



**National Competency Standards Level-5 in Mechanical Technology with
Specialization in Construction Machinery**





ACKNOWLEDGEMENTS

National Vocational and Technical Training Commission (NAVTTTC) extends its gratitude and appreciation to many representatives of business, industry, academia, government agencies, Provincial TEVTAs, Sector Skill Councils and trade associations who spared their time and expertise to the development and validation of these National Vocational Qualifications (Competency Standards, Curricula, Assessments Packs and related material). This work would not have been possible without the financial and technical support of the TVET Sector Support Programme co-funded by European Union, Norwegian and German Governments implemented by GIZ Pakistan. NAVTTTC is especially indebted to *Dr. Muqem ul Islam*, who lead the project from the front. The core team was comprised on:

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NAVTTTC team under the leadership of Dr. Muqem 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, NAVTTTC, 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 happen in this challenging time.

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1. Introduction

Heavy Machine Operators and Technicians are in demand across the country and abroad. Their services are required for everything from road and bridge construction, back hoe operation, bulldozing, loading and grading, dredging and heavy paving, to excavating and much, much more. This is a good career opportunity for a reliable and responsible individual with a strong work ethic. Heavy Machine Operators and Technicians not only work on regular construction building jobs, but also on infrastructure projects (roads, bridges, Dams and ports, otherwise called non-building construction), and in mining and timber operations.

In order to build the capacity of technical and vocational training institutes in Pakistan through provision of demand driven competencies-based trainings in construction sector the NAVTTC, and TEVT Sector Support Program (TSSP) have joined hands together to develop qualifications for construction sector. These qualifications will not only build the capacity of existing workers of this sector but also support the youth to acquire skills best fit for this sector. The benefits and impact of development of these qualifications will be on both demand and supply side.

Based upon this demand of industry these competency-based qualifications for Heavy Construction Machinery technology are developed under National Vocational Qualification Framework (NVQF) (Level 5). The qualifications mainly cover competencies along with related knowledge and professional skills which are essential for getting a job or self-employed.

The National Vocational & Technical Training Commission (NAVTTTC) has approved the Qualification Development Committee (QDC). The QDC consists experts from the relevant industries from different geographical locations across Pakistan and academicians who were consulted during the development process to ensure input and ownership of all the stakeholders. The National Competency Standards could be used as a referral document for the development of curricula to be used by training institutions.

Heavy Machine Operator and Technician curriculum will prepare students to efficiently operate heavy machines such as Dozers, Loaders, Excavator and Graders and to perform basic preventive maintenance on most types of heavy equipment. Coursework includes Safety, Heavy Machines operations, grades, Legal & environmental concerns & equipment maintenance. Graduates of this program may find employment with state and local government agencies and private contractors engaged in highway or other construction activities.

In fact, no sphere of life may be identified that does not include the contribution of construction machinery. Thus, the importance of construction machinery 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 cognizant of this fact, National Vocational & Technical Training Commission (NAVTTTC) developed competency standards for Mechanical technology with Specialization in Construction Machinery 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 Construction, Real States & Builder industry of the country.

2. Purpose of the qualification

The purpose of these qualifications is to set high professional standards for Construction Machinery. The specific objectives of developing these qualifications are as under:



1. Improve the professional competence of the trainees
2. Provide opportunities for recognition of skills attained through non-formal or informal pathways
3. Improve the quality and effectiveness of training and assessment for Construction Machinery.
4. Enable the existing workforce to capacitate themselves in new technologies and method so that train persons in this field can maintain construction machinery for its longer life.

