are not met by project personnel P5 Undertake work in a multi-disciplinary environment according to established human resource management practices, plans, guidelines and procedures P6 Resolve conflict within delegated authority according to agreed dispute-resolution processes

	P7 Assist in offering human resource development opportunities to individuals with skill gaps
4. Contribute to evaluating human resource practices	P1 Contribute to assessing effectiveness of project human resources management P2 Document lessons learned to support continuous improvement processes

Knowledge and 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. Identify alternative project personnel engagement options
K2. Explain job design principles and work breakdown structures
K3. Describe learning and development approaches that can be incorporated into project life cycle
K4. List methods for skills analysis
K5. Identify and describe project roles, responsibilities and reporting requirements for human resources.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to apply project human resources management approaches. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- produce work breakdown structures in human resource project planning
- produce work breakdown structures in human resource project planning
- construct effective methods for monitoring roles, responsibilities and performance in projects
- Demonstrate methods for providing feedback on performance and improving performance of project team members.

0715-M&MT-157. Direct human resources management of a project program

Overview:

This unit describes the skills and knowledge required to direct human resource organization and staffing across a program, direct project managers in relation to staff performance, and to provide leadership

within the program. It applies to individuals who are program managers, managing a suite of projects (a program).

Unit of Competency	Performance Criteria
1. Direct human resources management planning	P1 Direct stakeholder assessment to establish a basis for stakeholder management within projects and overall program P2 Direct stakeholder assessment to establish a basis for stakeholder management within projects and overall program P3 Direct responsibility assignment for project activities and tasks, and establish authorization protocols
2. Manage program organization and staffing	P1 Determine resource requirements for projects in consultation with project managers and appropriate stakeholders, to establish program staffing levels, allocation to projects and required competencies P2 Direct project organization and structure to optimize alignment of individual and group competencies within projects P3 Direct recruitment of staff for allocation to projects or reallocation within the organization, within agreed delegated authority, to meet competency requirements throughout the program P4 Direct project managers use of human resources management (HRM) methods, techniques and tools, and modify for program requirements P5 Utilize organizational HRM system and HRM processes across projects
3. Direct project staff performance management	P1 Obtain agreement on performance measurement criteria for clarity of roles and responsibilities and ongoing assessment P2 Ensure systems for ongoing development and training of personnel across the program are established and implemented by project managers P3 Measure individuals performance against agreed criteria and authorize actions to overcome shortfalls in performance and encourage career progression
4. Provide overall leadership to project teams	P1 Manage a system of continuous improvement of staff to enhance program effectiveness P2 Analyze individual and team performance and morale levels and take action where necessary P3 Direct procedures for interpersonal communication, counseling and conflict resolution by project managers, and review results to maintain and promote a positive working environment P4 Identify and positively manage intra-organizational and intra-project conflict to maximize achievement of program objectives P5 Aggregate HRM lessons learnt for application in planning and, where

	appropriate, pass on information to others for consideration in strategic planning and direction

Knowledge and 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 human resource management methods, techniques and tools

K2. Identify relevant legislation

K3. Describe models of performance management and performance development.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to direct human resources management of a project program. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- direct human resources management (HRM) planning, including:
  - directing project analysis to determine program requirements
  - directing stakeholder assessment
  - directing responsibility assignment and establishing authorization protocols
- manage program organization and staffing, including:
  - determining project resource requirements
  - directing project organization and structure
  - directing staff recruitment
  - directing project managers use of HRM methods, techniques and tools
  - utilizing organizational HRM system and processes across projects
- direct project staff performance management, including:
  - obtaining agreement on measurement criteria
  - ensuring systems for ongoing development and training
  - measuring individuals performance and authorizing relevant action
- provide overall leadership to project teams, including:
  - managing a continuous improvement system
  - analyzing and taking action on individual and team performance and morale levels

- directing procedures for interpersonal communication, counseling and conflict resolution by project managers, and reviewing results

- identifying and positively managing intra-organizational and intra-project conflict

- Aggregating and passing on HRM lessons learnt.

0715-M&MT-158. Develop a project management plan

Overview: This unit describes the skills and knowledge to develop a plan for a telecommunications project, including assessing project requirements and planning for all stages to completion and final documentation. It applies to individuals who are likely to have responsibility for the provision of installations, maintenance, upgrades and new services.

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

Knowledge and Understanding

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

K1. Explain the key attributes of common telecommunications applications and related equipment
K2. Identify and evaluate the connections to carrier infrastructure or equipment
K3. Identify current legislation relating to the design of installation of telecommunications equipment and connection to carrier services
K4. Evaluate the advantages of leasing and purchase options to assist in delivering cost effective solutions
K5. Identify and evaluate network and transmission equipment
K6. Outline network topologies, and interface and interconnect solutions
K7. Outline work health and safety (WHS) issues that need to be built into a plan, with consideration of:
- electrical safety
- materials handling
- physical hazards
- confined spaces
- heights
- lifting

K8. Describe and evaluate the power requirements and electrical safety aspects of the installation plan
K9. Describe typical performance parameters and typical faults that may be encountered in client equipment and related connection and transmission media
K10. Identify various test equipment types suitable for tests to be made
K11. Identify warranty information for equipment supplies and contractor work guarantees.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to develop a project management plan. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- determine the project attributes and specifications
- prepare a coherent draft project management plan
- consult on and revise a project management plan
- document final project management plan and obtain sign off

0715-M&MT-159. Maintain business resources

Overview: This unit describes the skills and knowledge required to determine, administer and maintain resources and equipment to complete a variety of tasks. It applies to individuals who are skilled operators and apply a broad range of competencies in various work contexts. They may exercise discretion and judgment using appropriate theoretical knowledge of business resources and their basic maintenance to provide technical advice and support to a team.

Unit of Competency	Performance Criteria
1. Advise on resource requirements	P1 Calculate estimates of future and present business resource needs in accordance with organizational requirements P2 Ensure advice is clear, concise and relevant to achieve organizational requirements P3 Provide information on the most economical and effective choice of equipment, materials and suppliers P4 Identify resource shortages and possible impact on operations
2. Monitor resource usage and maintenance	P1 Ensure resource handling is in accordance with established organizational requirements including occupational health and safety requirements P2 Use business technology to monitor and identify the effective use of resources P3 Use consultation with individuals and teams to facilitate effective decision-making on the appropriate allocation of resources P4 Identify and adhere to relevant policies regarding resource use in the performance of operational tasks P5 Routinely monitor and compare resource usage with estimated requirements in budget plans
3. Acquire resources	P1. Ensure acquisition and storage of resources is in accordance with organizational requirements, is cost effective, and consistent with organizational timelines P2 Acquire resources within available timelines to meet identified requirements P3 Review resource acquisition processes to identify improvements in future resource acquisitions

Knowledge and 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. List the key provisions of relevant legislation

K2. Identify the organizational resource acquisition policies, plans and procedures

K3. Identify the organizational procedures for record keeping/filing systems, security and safe recording practices.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to maintain business resources. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- collect and record data on resource use
- observe resource use over defined and operational timeframes
- Perform routine resource maintenance.

0715-M&MT-160. Develop a sales plan

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

Unit of Competency	Performance Criteria
1. Identify organizational strategic direction	P1 Obtain and analyze assessment of market needs and strategic planning documents P2 Review previous sales performance and successful approaches to identify factors affecting performance P3 Analyze information on market needs, new opportunities, customer profiles and requirements as a basis for decision making
2. Establish performance targets	P1 Determine practical and achievable sales targets P2 Establish realistic time lines for achieving targets P3 Determine measures to allow for monitoring of performance P4 Ensure objectives of the sales plan and style of the campaign are consistent with organizational strategic objectives and corporate image
3. Develop a sales plan for a product	P1 Determine approaches to be used to meet sales objectives P2 Identify additional expertise requirements and allocate budgetary resources accordingly P3 Identify risks and develop risk controls P4 Develop advertising and promotional strategy for product P5 Identify appropriate distribution channels for product P6 Prepare a budget for the sales plan P7 Present documented sales plan to appropriate personnel for approval
4. Identify support requirements	P1 Identify and acquire staff resources to implement sales plan P2 Develop an appropriate selling approach P3 Train staff in the selling approach selected P4 Develop and assess staff knowledge of product to be sold
5. Monitor and review sales plan	P1 Monitor implementation of the sales plan P2 Record data measuring performance versus sales targets P3 Make adjustments to sales plan as required to ensure required results are obtained

Knowledge and 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. Outline principles and techniques for selling

K2. Outline methods for monitoring sales outcomes

K3. Explain the statistical techniques for analyzing sales and market trends

K4. Outline internal and external sources of information that are relevant to identifying organizational strategic direction and developing a product sales plan.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to develop a sales plan. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- analyze information from a range of sources to develop a sales plan for a product and sales territory that meets organizational strategic direction including:
    - resource requirements and budget
    - achievable sales targets
    - performance measures
    - approaches to be used to meet objectives
    - risk management
    - advertising and promotional strategy
    - product distribution channels
- acquire staff, develop selling approach and provide training support on product knowledge and sales approach
- Monitor and evaluate performance and adjust the plan as appropriate.

0715-M&MT-161. Plan and implement business-to-business marketing

Overview:

This unit describes the skills and knowledge required to plan and implement business-to-business (B2B) marketing. It applies to individuals who work in a supervisory capacity in a team environment, who possess a sound theoretical knowledge base and demonstrate a range of managerial skills to ensure business activities are conducted effectively. In this role, individuals may work in small, medium or large enterprises across a variety of industries.

Unit of Competency	Performance Criteria
1. Identify and evaluate business-to-business marketing strategies	P1 Identify B2B markets in an industry context P2 Research characteristics of business markets in an industry context P3 Identify and analyze factors influencing business buyers in an industry context P4 Analyze the business buying process and its implications in the industry context P5 Research and analyze a range of B2B marketing strategies appropriate for the organization P6 Identify key personnel in buying decision process in the organization s business markets
2. Select business-to-business marketing strategies	P1 Analyze trends within business markets and identify B2B marketing opportunities for the organization P2 Identify and analyze success of the organization s previous B2B marketing strategies P3 Select most appropriate B2B marketing strategies and activities that fit with the organization s strategic and marketing plans
3. Plan and develop business-to-business marketing activities	P1 Record B2B marketing objectives and purpose P2 Calculate costs of B2B marketing activities with assistance of appropriate personnel P3 Select methods to report and measure effectiveness of B2B marketing activities P4 Assign responsibilities to team members for B2B marketing activities P5 Record B2B marketing plan and present to relevant stakeholders P6 Assemble required resources to implement B2B marketing plan
4. Implement and monitor business-to-business marketing plan	P1 Schedule work on each B2B marketing campaign element, according to lead times required and marketing plan P2 Brief staff and suppliers on their budgets, timelines, roles and responsibilities, and legal and ethical requirements

	P3 Plan implementation of B2B marketing activities according to marketing plan P4 Identify and use evaluation criteria and evaluation methods to determine effectiveness of marketing plan P5 Analyze success indictors of B2B marketing plan and record performance according to organizational reporting requirements

Knowledge and 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. Summaries key provisions of relevant legislation, codes of practice and national standards affecting marketing operations

K2. Explain business buying processes

K3. Outline characteristics of business markets compared to consumer markets

K4. Summaries factors influencing business buyers

K5. Discuss a range of strategies for B2B marketing

K6. Describe trends in B2B marketing.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to Plan and implement business-to-business marketing. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- produce a business-to-business (B2B) marketing plan which includes:
    - marketing objectives and strategies
    - a detailed marketing budget
    - methods of measuring effectiveness
    - assigning responsibilities within a team
- Implement a B2B marketing plan.