3. Summary of Competency Standards

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

Level-2

Workshop Practice-1 (MT-164)

Code	Competency Standards	Level	TH	PR	Total	Credits	Category
0716-MVS&A-01	Maintain Tools & Equipment.	3	8	22	30	3	Technical
0716-MVS&A-02	Apply technique of Hand and Power Tools	3	8	22	30	3	Technical
0716-MVS&A-03	Perform Metal/Bench Work	3	6	34	40	4	Technical
0716-MVS&A-04	Perform cutting on Metal Circular/Power Hack Saw	3	4	26	30	3	Technical
0716-MVS&A-05	Perform Grinding Operations	3	4	16	20	2	Technical
0716-MVS&A-06	Perform Tool & Cutter Grinding	5	4	16	20	2	Technical
0716-MVS&A-07	Perform Lathe Machine Operations	3	10	50	60	6	Technical
0716-MVS&A-08	Perform Shaper Machining Operations	3	6	34	40	4	Technical
0716-MVS&A-09	Perform CNC Lathe Operations	5	8	32	40	4	Technical
0716-MVS&A-10	Perform Pre-Welding Operations	3	8	22	30	3	Technical
0716-MVS&A-11	Perform Shielded Metal Arc Welding (SMAW)/Electric welding	3	8	22	30	3	Technical
0716-	Perform different welding	3	8	22	30	3	Technical



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MVS& A-12	joints						
0716-MVS& A-13	Perform Forging Operations	3	4	16	20	2	Technical

Engineering Drawing and CAD-I Mech-163

Code	Competency Standards	Level	TH	PR	Total	Credits	Category
0716-MVS& A-14	Perform Basic Manual Drawing	3	8	22	30	3	Allied
0716-MVS& A-15	Construct different Engineering Curves	5	8	22	30	3	Allied
0716-MVS& A-16	Construct multi-view drawings	5	6	34	40	4	Allied
0716-MVS& A-17	Install CAD software	3	4	16	20	2	Allied
0716-MVS& A-18	Manage display in CAD software	5	4	16	20	2	Allied
0716-MVS& A-19	Perform function of CAD general commands	5	8	32	40	4	Allied
0716-MVS& A-20	Perform Different CAD operations	5	8	32	40	4	Allied

Generic

Code	Competency Standards	Level	TH	PR	Total	Credits	Category
0716-MVS& A-21	Read and Develop Career Professionalism	1	2	8	10	1	Generic
0716-MVS& A-22	Apply basic Occupational Health & Safety regarding heavy machinery	1	2	8	10	1	Generic
0716-MVS& A-23	Perform general health, safety and environment practices	1	2	8	10	1	Generic
Total			138	532	670	67	

Level-3

Internal Combustion Engine (AD-133)

Code	Competency Standards	Level	TH	PR	TL	Credit	Category
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0716-MVS&A-24	Identify Engine Types Their Component and its Specifications	2	6	24	30	3	Technical
0716-MVS&A-25	Disassemble and assemble Engine Parts	4	6	24	30	3	Technical
0716-MVS&A-26	Maintain Engine Cooling System Components and Their Relationship	4	6	24	30	3	Technical
0716-MVS&A-27	Inspect Engine Lubrication System and working of its Components	4	6	24	30	3	Technical
0716-MVS&A-28	Locate Diesel Engine's Fuel System Components	2	6	24	30	3	Technical
0716-MVS&A-29	Maintain the Engine intake and Exhaust System Components	5	6	24	30	3	Technical
0716-MVS&A-30	Perform Overhauling of Four Stroke Engine	5	10	40	50	5	Technical

Automotive Electrics and Electronics (AD-143)

Code	Competency Standards	Level	TH	PR	TL	Credits	Category
0716-MVS&A-31	Perform Basic Electricity Measurements	2	8	32	40	4	Technical
0716-MVS&A-32	Identify The Electromagnetism And Its Application	2	8	32	40	4	Technical
0716-MVS&A-33	Perform Battery Service Of Vehicle	2	8	22	30	3	Technical
0716-MVS&A-34	Repair Engine Starting System	3	8	22	30	3	Technical
0716-MVS&A-35	Repair Battery Charging System	3	6	24	30	3	Technical
0716-MVS&A-36	Repair Spark Ignition System Of Internal Combustion Engine	3	8	32	40	4	Technical
0716-MVS&A-37	Adjust Ignition Timing of Spark Ignition Engine	3	8	32	40	4	Technical
0716-MVS&A-38	Repair Distributer-Less Ignition System	4	6	34	40	4	Technical
0716-MVS&A-39	Repair Lightning System of Vehicle	3	6	24	30	3	Technical