0715-M&MT-162. Address customer needs

Overview:

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

Unit of Competency	Performance Criteria
1. Assist customer to articulate needs	P1 Ensure customer needs are fully explored, understood and agreed P2 Explain and match available services and products to customer needs P3 Identify and communicate rights and responsibilities of customers to the customer as appropriate
2. Satisfy complex customer needs	P1 Explain possibilities for meeting customer needs P2 Assist customers to evaluate service and/or product options to satisfy their needs P3 Determine and prioritize preferred actions P4 Identify potential areas of difficulty in customer service delivery and take appropriate actions in a positive manner
3. Manage networks to ensure customer needs are addressed	P1 Establish effective regular communication with customers P2 Establish, maintain and expand relevant networks to ensure appropriate referral of customers to products and services from within and outside the organization P3 Ensure procedures are in place to ensure that decisions about targeting of customer services are based on up-to-date information about the customer and the products and services available P4 Ensure procedures are put in place to ensure that referrals are based on the matching of the assessment of customer needs and availability of products and services P5 Maintain records of customer interaction in accordance with organizational procedures
4. Convert customer enquiries into sales	P1 use information provided by customers or accessed from the customer relationship management (CRM) system to identify any needs P2 identify suitable products/services to meet needs P3 make convincing sales pitches to customers following standard scripts

	P4 handle customer queries, objections and rebuttals following standard scripts P5 adapt your approach and style to customer preferences, within the limits of your competence and authority P6 refer issues outside your area of competence and authority to appropriate people, following your organization's procedures P7 identify and act on opportunities to up-sell or cross-sell other products/services to customers P8 confirm customer wishes and needs in order to close sales P9 obtain required financial information from customers, following your organization's procedures P10 complete your organization's post-sales procedures in order to complete/ fulfill sales P11 comply with relevant standards, policies, procedures and guidelines when converting customer enquiries into sales

Knowledge and 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 organizational procedures and standards for establishing and maintaining customer service relationships

K2. Describe informed consent

K3. Explain consumer rights and responsibilities

K4. Describe ways to establish effective regular communication with customers

K5. Outline details of products or services including with reference to:

- possible alternative products and services
- Variations within a limited product and service range.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to address customer needs. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- address customer s needs
- check your work is complete and free from errors
- use organizational procedures to document customer satisfaction
- develop and maintain networks to support meeting customer needs
- Identify potential difficulties in meeting customer needs and taking appropriate action.
- communicate effectively with customers including
    - helping customers to articulate their needs and evaluate options
    - explaining products/services and how they match customer needs
    - establishing regular communication
    - explaining customer rights and responsibilities

0715-M&MT-163. Manage personal finances

Overview:

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

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

Knowledge and Understanding

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

K1. Explain the abilities to plan and organize to keep records and monitor a personal budget

K2. Describe abilities to set and review goals

K3. Explain basic financial management and record keeping to enable development and management of a personal budget

K4. Describe benefits of financial goal setting and personal budgeting to enable effective management of personal finances

K5. Outline numeracy skills to compare income and expenditure

Critical Evidence(s) Required

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

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

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- develop a personal budget based on analysis of expenditure and income;
- formulate goals and identify financial contingency plans; and
- Monitor expenditure for a period of up to 2 weeks.

0715-M&MT-164. Solve problems which jeopardize safety and security

Overview:

This unit is concerned with complex negotiation in critical incidents and the development of strategic responses designed to resolve threatening incidents.

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

	of security in the least restrictive manner. P5 Complete reports accurately and clearly provided to the appropriate authority promptly P6 Review, evaluate and analyze the incident and the organizational response to it and report it promptly and accurately.
5. Provide leadership. direction and guidance to the work group	P1 Link between the function of the group and the goals of the organization P2 Participate in decision making routinely to develop, implement and review work of the group and to allocate responsibilities where appropriate P3 Give opportunities and encouragement to others to develop new and innovative work practices and strategies P4 Identify conflict and resolve with minimum disruption to work group function P5 Provide staff with the support and supervision necessary to perform work safely and without risk to health P6 Allocate tasks within the competence of staff and support with appropriate authority, autonomy and training P7 Supervise appropriately the changing priorities and situations and takes into account the different needs of individuals and the requirements of the task

Knowledge and 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 organization's policies, guidelines and procedures related to control and surveillance, safety and preventing and responding to incidents and breaches of orders covered in the range of variables.
- **K2.** Explain organization's management and accountability systems
- **K3.** Describe teamwork principles and strategies
- **K4.** Outline the principles of effective communication
- **K5.** Outline the guidelines for use of equipment and technology
- **K6.** Explain code of conduct

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to Resolve problems which jeopardize safety and security. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Evidence of the following is essential:

- evidence of effective communication strategies including negotiation, counseling, mediation, advocacy demonstrated under pressure working effectively in a team environment
- evidence of knowledge and application of organizations policies, procedures and
- guidelines for critical incidents
- evidence of accurate and safe use of all emergency equipment
- evidence of managing effective outcomes using strategic planning, team
- leadership and situational analysis

0715-M&MT-165. Coordinate a work team

Overview:

This unit is concerned with the competencies required to achieve operational outcomes and effective working relationships through managing and developing individuals and teams.

Unit of Competency	Performance Criteria
1. Develop and maintain a cooperative work group	P1 Work contributions and suggestions from staff are continually sought and encouraged P2 Contributions to work group operations are acknowledged and suggestions are dealt with constructively P3 Develop staff skills according to work requirements P4 Implement new work practices P5 Address conflict between staff members in accordance with current personnel practices.
2. Communicate objectives and required standards	P1 Inform the staff of the objectives and standards required P2 Commit to objectives and standards P3 Practices of safe, fair and participative work principals are and promote to staff
3. Provide feedback on performance	P1 Give constructive feedback on all aspects of work performance provided to individuals and team P2 Access and address performance in a fair and timely manner in accordance with relevant guidelines, procedures and natural justice
4. Support and participate in development activities	P1 Assess training needs of all staff, implemented and promoted P2 Devise an action plan to meet individual and group training and development needs is collaboratively developed, agreed to and implemented P3 Identify specific training needs of individuals P4 Encourage staff in applying skills and knowledge in the workplace P5 Provide training to the required standard on the job P6 Support and encourage staff to attend training courses and to take up other development opportunities.
5. Provide leadership. direction and guidance to the work group	P1 Link between the function of the group and the goals of the organization P2 Participate in decision making routinely to develop, implement and review work of the group and to allocate responsibilities where appropriate P3 Give opportunities and encouragement to others to develop new and innovative work practices and strategies

	P4 Identify conflict and resolve with minimum disruption to work group function P5 Provide staff with the support and supervision necessary to perform work safely and without risk to health P6 Allocate tasks within the competence of staff and support with appropriate authority, autonomy and training P7 Supervise appropriately the changing priorities and situations and takes into account the different needs of individuals and the requirements of the task

Knowledge and Understanding

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

K1. Explain the principles of effective team operation

K2. Explain the principles of human resource management

K3. Describe the training delivery processes in the workplace

K4. Outline the industry assessment guidelines

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to coordinate a work team. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Evidence of the following is essential:

- assessing and evaluating skills
- working effectively in a team environment
- achievement of work outcomes

0715-M&MT-166. Lead small teams

Overview:

This unit describes the outcomes required to lead small teams including setting and maintaining team and individual performance standards.

Unit of Competency	Performance Criteria
1. Facilitate team development	P1 Identify work requirements, standards and purpose to team members. P2 Assist team to develop objectives, targets and key performance indicators relevant its purpose and workplace goals. P3 Allocate duties regard to the skills required to properly undertake the assigned task and according to company policy P4 Identify roles, responsibilities and expectations of each team member P5 Disseminate and discuss performance expectations to individual team members.
2. Motivate and build the team	P1 Develop positive and constructive relationships with and between team members P2 Facilitate team communication processes P3 Involve team members in the process of examining risks and options and making decisions, to ensure acceptance and support. P4 Encourage individual and team efforts and contributions P5 Strengths and weaknesses of team members are determined and sharing of work tasks is promoted to up skill team members. 2.6 Recognize team members' queries and discuss and deal with it.
3. Facilitate and monitor team effectiveness	P1 Monitor the implementation of work plan and team and individual performance against agreed strategies, targets and standards, according to workplace policies and procedures. P2 Monitor performance against defined performance criteria and/or assignment instructions and corrective action taken if required. P3 Support team in identifying and resolving problems that may impede performance and to suggest improvements in team Performance. P4 Consult team members in any review and revision of team objectives and goals. P5 Address performance issues which cannot be rectified within the team to appropriate personnel according to employer policy. P6 Refer concerns of a team and individual are referred to next level of management or appropriate specialist and conduct negotiations on their behalf. P7 Keep team members inform of any changes in the priority allocated to assignments, or tasks which might impact on client/customer needs and satisfaction.

	P8 Monitor team operations to ensure that internal or external employer/client needs and requirements are met. P9 Provide follow-up communication on all issues affecting the team P10 Conduct team meetings to review work operations and address issues according to workplace policies and procedures. P11 Support team in identifying and resolving problems that may impede performance and to suggest improvements in team performance. P12 Consult team members in any review and revision of team objectives and goals. P13 Raise any inappropriate values and standards exhibited in the workplace with the person concerned.

Knowledge and 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 conflict resolution techniques

K2: Explain management styles

K3: Describe methods of monitoring performance

K4: Outline the relevant legal requirements

K5: Outline strategies for dealing effectively with team member complaints or grievances and

K6: Explain team dynamics and facilitation processes

K7: Describe communication skills

K8: State workplace policies and procedures

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to lead small teams. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Evidence of the following is essential:

- demonstrate the ability to build positive team spirit and effectively manage overall team
- performance within a workplace context;
- demonstrate the ability to coordinate a work team in a range of contexts or occasions; and

- Show knowledge of leadership, motivation and teamwork principles.

0715-M&MT-167. Plan and organize work

Overview:

This unit covers the outcomes required in planning and organizing work. It may be applied to a small independent operation or to a section of a large organization.

Unit of Competency	Performance Criteria
1. Set objectives and plan work activities	P1 Identify work objectives in consultation with supervisor and consistent with organizational aims. P2 Determine work activities, consistent with, and linked to objectives and broken down into steps in accordance with set time frames. P3 Establish work activity priorities and deadlines in consultation with others, as appropriate, optimizing the use of time and resources. P4 Identify your own and team responsibilities and levels of authority to ensure understanding of roles. P5 Assess resource implications of the work activities as appropriate consistent with workplace procedures.
2. Plan and schedule work activities	P1 Coordinate schedule of work activities with personnel concerned P2 Conduct work within established workplace policies and the business goals of the workplace. P3 Schedule work tasks
3. Implement work plans	P1 Identify work methods and practices in consultation with personnel concerned. P2 Implement work plans in accordance with set time frames, resources and standards.
4. Monitor work activities	P1 Monitor work activities and compare with set objectives. P2 Monitor work performance P3 Report and coordinate deviations from work activities with appropriate personnel and in accordance with set standards. P4 Compile reporting requirements with in accordance with recommended format. P5 Maintain files in accordance with standard operating procedures.
5. Review and evaluate work plans and activities	P1 Review work plans, strategies and implementation based on accurate, relevant and current information. P2 Base the review on comprehensive consultation with appropriate personnel on outcomes of work plans and reliable feedback. P3 Get the feedback to identify and develop ways to improve competence within available opportunities. P4 Provide results of review to concerned parties and formed as the basis for

	adjustments/simplifications to be made to policies, processes and activities. P5 Conduct performance appraisal in accordance with organization rules and regulations. P6 Prepare performance appraisal report and document it regularly as per organization requirements. P7 Prepare recommendations and present to appropriate personnel/authorities. P8 Implement feedback mechanisms in line with organization policies

Knowledge and 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 Communication skills:

- sharing information,
- listening and understanding,
- negotiation,
- facilitation and team collaboration

K1. Explain the ways of conducting team meetings

K2. List down motivation skills

K3. Outline the organization's strategic plan, policies rules and regulations, laws and objectives for work unit activities and priorities

K4. Outline organizations policies, strategic plans, guidelines related to the role of the work unit

K5. Explain team dynamics and facilitation processes

K6. Describe the following

- Organizing
- Planning
- Presentation skills
- Team work and consultation strategies

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to plan and organise work. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Evidence of the following is essential:

- implemented work plans;
- monitored work activities;
- planned and scheduled work activities;
- reviewed and evaluated work plans and activities; and
- Set objectives.

0715-M&MT-168. Develop teams and individuals

Overview:

This unit covers the skills, knowledge and attitudes required to determine individual and team development needs and facilitate the development of the workgroup.

Unit of Competency	Performance Criteria
1. Monitor and evaluate workplace learning	P1 Utilize feedback from individuals or teams to identify and implement improvements in future learning arrangements. P2 Assess and record outcomes and performance of individuals/teams to determine the effectiveness of development programs and the extent of additional support. P3 Negotiate modifications to learning plans to improve the efficiency and effectiveness of learning. P4 Maintain records and reports of competency within organizational requirement.
2. Develop team commitment and cooperation	P1 Use open communication processes to obtain and share information are used by team. P2 Reach onto decisions by the team in accordance with its agreed roles and responsibilities. P3 Develop mutual concern and camaraderie in the team.
3. Plan learning and development in the team	P1 Identify learning and development needs systematically in line with organizational requirements based on feedback on performance and self-evaluation. P2 Develop and implement learning plan to meet individual and group training and developmental needs P3 Encourage individuals to self -valuate performance and identify areas for improvement.
4. Select suitable learning method	P1 Identify learning and development program goals and objectives to match the specific knowledge and skills requirements of competency standards. P2 List down appropriately the learning delivery methods to the learning goals, the learning style of participants and availability of equipment and resources. P3 Identify resources and timelines required for learning activities are identified and approved in accordance with organizational requirements.
5. Facilitate accomplishment of organizational goals	P1 Participate in team activities and communication processes. P2 Develop individual and joint responsibility for their actions.

	P3 Sustain collaborative efforts are sustained to attain organizational goals.

Knowledge and 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 ability to relate to people from a range of social, cultural, physical and mental backgrounds

K2. Explain the career paths and competency standards in the industry

K3. List down coaching and mentoring principles

K4. Outline the communication skills including receiving feedback and reporting, maintaining effective relationships and conflict management

K5. Describe facilitation skills to conduct small group training sessions

K6. Explain methods and techniques for eliciting and interpreting feedback

K7. Describe the methods for identifying and prioritizing personal development opportunities and options

K8. Elaborate planning skills to organize required resources and equipment to meet learning needs

K9. Explain the ways of reporting skills to organize information; assess information for relevance and accuracy and elaborate on learning outcomes

K10. Explain the ways to improve and develop team

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to develop teams and individuals. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Evidence of the following is essential:

- accessed and designated learning opportunities;
- facilitated participation of individuals in the work of the team;
- gave and received feedback constructively;
- identified and implemented learning opportunities for others;
- negotiated learning plans to improve the effectiveness of learning; and
- Prepared learning plans to match skill needs.

0715-M&MT-169. Apply problem solving techniques in the workplace using critical thinking

Overview:

This competency covers the knowledge, skills and attitudes required to apply the process of problem solving for problems beyond those associated directly with the process unit.

Unit of Competency	Performance Criteria
1. Analyze the problem	P1 Evaluate issues/concerns are evaluated based on data gathered. P2 Identify possible causes of problem are identified within the area of responsibility as based on experience and the use of problem solving tools/analytical techniques. P3 Develop possible cause statements based on findings. P4 Use analogies to support reasoning. P5 Identify cause and effects are identified based on the criteria or information provided to support reasoning.
2. Identify possible solutions	P1 Consider all possible options for solution of the problem in accordance with safety and operating procedures. P2 Determine strengths and weaknesses of possible options P3 Take corrective action to solve the problem and determine its possible future causes. P4 Analyze past experience P5 Provide samples to support generalization. P6 Implement simulations as needed.
3. Recommend solution to higher management	P1 Prepare report or documentation P2 Present recommendations to appropriate personnel. P3 Follow up recommendations, if required.
4. Implement solution	P1 Identify measurable objectives P2 Identify resource needs P3 Prepare timelines in accordance with plan.
5. Evaluate/monitor results and outcome	P1 Identify processes and improvements based on evaluative assessment of problem. P2 Prepare recommendations and submit to superiors.

Knowledge and 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 Analytical skills and broad knowledge of diagnostic tools

K2. Explain broad knowledge of the client business domain

K3. Elaborate broad understanding of organizational systems and functions

K4. Outline communication skills according to the type of audience

K5. Describe the ways to develop critical thinking

K6. Explain methods and techniques for decision making within a limited range of options

K7. Describe general customer service skills

K8. Elaborate problem solving tools:

- cause/effect
- pare to
- multicriteria matrix etc.

K9. Explain the methods of questioning and active listening employed to clarify general information

K10. Explain the ways to improve teamwork in reference to personal responsibility

K11. Explain the ways time management and planning

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to develop teams and individuals. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Evidence of the following is essential:

- analyze the problem and its cause with a critical thinking approach;
- identify possible solutions and scenarios;
- implement solutions;
- make reasoning based on facts, constructive arguments, analogies;
- outcomes evaluated/monitored; and Recommend solutions to higher management.

0715-M&MT-170. Manage human resource services

Overview:

This unit describes the skills and knowledge required to plan, manage and evaluate delivery of human resource services, integrating business ethics. It applies to individuals with responsibility for coordinating a range of human resource services across an organization. They may have staff reporting to them.

Unit of Competency	Performance Criteria
1. Determine strategies for delivery of human resource services	P1 Analyze business strategy and operational plans to determine human resource requirements P2 Review external business environment and likely impact on organization's human resource requirements P3 Consult line and senior managers to identify human resource needs in their areas P4 Review organization's requirements for diversity in the workforce P5 Develop options for delivery of human resource services that comply with legislative requirements, organizational policies and business goals P6 Develop and agree on strategies and action plans for delivery of human resource services P7 Agree and document roles and responsibilities of human resource team, line managers, and external contractors
2. Manage the delivery of human resource services	P1 Develop and communicate information about human resource strategies and services to internal and external stakeholders P2 Develop and negotiate service agreements between the human resource team, service providers and client groups P3 Document and communicate service specifications, performance standards and timeframes P4 Document and communicate service specifications, performance standards and timeframes P5 Agree on, and arrange monitoring of quality assurance processes P6 Ensure that services are delivered by appropriate providers, according to service agreements and operational plans P7 Identify and rectify underperformance of human resource team or service providers P8 Identify appropriate return on investment of providing human resource services
3. Evaluate human resource service delivery	P1 Establish systems for gathering and storing information needed to provide human resource services P2 Survey clients to determine level of satisfaction

	P3 Analyze feedback and surveys and recommend changes to service delivery P4 Capture ongoing client feedback for the review processes P5 Obtain approvals to variations in service delivery from appropriate managers P6 Support agreed change processes across the organization
4. Manage integration of business ethics in human resource practices	P1 Ensure personal behavior is consistently ethical and reflects values of the organization P2 Ensure code of conduct is observed across the organization, and its expectations are incorporated in human resource policies and practices P3 Observe confidentiality requirements in dealing with all human resource information P4 Deal promptly with unethical behavior P5 Ensure all persons responsible for human resource functions understand requirements regarding their ethical behavior

Knowledge and 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. Identify the key provisions of legal and compliance requirements that apply to managing human resources

K2. Summarize the organization's code of conduct

K3. Explain human resource strategies and planning processes and their relationship to business and operational plans

K4. Describe performance and contract management

K5. Explain how feedback is used to modify the delivery of human resources.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to manage human resource services. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- plan and manage human resource delivery within legislative, organizational and business ethics frameworks

- communicate effectively with a range of senior personnel

- identify and arrange training support where appropriate

- Calculate human resource return on investment within the organization.

0715.21 Soft Skills

0715-M&MT-171. Develop workplace policy and procedures for sustainability

Overview: This unit describes the skills and knowledge required to develop and implement a workplace sustainability policy and to modify the policy to suit changed circumstances. It applies to individuals with managerial responsibilities who undertake work developing approaches to create, monitor and improve strategies and policies within workplaces and engage with a range of relevant stakeholders and specialists.

Unit of Competency	Performance Criteria
1. Develop workplace sustainability policy	P1 Define scope of sustainability policy P2 Gather information from a range of sources to plan and develop policy P3 Identify and consult stakeholders as a key component of the policy development process P4 Include appropriate strategies in policy at all stages of work for minimizing resource use, reducing toxic material and hazardous chemical use and employing life cycle management approaches P5 Make recommendations for policy options based on likely effectiveness, timeframes and cost P6 Develop policy that reflects the organization s commitment to sustainability as an integral part of business planning and as a business opportunity P7 Agree to appropriate methods of implementation, outcomes and performance indicators
2. Communicate workplace sustainability policy	P1 Promote workplace sustainability policy, including its expected outcome, to key stakeholders P2 Inform those involved in implementing the policy about expected outcomes, activities to be undertaken and assigned responsibilities
3. Implement workplace sustainability policy	P1 Develop and communicate procedures to help implement workplace sustainability policy P2 Implement strategies for continuous improvement in resource efficiency P3 Establish and assign responsibility for recording systems to track continuous improvements in sustainability approaches
4. Review workplace sustainability policy implementation	P1 Review workplace sustainability policy implementation P2 Investigate successes or otherwise of policy P3 Monitor records to identify trends that may require remedial action and

	use to promote continuous improvement of performance P4 Modify policy and or procedures as required to ensure improvements are made

Knowledge & Understanding

K1: outline the environmental or sustainability legislation, regulations and codes of practice applicable to the organization identify internal and external sources of information and explain how they can be used to plan and develop the organization s sustainability policy

K2: explain policy development processes and practices

K3: outline organizational systems and procedures that relate to sustainability

K4: outline typical barriers to implementing policies and procedures in an organization and possible strategies to address them. Assessment Conditions

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to Develop workplace policy and procedures for sustainability. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- scope and develop organizational policies and procedures that comply with legislative requirements and support the organization s sustainability goals covering at a minimum:
    - minimizing resource use
    - resource efficiency
    - reducing toxic material and hazardous chemical use
    - employing life cycle management approaches
    - continuous improvement
- plan and implement sustainability policy and procedures including:
    - agreed outcomes
    - performance indicators
    - activities to be undertaken
    - assigned responsibilities
    - record keeping, review and improvement processes

- consult and communicate with relevant stakeholders to generate engagement with sustainability policy development, implementation and continuous improvement

- Review and improve sustainability policies.

0715-M&MT-172. Manage meetings

Overview: This unit describes the skills and knowledge required to manage a range of meetings including overseeing the meeting preparation processes, chairing meetings, organizing the minutes and reporting meeting outcomes. It applies to individuals employed in a range of work environments who are required to organize and manage meetings within their workplace, including conducting or managing administrative tasks in providing agendas and meeting material. They may work as senior administrative staff or may be individuals with responsibility for conducting and chairing meetings in the workplace.

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

Knowledge & Understanding

K1: outline meeting terminology, structures, arrangements

K2: outline responsibilities of the chairperson and explain group dynamics in relation to managing meetings

K3: describe options for meetings including face-to-face, teleconferencing, web-conferencing and using webcams

K4: identify the relevant organizational procedures and policies regarding meetings, chairing and minutes including identifying organizational formats for minutes and agendas.

Critical Evidence(s) Required

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

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

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

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

0715-M&MT-173. Manage recruitment selection and induction processes

Overview: This unit describes the skills and knowledge required to manage all aspects of recruitment selection and induction processes in accordance with organizational policies and procedures. It applies to individuals or human resource personnel who take responsibility for managing aspects of selecting new staff and orientating those staff in their new positions. It is not assumed that the individual will be directly involved in the selection processes themselves, although this may well be the case.

Unit of Competency	Performance Criteria
1. Develop recruitment, selection and induction policies and procedures	P1 Analyze strategic and operational plans and policies to identify relevant policies and objectives P2 Develop recruitment, selection and induction policies and procedures and supporting documents P3 Review options for technology to improve efficiency and effectiveness of recruitment and selection process P4 Obtain support for policies and procedures from senior managers P5 Trial forms and documents supporting policies and procedures and make necessary adjustments P6 Communicate policies and procedures to relevant staff and provide training if required
2. Recruit and select staff	P1 Determine future human resource needs in collaboration with relevant managers and sections P2 Ensure current position descriptors and person specifications for vacancies are used by managers and others involved in recruitment, selection and induction processes P3 Provide access to training and other forms of support to all persons involved in recruitment and selection process P4 Ensure advertising of vacant positions complies with organizational policy and legal requirements P5 Utilize specialists where necessary P6 Ensure selection procedures are in accordance with organizational policy and legal requirements P7 Ensure processes for advising applicants of selection outcome are followed P8 Ensure job offers and contracts of employment are executed promptly, and new appointments are provided with advice about salary, terms and conditions

3. Manage staff induction	P1 Provide access to training and ongoing support for all persons engaged in staff induction P2 Check induction processes are followed across the organization P3 Oversee management of probationary employees and provide them with feedback until their employment is confirmed or terminated P4 Obtain feedback from participants and relevant managers on extent induction process is meeting its objectives P5 Make refinements to induction policies and procedures

Knowledge & Understanding

K1: describe recruitment and selection methods, including assessment centers

K2: explain the concept of outsourcing

K3: describe the purpose of employee contracts and industrial relations

K4: summarize relevant legislation, regulations, standards and codes of practice that may affect recruitment, selection and induction

K5: explain why terms and conditions of employment are an important aspect of recruitment

K6: explain the relevance of psychometric and skills testing programs to recruitment.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to manage recruitment selection and induction processes. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- develop or critically analyze a policy and procedures framework for recruitment, selection and induction
- identify the need for recruitment
- prepare and oversee appropriate documentation required for recruitment
- select and advise job applicants appropriately
- manage the induction process
- Comply with relevant legislation and organizational requirements.