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A-39							
0716-MVS&A-40	Repair Cooling System And Vehicle Accessories	4	8	42	50	5	Technical
0716-MVS&A-41	Recognize Electrical System of vehicle	4	10	40	50	5	Technical

Generic

Code	Competency Standards	Level	TH	PR	TL	Credits	Category
0716-MVS&A-42	Participate In Workplace Communication		2	8	10	1	Generic
0716-MVS&A-43	Practice Occupational Health and Safety Procedures		2	8	10	1	Generic
0716-MVS&A-44	Perform Work In Team Environment		2	8	10	1	Generic
Total			136	544	680	68	

Level-4

Problems in Internal Combustion Engines AD-203

Code	Competency Standards	Level	TH	PR	TL	Credits	Category
0716-MVS&A-45	Diagnose and Adjust Engine Fault	5	8	22	30	3	Technical
0716-MVS&A-46	Diagnose and adjust faults of engine exhaust system	5	4	16	20	2	Technical
0716-MVS&A-47	Diagnose faults of engine cylinder head	5	6	24	30	3	Technical
0716-MVS&A-48	Diagnose faults of engine cylinder block	5	4	16	20	2	Technical
0716-MVS&A-49	Perform Complete Overhauling of Diesel Engine	5	6	44	50	5	Technical
0716-MVS&A-50	Diagnose Engine Cooling System Faults and Repair	5	8	22	30	3	Technical
0716-MVS&A-51	Diagnose Engine Lubrication System Faults and Repair	5	8	22	30	3	Technical
0716-MVS&A	Perform Testing of engine with the help of Work Bench	5	8	42	50	5	Technical



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Workshop Practice-II AD-224

Code	Competency Standards	Level	TH	PR	TL	Credits	Category
0716-MVS&A-53	Recognize types of Tools	2	6	24	30	3	Technical
0716-MVS&A-54	Identify Gauges	3	6	24	30	3	Technical
0716-MVS&A-55	Demonstrate Gas Analyzer	3	6	24	30	3	Technical
0716-MVS&A-56	Carry out operation of Head surface grinding machine	4	4	26	30	3	Technical
0716-MVS&A-57	Carry out operation of Honing Machine	4	4	26	30	3	Technical
0716-MVS&A-58	Carry out operation of Main line boring machine	4	4	26	30	3	Technical
0716-MVS&A-59	Carry out operation of Connecting Rod Boring Machine	4	4	26	30	3	Technical
0716-MVS&A-60	Carry out operation of Crankshaft grinding machine	4	4	26	30	3	Technical

Fuel System - I

Code	Competency Standards	Level	TH	PR	TL	Credits	Category
0716-MVS&A-61	Recognize Inline Fuel system	3	6	24	30	3	Technical
0716-MVS&A-62	Recognize PT (Pressure Time) Fuel System	3	6	24	30	3	Technical
0716-MVS&A-63	Recognize DPA (Distributor Pump Assembly) Fuel System	3	6	24	30	3	Technical
0716-MVS&A-64	Recognize CRI (Common Rail Injection) Fuel System	4	6	24	30	3	Technical
0716-MVS&A-65	Recognize MEUI (Mechanical Electrical Unit Injector) Fuel System	4	6	24	30	3	Technical
0716-MVS&A	Recognize HEUI (Hydraulic Electric Unit Injector) Fuel	4	6	24	30	3	Technical



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-66	System						
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Generic

Code	Competency Standards	Level	TH	PR	TL	Credits	Category
0716-MVS&A-67	Lead Small Teams	2	2	8	10	1	Generic
0716-MVS&A-68	Develop Negotiation Skills	2	2	8	10	1	Generic
0716-MVS&A-69	Solve Problems Related To Work Activities	2	2	8	10	1	Generic