0715-M&MT-174. Manage personal work priorities and professional development

Overview: This unit describes the skills and knowledge required to create systems and process to organize information and prioritize tasks. It applies to individuals working in managerial positions who have excellent organizational skills. The work ethic of individuals in this role has a significant impact on the work culture and patterns of behavior of others as managers at this level are role models in their work environment.

Unit of Competency	Performance Criteria
1. Establish personal work goals	P1 Serve as a positive role model in the workplace through personal work planning P2 Ensure personal work goals, plans and activities reflect the organization s plans, and own responsibilities and accountabilities P3 Measure and maintain personal performance in varying work conditions, work contexts and when contingencies occur
2. Set and meet own work priorities	P1 Take initiative to prioritize and facilitate competing demands to achieve personal, team and organizational goals and objectives P2 Use technology efficiently and effectively to manage work priorities and commitments P3 Maintain appropriate work-life balance, and ensure stress is effectively managed and health is attended to
3. Develop and maintain professional competence	P1 Assess personal knowledge and skills against competency standards to determine development needs, priorities and plans P2 Seek feedback from employees, clients and colleagues and use this feedback to identify and develop ways to improve competence P3 Identify, evaluate, select and use development opportunities suitable to personal learning style/s to develop competence P4 Participate in networks to enhance personal knowledge, skills and work relationships P5 Identify and develop new skills to achieve and maintain a competitive edge

Knowledge & Understanding

K1: explain principles and techniques involved in the management and organization of:

- performance measurement
- personal behavior, self-awareness and personality traits identification
- a personal development plan
- personal goal setting

- time

K2: discuss management development opportunities and options for self

K3: describe methods for achieving a healthy work-life balance

K4: outline organization s policies, plans and procedures

K5: explain types of learning style/s and how they relate to the individual

K6: describe types of work methods and practices that can improve personal performance.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to manage personal work priorities and professional development. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- use business technology to create and use systems and processes to organise and prioritise tasks and commitments
- measure and maintain personal work performance including assessing competency against competency standards and seeking feedback
- maintain an appropriate work-life balance to manage personal health and stress
- participate in networks
- develop a personal development plan which includes career objectives and an action plan
- Develop new skills.

0715-M&MT-175. Manage workforce planning

Overview: This unit describes the skills and knowledge required to manage planning in relation to an organization's workforce including researching requirements, developing objectives and strategies, implementing initiatives and monitoring and evaluating trends. It applies to individuals who are human resource managers or staff members with a role in a policy or planning unit that focuses on workforce planning.

Unit of Competency	Performance Criteria
1. Research workforce requirements	P1 Review current data on staff turnover and demographics P2 Assess factors that may affect workforce supply P3 Establish the organization's requirements for a skilled and diverse workforce
2. Develop workforce objectives and strategies	P1 Review organizational strategy and establish aligned objectives for modification or retention of the workforce P2 Consider strategies to address unacceptable staff turnover, if required P3 Define objectives to retain required skilled labor P4 Define objectives for workforce diversity and cross-cultural management P5 Define strategies to source skilled labor P6 Communicate objectives and rationale to relevant stakeholders P7 Obtain agreement and endorsement for objectives and establish targets P8 Develop contingency plans to cope with extreme situations
3. Implement initiatives to support workforce planning objectives	P1 Implement action to support agreed objectives for recruitment, training, redeployment and redundancy P2 Develop and implement strategies to assist workforce to deal with organizational change P3 Develop and implement strategies to assist in meeting the organization's workforce diversity goals P4 Implement succession planning system to ensure desirable workers are developed and retained P5 Implement programs to ensure workplace is an employer of choice
4. Monitor and evaluate workforce trends	P1 Review workforce plan against patterns in exiting employee and workforce changes P2 Monitor labor supply trends for areas of over- or under-supply in the external environment P3 Monitor effects of labor trends on demand for labor P4 Survey organizational climate to gauge worker satisfaction

	P5 Refine objectives and strategies in response to internal and external changes and make recommendations in response to global trends and incidents P6 Regularly review government policy on labor demand and supply P7 Evaluate effectiveness of change processes against agreed objectives

Knowledge & Understanding

K1: explain current information about external labor supply relevant to the specific industry or skill requirements of the organization

K2: outline industrial relations relevant to the specific industry

K3: describe labor force analysis and forecasting techniques

Critical Evidence(s) Required

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

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

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- review and interpret information from a range of internal and external sources to identify:
  - current staff turnover and demographics
  - labor supply trends factors that may affect workforce supply
  - organization's workforce requirements objectives and strategies
- manage workforce planning including developing, implementing, monitoring and reviewing strategies to meet workforce needs
- review relevant trends and supply and demand factors that will impact on an organization's workforce
- Develop a workforce plan that includes relevant research and specific strategies to ensure access to a skilled and diverse workforce.

0715-M&MT-176. Undertake project work

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

Unit of Competency	Performance Criteria
1. Define project	P1 Access project scope and other relevant documentation P2 Define project stakeholders P3 Seek clarification from delegating authority of issues related to project and project parameters P4 Identify limits of own responsibility and reporting requirements P5 Clarify relationship of project to other projects and to the organization's objectives P6 Determine and access available resources to undertake project
2. Develop project plan	P1 Develop project plan in line with the project parameters P2 Identify and access appropriate project management tools P3 Formulate risk management plan for project, including Work Health and Safety (WHS) P4 Develop and approve project budget P5 Consult team members and take their views into account in planning the project P6 Finalize project plan and gain necessary approvals to commence project according to documented plan
3. Administer and monitor project	P1 Take action to ensure project team members are clear about their responsibilities and the project requirements P2 Provide support for project team members, especially with regard to specific needs, to ensure that the quality of the expected outcomes of the project and documented time lines are met P3 Establish and maintain required recordkeeping systems throughout the project P4 Implement and monitor plans for managing project finances, resources and quality P5 Complete and forward project reports as required to stakeholders P6 Undertake risk management as required to ensure project outcomes are met P7 Achieve project deliverables
4. Finalize project	P1 Complete financial recordkeeping associated with project and check for accuracy P2 Ensure transition of staff involved in project to new roles or reassignment to previous roles P3 Complete project documentation and obtain necessary sign-offs for concluding project

Knowledge & Understanding

K1: give examples of project management tools and how they contribute to a project

K2: outline types of documents and other sources of information commonly used in defining the parameters of a project

K3: explain processes for identifying and managing risk in a project

K4: outline the organization's mission, goals, objectives and operations and how the project relates to them

K5: explain the organization's procedures and processes that are relevant to managing a project including:

- lines of authority and approvals
- quality assurance
- human resources
- budgets and finance
- recordkeeping
- reporting

Outline the legislative and regulatory context of the organization in relation to project work, including work health and safety (WHS) requirements**.**

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to undertake project work. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- define the parameters of the project including:
    - project scope
    - project stakeholders, including own responsibilities
    - relationship of project to organizational objectives and other projects
    - reporting requirements
    - resource requirements
- use project management tools to develop and implement a project plan including:
    - deliverables
    - work breakdown
    - budget and allocation of resources
    - timelines
    - risk management

- recordkeeping and reporting

- consult and communicate with relevant stakeholders to generate input and engagement in planning, implementing and reviewing the project

- provide support to team members to enable them to achieve deliverables and to transition them as appropriate at completion of the project

- finalize the project including documentation, sign-offs and reporting

Review and document the project outcomes.

0715-M&MT-177. Identify and communicate trends in career development

Overview: This unit describes the skills and knowledge required to conduct research to identify and communicate career trends. It establishes the need to interact professionally with others in assessing career needs, to effectively assist clients identify competencies they require for a career and employability in a given context. It also examines how to maintain quality of career development services and professional practice. It applies to individuals seeking to identify and communicate trends in career development.

Unit of Competency	Performance Criteria
1. Research and confirm career trends	P1 Apply knowledge of changing organizational structures, lifespan of careers and methods of conducting work search, recruitment and selection processes P2 Analyze changing worker and employer issues, rights and responsibilities in context of changing work practices P3 Examine importance of quality careers development services P4 Maintain all research, documentation, sources and references (electronic or physical) to a high degree of currency and relevance P5 Analyze implications of relevant policy, legislation, professional codes of practice and national standards relating to worker and employer issues P6 Research changes and trends in theory of career development counseling and practice P7 Confirm clusters, levels and combinations of transferable employability skills and preferences that may open employment options spanning more than one occupation or career pathway
2. Assess and confirm ongoing career development needs of target group	P1 Analyze history and records in assessing needs of target group P2 Assess success of previous career development services and techniques used for individual or target group P3 Deploy other means to investigate appropriate care and counseling approaches as required P4 Maintain privacy and security of all data, research and personal records according to relevant policy, legislation, professional codes of practice and national standards P5 Establish existing work-life balance requirements, issues and needs
3. Maintain quality of career development services and professional practice	P1 Analyze and review relevance of career theories, models, frameworks and research for target group P2 Incorporate into career development services and professional practice,

	major changes and trends influencing workplace and career-related options and choices P3 Comply with all relevant policy, legislation, professional codes of practice and national standards that influence delivery of career development services

Knowledge & Understanding

K1: explain client care and counseling techniques and processes in the context of career development services

K2: describe diversity and its potential effects on career choices

K3: outline human psychological development and needs in relation to careers development

K4: outline relevant policy, legislation, codes of practice and standards relevant to career development

K5: explain recruitment and selection processes in the context of career development services

K6: describe a range of data gathering and research techniques

K7: explain techniques used to analyze trends.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to identify and communicate trends in career development. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- research and analyze current economic, labor market, employment, career and vocational, educational and training trends
- identify choices and career development needs for individuals and target groups within a given context
- report and document management of research and career development materials
- Comply with all relevant local, state/territory and national legislation, policies and practices.

0715-M&MT-178. Apply specialist interpersonal and counseling interview skills

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

involves working with clients on personal and psychological issues within established policies, procedures and guidelines.

Unit of Competency	Performance Criteria
1. Communicate effectively	P1 Identify communication barriers and use strategies to overcome these barriers in the client-counselor relationship P2 Facilitate the client-counselor relationship through selection and use of micro skills P3 Integrate the principles of effective communication into work practices P4 Observe and respond to non-verbal communication cues P5 Consider and respond to the impacts of different communication techniques on the client-counselor relationship in the context of individual clients P6 Integrate case note taking with minimum distraction
2. Use specialized counseling interviewing skills	P1 Select and use communication skills according to the sequence of a counseling interview P2 Identify points at which specialized counseling interviewing skills are appropriate for inclusion P3 Use specialized counseling communication techniques based on their impacts and potential to enhance client development and growth P4 Identify and respond appropriately to strong client emotional reactions
3. Evaluate own communication	P1 Reflect on and evaluate own communication with clients P2 Recognize the effect of own values and beliefs on communication with clients P3 Identify and respond to the need for development of own skills and knowledge

Knowledge & Understanding

K1: legal and ethical considerations for communication in counseling practice, and how these are applied in individual practice:

- codes of conduct/practice
- discrimination
- duty of care
- human rights
- practitioner/client boundaries
- privacy, confidentiality and disclosure
- rights and responsibilities of workers, employers and clients
- work role boundaries responsibilities and limitations of the counselor role

- work health and safety

K2: principles of person-centered practice

K3: key objectives of counseling interviewing

K4: stages of a counseling interview

K5: potential impacts of using different communication skills and techniques in counseling contexts

K6: communication techniques and micro-skills including:

- attending behaviors active listening, reflection of content feeling, summarizing
- questioning skills open, closed, simple and compound questions
- client observation skills
- noting and reflecting skills
- providing client feedback

K7: specialized counseling communication techniques, and how they are used, including:

- challenging
- reframing
- focusing

K8: components of the communication process including:

- encoder
- decoder

K9: primary factors that impact on the communication process including:

- context
- participants
- rules
- messages
- channels
- noise
- feedback

K10: communication barriers and resolution strategies, including:

- environmental
- physical
- individual perceptions
- cultural issues
- language
- age issues
- disability

K11: observational techniques including:

- facial expressions

- non-verbal behavior
- posture
- silence

K12: ways in which different people absorb information, including:

- visual
- auditory
- kinesthetic

K13: obstacles to the counseling process

K14: impacts of trauma and stress on the communication process, including on:

- concentration and attention
- memory
- use of verbal and written language
- use of body language
- challenging within the counseling session

K15: self-evaluation practices, including:

- how to recognize own biases
- Impact of own values on the counseling relationship.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to apply specialist interpersonal and counseling interview skills. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- interviewed at least 3 different clients using specialized interpersonal communication and counseling interviewing skills, including:
- micro-skills and communication techniques, including:
    - attending behaviors active listening,
    - reflection of content, summarizing
    - questioning skills open, closed, simple and compound questions
    - client observation skills
    - noting and reflecting skills

- providing client feedback

- specialized counseling interviewing skills, including:

  - challenging

  - reframing

  - focusing

- integrated clear case note taking into the interview process

- Completed a structured process of self-reflection and evaluation of own communication used during the 3 interviews.

0715-M&MT-179. Work safely in an office environment

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

Unit of Competency	Performance Criteria
1. Work safely	P1 Follow established safety procedures when conducting work P2 Carry out pre-start systems and equipment checks in accordance with workplace procedures
2. Implement workplace safety requirements	P1 Identify designated persons for reporting queries and concerns about safety in the workplace P2 Identify existing and potential hazards in the workplace, report them to designated persons and record them in accordance with workplace procedures P3 Identify and implement workplace procedures and work instructions for controlling risks P4 Report emergency incidents and injuries to designated persons
3. Participate in OHS consultative processes	P1 Contribute to workplace meetings, inspections or other consultative activities P2 Raise OHS issues with designated persons in accordance with organizational procedures P3 Take actions to eliminate workplace hazards or to reduce risks
4. Follow safety procedures	P1 Identify and report emergency incidents P2 Follow organizational procedures for responding to emergency incidents

Knowledge & Understanding

K1: Explain responsibilities of employers and employees under relevant health and safety regulation

K2: describe emergency procedures including procedures for fires, accidents and evacuation

K3: outline commonly used hazard signs and safety symbols

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to participate in workplace OHS processes. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. The unit assessment must ensure the safety processes; hazards and risk are relevant to the area of work. Evidence of the following is essential:

- Accurately following all relevant safety procedures
- Identifying and reporting hazards to designated personnel
- Knowledge of relevant health and safety regulations
- Knowledge of relevant materials, equipment and work processes.

0715-M&MT-180. Develop workplace documents

Overview: This unit covers interpreting and composing a range of workplace documents from a number of sources. It includes interpreting written information for workplace purposes as well as planning, drafting and reviewing a basic document before writing the final version. The focus is on the content and structure of written materials and not on the use of computer technology

Unit of Competency	Performance Criteria
1. Interpret written information	P1 Read workplace materials to identify the subject and key information for using or reporting to others. P2 Read procedural manuals and codes of practice to locate specific information to carry out work functions in accordance with policy and standards. P3 Read a range of written materials to locate and select required information for summaries, short reports and responses to requests. P4 Identify the cultural context and prior knowledge required to interpret workplace information and obtain assistance when required. P5. Determine audience and purpose for the document P6 Seek assistance with interpretation of complex materials in accordance with organizational procedures.
2. Develop written materials	P1 Identify and comply with established requirements for a range of written materials in accordance with organizational procedures and standard templates. P2. Determine format and structure P3. Establish key points for inclusion P4. Identify organizational requirements P5. Establish method of communication P6. Establish means of communication
3. Draft document	P1 Develop draft document to communicate key points P2. Obtain and include any required additional information P3 Prepare written information in an accurate, concise and unambiguous manner that meets intended audience and organizational requirements.
4. Review document	P1 Check draft for suitability of tone for audience, purpose, format and communication style P2. Check draft for readability, grammar, spelling, sentence and paragraph construction and correct any inaccuracies or gaps in content. P3. Check draft for sequencing and structure

	P4. Check draft to ensure it meets organizational requirements P5. Ensure draft is proofread, where appropriate, by supervisor or colleague
5. Write final document	P1 Make and proofread necessary changes P2. Ensure document is sent to intended recipient within required time frames P3. File copy of document in accordance with organizational policies and procedures

Knowledge & Understanding

K1: Explain the reading and writing procedures at a level to cope with a range of workplace materials

K2: Explain the integration of information from a number of sources in order to generate meaning

K3: Describe the ways to write and sequence paragraphs according to the required purpose of written material

K4: Outline the linking ideas in written material through selection and use of words, grammatical structures, headings and punctuation appropriate to the purpose

K5: Elaborate spelling, punctuation and grammar for workplace documents at an experienced level

K6: Explain the response to diversity, including gender and disability

K7: Explain the implementation of ergonomic requirements for office work

K8: Explain the environmental policies such as those relating to paper use/wastage/recycling

K9: Describe the preparation of general information and papers according to target audience

K10: Elaborate the ways of proofreading and editing documents to ensure clarity of meaning and conformity to organizational requirements

K11: Describe the problem-solving skills to determine document design and production processes

K12: Explain the usage of resources to assist in document production, such as dictionary, thesaurus, templates, style sheets

K13: Describe the ways to produce business letters, memos, job applications, resumes, meeting agendas and minutes

K14: Explain the ways to fold and insert letters into a standard and window faced envelope.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to interpret written information for workplace purposes and plan, draft and review a basic document before writing the final version. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Evidence of the following is essential:

- Producing a range of documents that accurately convey required information including single and multipage business letters, memos, job applications, resumes, meeting agendas and minutes.

- Using formatting suitable for intended audience

- Knowledge of organizational policies and procedures for document production

0715-M&MT-181. Prepare and implement negotiation

Overview: This unit covers the skills, knowledge and attitudes required to prepare for and participate in a process of negotiation.

Unit of Competency	Performance Criteria
1. Prepare for the negotiation	P1 Identify objectives and preferred outcome of the negotiation and determine minimum acceptable outcome P2 Understand in relation to what can be offered and what is needed from the other party P3 Gather information regarding the other party – objectives, needs, preferences, resources, what they want to achieve - in order to determine best negotiating points P4 List and rank the issues to consider concessions that may be made. P5 Find examples and refine negotiation argument. P6 Check information to ensure it is correct and up-to-date. P7 Develop a negotiation plan that includes information about the other party and its interests and a set of responses and strategies to the anticipated tactics. P8 Prepare an agenda in advance, which includes discussion topics, participants, location and schedule
2. Participate in negotiations	P1 Analyze all aspects of the incident for degree of hazard, priorities, optional outcomes and appropriate strategies P2 Analyze and determine strategies and priorities on the incident sought from a range of sources P3 Assess long term objectives against resources and priorities P4 Apply a range of communication techniques to make and maintain contact with the key people P5 Provide clear and factual information to enable an honest and realistic assessment of the interests of the key people and their positions P6 Resolve the conflict and express their likely consequences clearly and do an analysis of the benefits P7 Reassess points of disagreements for common positive positions
3. Coordinate support services	P1 Assess the need for support services in terms of the determined strategies and priorities P2 Negotiate the resources of support services according to established procedures and availability

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

Knowledge & Understanding

K1: Explain organization's policies, guidelines and procedures related to control and surveillance, safety and preventing and responding to incidents and breaches of orders covered in the range of variables.

K2: Explain organization's management and accountability systems

K3: Describe teamwork principles and strategies

K4: Outline the principles of effective communication

K5: Outline the guidelines for use of equipment and technology

K6: Explain code of conduct

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to solve problems which jeopardize safety and security. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Evidence of the following is essential:

- evidence of effective communication strategies including negotiation, counseling, mediation, advocacy demonstrated under pressure working effectively in a team environment
- evidence of knowledge and application of organizations policies, procedures and
- guidelines for critical incidents
- evidence of accurate and safe use of all emergency equipment
- evidence of managing effective outcomes using strategic planning, team leadership and situational analysis

0715-M&MT-182. Maintain professionalism in the workplace

Overview: This unit of competency describes the outcomes required maintain a professional image in the workplace, including behaving ethically, demonstrating motivation, respecting timeframes and maintaining personal appearance.

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

Knowledge & Understanding

K1: Explain application of good manners and right conduct

K2: Explain basic practices for oral and personal hygiene

K3: Describe common products used for oral and personal hygiene

K4: Outline the company code of conduct/values

K5: Outline the Company regulations, performance and ethical standards

K6: Explain work responsibilities/job functions

K7: Describe communication skills

K8: State workplace hygiene standards

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to maintain professionalism in the workplace .The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Evidence of the following is essential:

- clarify and affirm work values/ethics/concepts consistently in the workplace;
- comply with required working times;
- conduct work practices satisfactorily and consistently, in compliance with work ethical standards, organizational policy and guidelines;
- Develop suitable hygiene

Keep adequate distance while interacting with colleagues and clients.

0715-M&MT-183. Maintain professional development and career professionalism

Overview: This unit describes the outcomes required to promote own learning career growth and advancement.

Unit of Competency	Performance Criteria
1. Identify own learning needs	P1 Identify earning needs through evaluation of existing skills and knowledge against job and career progression requirements. P2 Gather feedback and appraisal is gathered from supervisors, colleagues and clients and used to identify learning needs and skill gaps. P3 Give advice to relevant personnel regarding identified professional needs.
2. Motivate and build the team	P1 Sought opportunities are sought for undertaking skill-development activities and are planned in liaison with work group and relevant personnel. P2 Follow and apply advice on the job coaching/mentoring P3 Undertake formal training programs where available. P4 Utilize knowledge and skills gained through professional development activities in the workplace and for career development. P5 Collect constructive assessment and feedback on work performance from colleagues and supervisor to identify ongoing learning needs and opportunities.
3. Maintain professional growth and development	P1 Sought recognitions as evidence of career advancement. P2 Obtain licenses and/or certifications relevant to job and career P3 Lay down professional goals and strategies to develop the required skills and knowledge through professional development

Knowledge & Understanding

K1: Explain all possible learning and development tools: training, mentoring, coaching, networking, seminars, project assignments

K2: Explain education, qualification and certification systems in the country

K3: Describe fundamental rights at work including gender sensitivity

K4: Outline methodology to identify own learning needs and preferred learning style

K5: Elaborate methods of obtaining feedback

K6: Explain Range of options for undertaking personal skill development

K7: Describe Workplace policies and procedures

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to lead small teams. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Evidence of the following is essential:

- determine areas for skills and knowledge improvement;
- identify job skill and knowledge requirements; and

Seek and implement feedback on own learning needs

0715-M&MT-184. Organize schedules

Overview: This unit describes the skills and knowledge required to manage appointments and diaries for personnel within an organization, using manual and electronic diaries, schedules and other appointment systems. It applies to individuals employed in a range of work environments who provide administrative support to teams and individuals.

Unit of Competency	Performance Criteria
1. Establish schedule requirements	P1 Identify organizational requirements and protocols for diaries and staff planning tools P2 Identify organizational procedures for different types of appointments P3 Determine personal requirements for diary and schedule items for individual personnel P4 Establish appointment priorities and clarify in discussion with individual personnel
2. Manage schedules	P1 Identify recurring appointments and deadlines, and schedule these in accordance with individual and organizational requirements P2 Establish availability of attendees, and schedule new appointments in accordance with required timelines and diary commitments P3 Negotiate alternative arrangements and confirm when established appointments are changed P4 Record appointments and manage schedules in accordance with organizational policy and procedures

Knowledge & Understanding

K1: identify the key provisions of relevant legislation, standards and codes that affect aspects of business operations or the achievement of team goals

K2: describe organizational requirements for managing appointments for personnel within the organization

K3: summarize the range of appointment systems that could be used

K4: outline important considerations when managing the schedules of others.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to organize schedules. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- Appropriately manage the schedules of various individuals through a process of careful planning and negotiation.

0715.22 Digital Skills

0715-M&MT-185. Install computer operating systems and hardware

Overview: This unit describes the performance outcomes, skills and knowledge required to select, configure and use computer operating systems and basic computer hardware.

Unit of Competency	Performance Criteria
1. Identify operating system and hardware components	1.1 Determine ICT organizational requirements and specifications 1.2 Identify and select operating system 1.3 Identify appropriate external hardware components 1.4 Identify internal hardware components
2. Install and configure operating system and application software with hardware components	2.1 Install and configure operating system to meet organizational requirements 2.2 Identify the functions associated with the operating system and associated boot process 2.3 Configure power-management settings to minimize power consumption as an environmentally sustainable measure 2.4 Use both the graphical user interface and the command line interface to perform basic tasks 2.5 Install or upgrade application software onto the operating system and hardware configuration 2.6 Determine the relationship between an application program, the operating system and hardware 2.7 Identify general differences between the different computer platforms and their respective operating systems
3. Optimize operating system and hardware components	3.1 Optimize operating system using included tools or third-party utilities 3.2 Customize the graphical user interface 3.3 Use techniques unique to the command line interface 3.4 Set up and configure external hardware components and check functionality 3.5 Install drivers as appropriate and check functionality

Knowledge & Understanding

K1: Basic knowledge of current industry-accepted operating system, hardware and software products

K2: Compatibility of an operating system, in respect to other versions

K3: Function of single-user and multi-user operating systems

K4: Interoperability between operating systems

K5: OHS principles and responsibilities, including ergonomic principles to avoid injury associated with using computer systems.

Critical Evidence(s) Required

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

A person who demonstrates competency in this unit must be able to provide evidence of the ability to select, configure and use computer operating systems and basic computer hardware. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- Use an operating system in a variety of scenarios and across functions, including:
    - scheduling, loading, initiating, and supervising the execution of programs
    - allocating storage
    - initiating and controlling input and output operations
    - handling errors
- Identify and install suitable hardware components
- Install and upgrade application software.

0715-M&MT-186. Operate digital media technology

Overview: This unit describes the performance outcomes, skills and knowledge required to identify, select and use a digital media package and supporting technologies.

Unit of Competency	Performance Criteria
1. Use appropriate OHS office work practices	1.1 Use safe work practices to ensure ergonomic, work organization, energy and resource conservation requirements are addressed 1.2 Use wrist rests and document holders where appropriate 1.3 Use monitor anti-glare and radiation reduction screens where appropriate
2. Identify and select appropriate digital media package	2.1 Identify the basic requirements of a design brief, including user environment 2.2 Research and review suitable available digital media packages 2.3 Select an appropriate digital media package to meet design brief requirements
3. Use digital media package	3.1 Procure or create suitable data to meet requirements of the brief 3.2 Manipulate data using digital media package tools 3.3 Ensure naming and storing of documents in appropriate file format in directories or folders
4. Review digital media design	4.1 Evaluate design for creative, dramatic and technical quality, file size, and suitability to meet the brief 4.2 Test and run any incorporated graphics, video or sound as part of a digital media presentation and present designs in the appropriate format 4.3 Review final product against design brief

Knowledge & Understanding

K1: Basic principles of visual design

K2: Functions and features of digital media packages and technologies

K3: Graphic design and stylistic language conventions

K4: OHS principles and responsibilities for ergonomics, such as work periods and breaks

K5: Principles of digital imaging and file formats, video and sound file formats, file management and transfer systems

K6: Vendor product directions in digital media hardware and software

K7: Visualization and interpreting creative information, scripts (text) and images

Critical Evidence(s) Required

A person who demonstrates competency in this unit must be able to provide evidence of the ability to identify, select and use a digital media package and supporting technologies. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorised work practices, safety requirements and environmental constraints. Demonstrated evidence of the ability to:

- Identify basic requirements of a design brief
- Use digital media package to meet organizational requirements
- Use OHS principles and responsibilities for ergonomics, such as work periods and breaks
- Use help manuals and online help when appropriate
- Use digital media technologies to support design brief requirements.

0715-M&MT-187. Perform computer operations

Overview: This unit covers the knowledge, skills and attitudes and values needed to perform computer operations which include inputting, accessing, producing and transferring data using the appropriate hardware and software.

Unit of Competency	Performance Criteria
1. Plan and prepare for task to be undertaken	1.1 Requirements of task are determined as per standard operating procedures 1.2 Appropriate hardware and software is selected according to task assigned and required outcome 1.3 Task is planned to ensure
2. Input data into computer	2.1 Data are entered into the computer using appropriate program/application in accordance with company procedures 2.2 Accuracy of information is checked and information is saved in accordance with standard operating procedures 2.3 Inputted data are stored in storage media according to requirements 2.4 Work is performed within ergonomic guidelines
3. Access information using computer	3.1 Correct program/application is selected based on job requirements 3.2 Program/application containing the information required is accessed according to company procedures 3.3 Desktop icons are correctly selected, opened and closed for navigation purposes 3.4 Keyboard techniques are carried out in line with OH & S requirements for safe use of keyboards
4. Produce/output data using computer system	4.1 Entered data are processed using appropriate software commands 4.2 Data are printed out as required using computer hardware/peripheral devices in accordance with standard operating procedures 4.3 Files and data are transferred between compatible systems using computer software, hardware/ eripheral devices in accordance with standard operating procedures
5. Maintain computer equipment and systems	5.1 Systems for cleaning, minor maintenance and replacement of consumables are implemented 5.2 Procedures for ensuring security of data, including regular back-ups and virus checks are implemented in accordance with standard operating procedures

	5.3 Basic file maintenance procedures are implemented in line with the standard operating procedures

Knowledge & Understanding

K1: Basic ergonomics of keyboard and computer use

K2: Main types of computers and basic features of different operating systems

K3: Main parts of a computer

K4: Storage devices and basic categories of memory

K5: Relevant types of software

K6: General security

K7: Viruses

K8: OH & S principles and responsibilities

K9: Calculating computer capacity

Critical Evidence(s) Required

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

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- Selected and used hardware components correctly and according to the task requirement
- Identified and explain the functions of both hardware and software used, their general features and capabilities
- Produced accurate and complete data in accordance with the requirements
- Used appropriate devices and procedures to transfer files/data accurately
- Maintained computer system

0715-M&MT-188. Use computer applications

Overview: This unit describes the performance outcomes, skills and knowledge required to identify, select and operate three commercial software packages, including a word-processing, a spreadsheet and presentation application package.

Unit of Competency	Performance Criteria
1. Use appropriate OHS office work practices	1.1 Use safe work practices to ensure ergonomic, work organization, energy and resource conservation requirements are addressed 1.2 Use wrist rests and document holders where appropriate 1.3 Use monitor anti-glare and radiation reduction screens where appropriate
2. Install and remove software	2.1 Select software to be installed 2.2 Follow installation instructions 2.3 Delete unrequired software
3. Use appropriate word-processing software	3.1 Select word-processing software appropriate to perform activity 3.2 Identify document purpose, audience and presentation requirements, and clarify with personnel as required 3.3 Identify organizational requirements for text-based business documents and design document structure and layout to ensure consistency of style and image 3.4 Match document requirements with software functions to provide efficient production of documents 3.5 Use technical functions, other data and formatting to finalize documents 3.6 Ensure the naming and storing of documents in appropriate directories or folders and the printing of documents to the required specifications
4. Use appropriate spreadsheet software	4.1 Select spreadsheet software appropriate to perform activity 4.2 Identify document purpose, audience and presentation requirements, and clarify with personnel as required 4.3 Enter simple formulas and functions using cell referencing where required 4.4 Customize spreadsheet settings and format documents to meet requirements 4.5 Ensure the naming and storing of documents in appropriate directories or folders and the printing of documents to the required specifications
5. Use appropriate presentation software	5.1 Select software application package appropriate to perform activity 5.2 Identify purpose, audience and presentation requirements, and clarify

	with personnel as required 5.3 Use technical functions, other data and formatting to finalize documents 5.4 Ensure documents are named and stored in appropriate directories or folders and printed to required specifications 5.5 Make a presentation

Knowledge & Understanding

K1: Application software packages used by the organization

K2: Basic technical terminology related to reading help files and responding to system help prompts

K3: Basic knowledge of system usage

K4: Current business practices related to using software to prepare reports

K5: Features and functions of commercial computing packages

K6: Import and export software functions

K7: Linking documents

K8: OHS principles and responsibilities for ergonomics, such as work periods and breaks

K9: Purpose, use and functions of applications

K10: Use of input and output devices

K11: Functions and uses of word processing, spreadsheet and presentation software

Critical Evidence(s) Required

A person who demonstrates competency in this unit must be able to provide evidence of the ability to identify, select and operate three commercial software packages, including a word-processing and a spreadsheet application package. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Evidence of the ability to:

- Produce workplace documents using a minimum of three different software application packages
- Open, amend and save files and documents according to organizational requirements
- Use OHS principles and responsibilities for ergonomics, such as work periods and breaks
- Use help manuals and online help.

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- Use an operating system in a variety of scenarios and across functions, including:
    - scheduling, loading, initiating, and supervising the execution of programs
    - allocating storage

- initiating and controlling input and output operations

- handling errors

- Identify and install suitable hardware components

- Install and upgrade application software.

0715-M&MT-189. Create user documentation

Overview: This unit describes the performance outcomes, skills and knowledge required to create user documentation that is clear to the target audience and easy to navigate.

Unit of Competency	Performance Criteria
1. Determine documentation standards and requirements	1.1 Determine documentation requirements 1.2 Investigate documentation and industry standards for requirements and determine appropriate application to user documentation 1.3 Design documentation templates using appropriate software and obtain approval from appropriate person
2. Produce user documentation	2.1 Conduct a review of the subject system, program, network or application in order to understand its functionality 2.2 Gather existing technical, design or user specifications and supporting documentation 2.3 Create user documentation based on template to record the operation of the subject system, program, network or application
3. Review and obtain sign-off	3.1 Submit user documentation to target audience for review 3.2 Gather and analyze feedback 3.3 Make changes to user documentation 3.4 Submit user documentation to appropriate person for approval

Knowledge & Understanding

K1: Content features, including clarity and readability

K2: Document design, web design and usability

K3: Functions and features of templates and style guides

K4: Instructional design principles

Critical Evidence(s) Required

A person who demonstrates competency in this unit must be able to provide evidence of the ability to create user documentation that is clear to the target audience and easy to navigate. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to create user documentation that:

- Meets business requirements
- Caters for a diverse readership

- Is clear to the target audience

- Is easy to navigate.

0715-M&MT-190. Create technical documentation

Overview: This unit describes the performance outcomes, skills and knowledge required to create technical documentation that is clear to the target audience and easy to navigate.

Unit of Competency	Performance Criteria
1. Identify and analyze documentation requirements and client needs	1.1 Consult with client to identify documentation requirements 1.2 Interpret and evaluate documentation requirements and confirm details with client 1.3 Investigate industry and documentation standards for requirements 1.4 Define and document the scope of work to be produced 1.5 Consult with client to validate and confirm the scope of work
2. Design documentation	2.1 Identify information requirements with reference to layout and document structure 2.2 Create document templates and style guides consistent with information requirements 2.3 Conduct a review of the system in order to understand its functionality 2.4 Extract content that meets information requirements according to copyright restrictions 2.5 Develop the structure of the technical documentation giving focus to the flow of information, style, tone and content format 2.6 Validate the technical documentation structure with the client
3. Develop documentation	3.1 Write technical documentation based on the template and scope of work using the information gathered 3.2 Translate technical terminology into plain English where appropriate 3.3 Apply content format and style according to documentation standards and templates
4. Evaluate and edit documentation	4.1 Submit technical documentation to appropriate person for review 4.2 Gather and analyze feedback 4.3 Incorporate alterations into the technical documentation 4.4 Edit the technical documentation for technical and grammatical accuracy
5. Prepare documentation for publication	5.1 Check that the completed technical documentation meets client requirements and scope of work 5.2 Submit the technical documentation to appropriate person for approval 5.3 Prepare the technical documentation for publication and distribution using appropriate channels

Knowledge & Understanding

K1: Content features, such as clarity and readability

K2: Document design, web design and usability

K3: Functions and features of templates and style guides

K4: Instructional design principles

K5: Organizational policies, procedures and standards that cover document design.

Critical Evidence(s) Required

A person who demonstrates competency in this unit must be able to provide evidence of the ability to create technical documentation that is clear to the target audience and easy to navigate. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- Establish customer needs
- Design and develop technical documentation, such as system, procedures, training material and user guides, incorporating appropriate standards
- Update document with client feedback
- Prepare documentation for publication.

0715-M&MT-191. Create basic databases

Overview: This unit describes the skills and knowledge required to design, develop and test a database in order to meet a specification. It applies to individuals who may be either database, or web designers, required to create a simple database to store information for an online application, using a simple entity relational database.

Unit of Competency	Performance Criteria
1. Analyze the requirements for the database	1.1 Determine the information that the database is required to hold 1.2 Develop a written requirement report for the functionality of the database 1.3 Complete the documentation, and submit it to the appropriate person for approval
2. Use data modeling to design the database to suit requirements	2.1 Design an entity-relationship (ER) diagram to model the relationships between the entities and the attributes that the database will hold 2.2 Develop primary and foreign keys to link the entities 2.3 Develop a data dictionary 2.4 Complete the documentation, and submit it to the appropriate person for approval
3. Create a database on a web or database server	3.1 Use the appropriate language on a web or database server to create one or more databases 3.2 Use the appropriate language on a web or database server to create tables 3.3 Populate the database fields
4. Test the database and debug	4.1 Test the database on the web or database server 4.2 Ensure that the information represented matches the requirements

Knowledge & Understanding

K1: outline the principles of open platforms, including browsers and databases

K2: list the processes associated with the creation of entities, attributes, and I populating fields, using both software solutions and script- based input

K3: describe data-modeling techniques to design a database

K4: outline the steps in database design, modeling and implementation

K5: describe the internet operation related to web servers and clients

K6: identify the naming conventions appropriate to database design

K7: identify security restrictions on servers, incorporating some theoretical concepts

K8: describe best practice communication, and accessibility, for audiences with special needs.

Critical Evidence(s) Required

A person who demonstrates competency in this unit must be able to provide evidence of the ability to create technical documentation that is clear to the target audience and easy to navigate. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- research client requirements for a database solution
- design a database that meets client requirements
- create a database on a web hosting service or server to meet client requirements by a due date
- Test and debug the database.

0715-M&MT-192. Use social media tools for collaboration and engagement

Overview: This unit describes the performance outcomes, skills and knowledge required to establish a social networking presence using social media tools and applications. The unit specifically identifies the requirement to review, compare and use different types of social networking tools and applications.

Unit of Competency	Performance Criteria
1. Describe different types of social media tools and applications	1.1 Explain characteristics of the term social media 1.2 Identify different types of social-media tools and applications 1.3 Illustrate some of the issues associated with the use of social media tools and applications
2. Compare different types of social media tools and applications	2.1 Select one social media type for review 2.2 Review most popular tools and applications within that social media type 2.3 Itemize benefits across a range of the most popular tools and applications 2.4 Select most appropriate social media tool or application
3. Set up and use popular social media tools and applications	3.1 Identify social media tools and applications for possible implementation 3.2 Initiate preferred social media tools and applications for use 3.3 Establish social media interface using text and file content 3.4 Initiate social networking interaction 3.5 Test and evaluate tools and applications for ease of use 3.6 Present findings

Knowledge & Understanding

K1: Basic technical terminology in relation to social networking and social media applications and tools

K2: Basic knowledge of uploading images, text files, pdf files, audio files, video files and link associated files

K3: Features and functions of social media applications

K4: Import and export software functions

K5: Linking documents

K6: OHS principles and responsibilities for ergonomics, including work periods and breaks

K7: Tagging to facilitate collaborative folksonomy

K8: Social media applications and procedures for connecting to social networking sites

K9: Use of input and output devices

K10: Use of RSS feeds to connect a social network.

Critical Evidence(s) Required

A person who demonstrates competency in this unit must be able to provide evidence of the ability to create technical documentation that is clear to the target audience and easy to navigate. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- Establish customer needs
- Design and develop technical documentation, such as system, procedures, training material and user guides, incorporating appropriate standards
- Update document with client feedback
- Prepare documentation for publication.

0715-M&MT-193. E-Commerce- SEO (Search Engine Optimization)

Overview: The aim of this module is to develop efficient E-Marketing strategies in accordance with the Vision and Mission statement of the organization driven by Electronic means.

Unit of Competency	Performance Criteria
1. SEO (Search Engine Optimization)	1.1 Apply SEO techniques 1.2 Employ SEO key words 1.3 Demonstrate SEO techniques to priorities their site or web application using automated tools

Knowledge & Understanding

K1: Explain different SEO Methods including but not limited to Getting Indexed, Preventing Crawling, and Increasing Prominence.

K2: Elaborate White-hat, Black-hat SEO techniques for web application

K3: Knowledge of SEO key words for web pages translation.

K4: Application of SEO tools usage

Critical Evidence(s) Required

A person who demonstrates competency in this unit must be able to provide evidence of the ability to write and edit copy that is clear to the target audience and easy to navigate. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

0715-M&MT-194. E-Commerce- SCM (Supply Chain Management)

Overview: The aim of this module is to develop efficient E-Marketing strategies in accordance with the Vision and Mission statement of the organization driven by Electronic means.

Unit of Competency	Performance Criteria
1. SCM (Supply Chain Management)	1.1 Identity potential Suppliers 1.2 Select the appropriate supplier 1.3 Place order as per requirement/inventory 1.4 Inspect received order 1.5 Maintain Inventory as per Inventory Control / store keeping techniques 1.6 Identity different available transportation mode 1.7 Identify steps of reverse SCM i-e from consumer to organization

Knowledge & Understanding

K1: Elaborate knowledge of procurement Cycle (Launch of RFP/RFQ, Tender, Bidding, Comparative Statement, Award of Contract, Maintenance)

K2: Explain different techniques to manage

K3: Explain product delivery and their traceability

K4: Knowledge of Incorporation of Outsourcing in logistics.

K5: Information about electronic Data Interchange methodologies and format

Critical Evidence(s) Required

A person who demonstrates competency in this unit must be able to provide evidence of the ability to write and edit copy that is clear to the target audience and easy to navigate. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

0715-M&MT-195. E-Commerce- Social Media Marketing

Overview: The aim of this module is to develop efficient E-Marketing strategies in accordance with the Vision and Mission statement of the organization driven by Electronic means.

Unit of Competency	Performance Criteria
1. Social Media Marketing	1.1 Identify different Social media marketing techniques 1.2 Apply suitable Classified Advertisement techniques on social media 1.3 Perform Electronic Mail Marketing 1.4 Creation of Blogs

Knowledge & Understanding

K1: Describe Knowledge of different social media sites that is Facebook, Twitter, LinkedIn, Google+ etc., Comparative Statement, Award of Contract, Maintenance)

K2: Explain Brand pages creation on social media sites.

K3: Evaluate familiarity of banner ads integration on different web sites like newspaper site in any demographic region.

K4: Mention skills to regularly update brand/product/service blogs.K5: Information about electronic Data Interchange methodologies and format

K5: Elaborate direct marketing techniques e.g. Email, SMS (Mobile- Commerce) for the projection of company newsletters

Critical Evidence(s) Required

A person who demonstrates competency in this unit must be able to provide evidence of the ability to implement e-marketing strategies that is clear to the target audience and easy to navigate. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

0715-M&MT-196. Use digital devices

Overview: This unit describes the skills and knowledge required to use a range of digital devices, such as a digital camera, video camera, or personal digital assistant (PDA) device. It applies to individuals who require entry level information and communications technology (ICT) knowledge and literacy skills to support their work in a home office or small office environment.

Unit of Competency	Performance Criteria
1. Prepare to use the digital device	1.1 Review the instruction manual and ensure identified components are available 1.2 Identify the physical components of the digital device 1.3 Turn on and follow access procedures to activate the digital device 1.4 Alter the digital device settings to best suit intended use 1.5 Configure power management settings where appropriate to minimize power consumption, as an environmentally sustainable measure
2. Set up and use the digital device	2.1 Identify and set the basic operating, security and menu settings 2.2 Navigate and manipulate the screen environment 2.3 Customize screen icons and access to applications where applicable 2.4 Use the digital device, and save and edit output where applicable 2.5 Identify more advanced features available and use as required
3. Access and use basic connectivity devices	3.1 Connect to external digital devices, such as computer devices or storage devices, to retrieve, copy, move and save information 3.2 Check physical connectivity of computer devices or storage devices to ensure operation and performance 3.3 Connect to a printer either through a computer device or directly, and use printer settings and print data 3.4 Access audio-visual devices to view and play a multimedia file
4. Shut down digital device	4.1 Save current work and back up important data 4.2 Close open programs on the digital device and any computer device or storage device 4.3 Shut down digital devices, according to manufacturer instructions

Knowledge & Understanding

K1: outline the capabilities and connectivity requirements of relevant:

- audio-visual devices
- peripheral devices
- storage devices

K2: list basic security functions

K3: explain basic software operation and associated applications

K4: explain digital device functions

K5: explain digital device settings.

Critical Evidence(s) Required

A person who demonstrates competency in this unit must be able to provide evidence of the ability to use digital devices that is clear to the target audience and easy to navigate. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- turn on a digital device
- use the menu features and navigate a graphical user interface
- use device features to perform tasks
- Save the results of work.

0715-M&MT-197. Operate word-processing applications

Overview: This unit describes the skills and knowledge required to operate word- processing applications and perform basic operations, including creating and formatting documents, creating tables and printing labels. It applies to individuals in the workplace using fundamental knowledge of word-processing under direct supervision or with limited responsibility.

Unit of Competency	Performance Criteria
1. Apply workplace health and safety (WHS) practices	1.1 Use workplace ergonomic work practices and strategies 1.2 Organize work area to ensure an ergonomic work environment
2. Create documents	2.1 Open word-processing application, create document and add data according to information requirements 2.2 Use document templates as required 2.3 Use simple formatting tools when creating the document 2.4 Save document to directory
3. Customize basic settings to meet page layout conventions	3.1 Adjust page layout to meet information requirements 3.2 Open and view different toolbars 3.3 Change font format to suit document purpose 3.4 Change alignment and line spacing according to document information requirements 3.5 Modify margins to suit the document purpose 3.6 Open and switch between several documents
4. Format documents	4.1 Use formatting features and styles as required 4.2 Highlight and copy text from another area in the document or from another active document 4.3 Insert headers and footers to incorporate necessary data 4.4 Save document in another file format 4.5 Save and close document to a storage device
5. Create tables	5.1 Insert standard table into document 5.2 Change cells to meet information requirements 5.3 Insert and delete columns and rows as necessary 5.4 Use formatting tools according to style requirements
6. Add images	6.1 Insert appropriate images into document and customize as necessary 6.2 Position and resize images to meet document formatting needs
7. Print documents	7.1 Preview document in print preview mode 7.2 Select basic print settings 7.3 Print document or part of document from printer

Knowledge & Understanding

K1: describe formatting styles and their effect on formatting, readability and appearance of documents

K2: identify organizational requirements for ergonomics, including work periods and breaks

K3: select organizational style guide to use

K4: outline purpose, use and function of word-processing software.

Critical Evidence(s) Required

A person who demonstrates competency in this unit must be able to provide evidence of the ability to create word documents that is clear to the target audience and easy to navigate. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- follow organizational ergonomic work health and safety (WHS) requirements and practices
- create, open and retrieve documents using customized basic settings
- format documents by creating tables and adding text, objects and images
- Save and prints documents.

0715-M&MT-198. Operate spreadsheet applications

Overview: This unit describes the skills and knowledge required to operate word- processing applications and perform basic operations, including creating and formatting documents, creating tables and printing labels. It applies to individuals in the workplace using fundamental knowledge of word-processing under direct supervision or with limited responsibility.

Unit of Competency	Performance Criteria
1. Create presentations	1.1 Open presentation package and create a simple design for a presentation according to organizational requirements 1.2 Open blank presentation and add text and graphics 1.3 Apply existing styles within a presentation 1.4 Use presentation template and slides to create a presentation 1.5 Use various tools to improve the look of the presentation 1.6 Save presentation to the appropriate storage device and folder
2. Customize basic settings	2.1 Adjust display to meet user requirements 2.2 Open and view different toolbars to view options 2.3 Ensure font settings are appropriate for the presentation purpose 2.4 View multiple slides at once
3. Format presentations	3.1 Use and incorporate organizational charts and bulleted lists, and modify as required 3.2 Add objects and manipulate to meet presentation purposes 3.3 Import objects and modify for presentation purposes 3.4 Modify slide layout, including text and colors, to meet presentation requirements 3.5 Use formatting tools as required within the presentation 3.6 Duplicate slides within and across a presentation 3.7 Reorder sequence of slides and delete slides for presentation purposes 3.8 Save presentation in another format 3.9 Save to storage device and close presentation
4. Add slide show effects	4.1 Incorporate pre-set animation and multimedia effects into presentation as required to enhance the presentation 4.2 Add slide transition effects to presentation to ensure smooth progression through the presentation 4.3 Test presentation for overall effect 4.4 Use onscreen navigation tools to start and stop slide show or move between different slides as required

5. Print presentation and notes	5.1 Select appropriate print format for presentation 5.2 Select preferred slide orientation 5.3 Add notes and slide numbers 5.4 Preview slides and run spell check before presentation 5.5 Print selected slides and submit presentation to appropriate person for feedback

Knowledge & Understanding

K1: list basic technical terminology to read help files and prompts

K2: outline the different types of:

- formal and informal presentations
- audience

K3: explain the effect of design and formatting on the readability and usability of presentations

K4: outline presentation pitfalls

K5: identify suitable presentation effects for different audiences.

Critical Evidence(s) Required

A person who demonstrates competency in this unit must be able to provide evidence of the ability to presentations that is clear to the target audience and easy to navigate. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- create, format and prepare presentations for distribution and display
- customize basic settings
- Add slide show effects.

0715-M&MT-199. Operate presentation packages

Overview: This unit describes the skills and knowledge required to operate word- processing applications and perform basic operations, including creating and formatting documents, creating tables and printing labels. It applies to individuals in the workplace using fundamental knowledge of word-processing under direct supervision or with limited responsibility.

Unit of Competency	Performance Criteria
1. Create spreadsheets	1.1 Open the spreadsheet application, create spreadsheet files and enter numbers, text and symbols into cells according to information requirements 1.2 Enter simple formulas and functions using cell referencing when required 1.3 Correct formulas when error messages occur 1.4 Use a range of common tools during spreadsheet development 1.5 Edit columns and rows within the spreadsheet 1.6 Use the auto-fill function to increment data where required 1.7 Save the spreadsheet to a folder on a storage device
2. Customize basic settings	2.1 Adjust page layout to meet user requirements or special needs 2.2 Open and view different toolbars 2.3 Change font settings so they are appropriate for the document purpose 2.4 Change alignment options and line spacing according to spreadsheet formatting features 2.5 Format cell to display different styles as required 2.6 Modify margin sizes to suit the purpose of the spreadsheets 2.7 View multiple spreadsheets concurrently
3. Format spreadsheet	3.1 Use formatting features as required 3.2 Copy selected formatting features from another cell in the spreadsheet or from another active spreadsheet 3.3 Use formatting tools as required within the spreadsheet 3.4 Align information in a selected cell as required 3.5 Insert headers and footers using formatting features 3.6 Save spreadsheet as another file type 3.7 Save to storage device and close spreadsheet
4. Incorporate object and chart in spreadsheet	4.1 Import an object into an active spreadsheet 4.2 Manipulate imported object by using formatting features 4.3 Create a chart using selected data in the spreadsheet

	4.4 Display selected data in a different chart 4.5 Modify chart using formatting features

5. Print spreadsheet	5.1 Preview spreadsheet in print preview mode 5.2 Select basic printer options 5.3 Print spreadsheet or selected part of spreadsheet 5.4 Submit the spreadsheet to appropriate person for approval or feedback

Knowledge & Understanding

K1: list basic technical terminology related to reading help files and prompts

K2: explain the effect of formatting and appearance on the readability and usability of spreadsheets

K3: outline log-in procedures relating to accessing a personal computer (PC)

K4: describe the purpose, use and function of spreadsheet applications

Critical Evidence(s) Required

A person who demonstrates competency in this unit must be able to provide evidence of the ability to create technical documentation that is clear to the target audience and easy to navigate. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- create spreadsheets
- customize basic settings
- format spreadsheets
- create basic formulas
- insert objects and charts in spreadsheets
- Save and print spreadsheets.

0715-M&MT-200. Perform writing and editing tasks

Overview: This unit describes the skills and knowledge required to apply the conventions of plain English to writing and editing tasks of different forms. It also includes editing and proofreading techniques. It applies to individuals in various writing contexts who write and edit texts using appropriate language, style, grammar, spelling, and standard conventions for editing and proofreading.

Unit of Competency	Performance Criteria
1. Apply clear and appropriate language and style to writing and editing tasks	1.1 Use safe work practices including addressing ergonomic requirements when undertaking writing tasks 1.2 Use clear, concise and plain English in writing and editing tasks 1.3 Apply appropriate paragraph structure to written material to ensure clarity of meaning and ease of reading 1.4 Make clear and logical connections between sentences, paragraphs and sections 1.5 Determine and incorporate the language and style of the audience
2. Apply the appropriate voice, tone and tense	2.1 Determine appropriate voice, tone and tense of the written materials according to audience requirements 2.2 Maintain consistent voice, tone and tense throughout written material
3. Apply appropriate grammar, spelling and punctuation	3.1 Apply appropriate grammar conventions to a range of written contexts including use of numbers, quotations, and tables 3.2 Apply appropriate spelling and punctuation conventions in writing and editing tasks.
4. Perform editing and proofreading tasks to meet requirements	4.1 Edit written material to ensure clear meaning through language and paragraphs, consistent voice, tone and tense 4.2 Copyedit written material by checking grammar, spelling and punctuation using standard editing conventions 4.3 Proofreading using style guides and by monitoring written material for errors

Knowledge & Understanding

K1: main features of clear, concise and plain English language for written material

K2: grammar, punctuation and spelling conventions that meet the task requirements

K3: editing conventions used in substantive editing and copyediting of written material

K4: basic software used to write and collect feedback

Critical Evidence(s) Required

A person who demonstrates competency in this unit must be able to provide evidence of the ability to perform writing and editing tasks that is clear to the target audience and easy to navigate. The evidence should integrate employability skills with workplace tasks and job roles and verify competency is able to be transferred to other circumstances and environments.

Performance requirements

This competency is to be assessed using standard and authorized work practices, safety requirements and environmental constraints. Demonstrated evidence is required of the ability to:

- write and edit at least one written material (2500-4000 words) and edit another material written by another author (2500-4000 words), of different forms (e.g. blog, journal, book) that demonstrate use of:
    - clear and concise language
    - clear and logical paragraph structures
    - appropriate voice, tone, tense and language
    - plain English grammar, spelling and punctuation
    - accepted grammar conventions for a range of written contexts including use of numbers, quotation and tables
    - standard editing conventions
- complete editing and proofreading tasks using handwritten and digital methods
- accurately follow a style guide where required

follow relevant health and safety practices for writing tasks

Islamabad 31st May, 2019

NOTIFICATION

No. F. 5(13)/2018-DD (TE): In pursuance of sub-section (d) of section-6" Functions of the Commission" National Vocational & Technical Training Commission (NAVTTC) Act-2011, NAVTTC is pleased to approve and notify following qualifications in twenty (20) trades for Level 1-5 under National Vocational Qualification Framework (NVQF), which have been developed in compatibility with latest global trends in the fields and fulfilling requirements of competency based training and assessment (CBT&A) system. The qualifications have been developed and validated in collaboration with TEVTAs, QABs, industry and other relevant stakeholders: -

S#	National Vocational Qualifications
1.	National Qualification Level-5 diploma in Automobile Technology
2.	National Qualification Level-5 diploma in Civil Technology
3.	National Qualification Level-5 diploma in Construction Technology
4.	National Qualification Level-5 diploma in Information & Commutation Technology (ICT)
5.	National Qualification Level-5 diploma in Garment Manufacturing Technology
6.	National Qualification Level-5 diploma in Electrical Technology
7.	National Qualification Level-5 diploma in Electronics Technology
8.	National Qualification Level-5 diploma in Instrumentation Technology
9.	National Qualification Level-5 diploma in Computer Aided Design & Manufacturing (CAD /CAM)
10.	National Qualification Level-5 diploma in Mechanical Technology
11.	National Qualification Level-5 diploma in Graphics Designing
12.	National Qualification Level-5 diploma in Heating, Ventilation, Air-conditioning & Refrigeration (HVACR) Technology
13.	National Qualification Level-5 diploma in Media Production
14.	National Qualification Level-5 diploma in Hotel Management
15.	National Qualification Level-5 diploma in Professional Chef
16.	National Qualification Level-5 diploma in Tourism Management
17.	National Qualification Level-5 diploma in Hair & Beauty Services
18.	National Qualification Level-5 diploma in Fashion Designing
19.	National Qualification Level-5 diploma in Ceramics Technology
20.	National Qualification Level-5 diploma in Telecom Technology

2. All the TVET related institutions / organizations are required to implement aforementioned qualifications so that a uniform and standardized TVET qualification system is established in Pakistan and

efforts are made for international equivalence / recognition of these qualifications.

3. Competency Standards of the above enlisted qualifications can be accessed at NAVTTC's website **(www.navttc.org).**

(Muqeem Islam)
Director General (Skill Standards & Curricula)
Phone: 051-9215385

Distribution:

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4. Federal Secretary, Ministry of Textile Industry, Govt of Pakistan, Islamabad
5. Federal Secretary, Ministry of Commerce, Govt of Pakistan, Islamabad
6. Federal Secretary, Ministry of Railway, Govt of Pakistan, Islamabad
7. Federal Secretary, Ministry of Climate Change, Govt of Pakistan, Islamabad
8. Federal Secretary, Ministry of Religious Affairs, Govt of Pakistan, Islamabad
9. Federal Secretary, Ministry of Communication, Govt of Pakistan, Islamabad
10. Federal Secretary, Ministry of Aviation Division, Govt of Pakistan, Islamabad
11. Federal Secretary, Ministry of Science & Technology, Govt of Pakistan, Islamabad
12. Chairperson, Punjab Technical Education and Vocational Training Authority (P-TEVTA), Lahore
13. Managing Director, Khyber Pakhtunkhwa Technical Education and Vocational Training Authority (KP-TEVTA),
14. Managing Director, Sindh Technical Education and Vocational Training Authority (S-TEVTA), Karachi
15. Chairman, Azad Jammu & Kashmir, Technical Education and Vocational Training Authority (AJ&K TEVTA), Muzafarabad
16. Director TVET Cell, Gilgit Baltistan, Gilgit

17. Director General, Punjab Vocational Training Council (PVTC), Punjab
18. Managing Director, Technology Upgradation and Skill Development Company (TUSDEC) Lahore
19. Project Director, Punjab Skill Development Program (PSDP) Lahore
20. CEO, Punjab Skill Development Fund, Lahore
21. Rector, UNTECH University Islamabad
22. National Deputy Leader, GIZ Islamabad
23. PS to Minister of Federal Education & Professional Training, Govt of Pakistan
24. PS to Special Adviser to the Prime Minister on Youth Affairs, Prime Minister's Office, Islamabad
25. Chairperson, Federal of Pakistan Chamber of Commerce and Industry (FPCCI), Karachi
26. Conveyor, Sector Skills Council (Textile/ Construction/ Renewable Energy/ Hospitality and Tourism)
27. Director Technical Education and Vocational Training Authorities (TEVTA), Balochistan
28. Chairman, Pakistan Tourism Development Corporation, Lahore
29. Chairman, PCSIR Headquarters, Islamabad
30. Director General, Pakistan Forest Institute, Peshawar
31. Chairman, Wafaq ul Madaris, Multan
32. Director General, Staff Welfare, Islamabad
33. Director General, NISTE Capital Administration and Development Division, Islamabad
34. Director General, National Training Bureau, Islamabad
35. Chairmen, Provincial Technical Education Boards
36. Chairmen, Provincial Trade Testing Boards
37. Secretary, IBCC, Islamabad: with the request that National qualifications of Level 5 diploma in the aforementioned trades may be considered equivalent to Diploma of Associate Engineer/HSSC after inclusion of compulsory courses in the light of IBCC general requirement.

Copy for information to: -

1. DG (P&D)/(A&F)/ (A&C) (S&C) NAVTTC
2. Director General(s), NAVTTC Regional Office(s).

3. Sr. Technical Advisor, TSSP-GIZ