Fuel System - II

Code	Competency Standards	Level	TH	PR	TL	Credits	Category
0716-MVS&A-70	Maintain Inline Fuel System	5	4	26	30	3	Technical
0716-MVS&A-71	Maintain PT (Pressure Time) Fuel System	5	4	26	30	3	Technical
0716-MVS&A-72	Maintain DPA (Distributor Pump Assembly) Fuel System	5	4	26	30	3	Technical
0716-MVS&A-73	Maintain CRI (Common Rail Injection) Fuel System	5	8	32	40	4	Technical
0716-MVS&A-74	Maintain MEUI (Mechanical Electrical Unit Injector) Fuel System	5	4	26	30	3	Technical
0716-MVS&A-75	Maintain HEUI (Hydraulic Electric Unit Injector) Fuel System	5	8	32	40	4	Technical

Thermodynamics

Code	Competency Standards	Level	TH	PR	TL	Credits	Category
0716-MVS&A-76	Analyze Thermodynamic Performance	4	8	12	20	2	Functional
0716-MVS&A-77	Solve Problems Related To Fundamentals of Thermodynamics	4	8	12	20	2	Functional
0716-MVS&A-78	Solve Problems of Laws And Properties of Perfect Gases	4	8	12	20	2	Functional



National Competency Standards Level-5 in Construction Machinery



0716-MVS&A-79	Derive Thermodynamics Processes and Cycles	4	8	22	30	3	Functional
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Operation of Construction Machinery

Code	Competency Standards	Level	TH	PR	TL	Credits	Category
0716-MVS&A-80	Identify Machines & its Attachments	4	4	16	20	2	Technical
0716-MVS&A-81	Maintain Machines (with Engine Off)	5	2	8	10	1	Technical
0716-MVS&A-82	Maintain Machines (with Engine Running)	4	2	8	10	1	Technical
0716-MVS&A-83	Perform Parking of Machines	3	2	8	10	1	Technical
0716-MVS&A-84	Perform Transportation of Machines	3	2	8	10	1	Technical
0716-MVS&A-85	Operate Excavator	4	6	34	40	4	Technical
0716-MVS&A-86	Conduct dump truck operations	3	6	14	20	2	Technical
0716-MVS&A-87	Operate Bulldozer	3	6	34	40	4	Technical
0716-MVS&A-88	Operate wheel Loader	3	6	34	40	4	Technical
0716-MVS&A-89	Operate Road Roller	3	6	34	40	4	Technical
0716-MVS&A-90	Operate a wheel-mounted loading crane	4	6	34	40	4	Technical
0716-MVS&A-91	Operate Motor Grader	4	6	34	40	4	Technical
0716-MVS&A-92	Conduct asphalt paver operations	5	6	24	30	3	Technical

Generic

Code	Competency Standards	Level	TH	PR	TL	Credits	Category
0716-MVS&	Develop Communication Skill		2	8	10	1	Generic



National Competency Standards Level-5 *in Construction Machinery*



A-93							
0716-MVS&A-94	Develop Administrative Skills		2	8	10	1	Generic
Total			260	1110	1370	137	

Level- 5

Power Generators (Gen Set)

Code	Competency Standards	Level	TH	PR	TL	Credits	Category
0716-MVS&A-95	Analyze parts of Generators	5	6	24	30	3	Functional
0716-MVS&A-96	Analyze Main Alternator	5	6	24	30	3	Functional
0716-MVS&A-97	Analyze Operation of Control Panel	5	6	24	30	3	Functional
0716-MVS&A-98	Perform Preventive Maintenance	3	6	24	30	3	Functional
0716-MVS&A-99	Carry out Trouble Shooting Guide	5	6	24	30	3	Functional
0716-MVS&A-100	Perform Safety Practices and Procedures of Gen Set	5	6	14	20	2	Functional

Steering and Brake System

Code	Competency Standards	Level	TH	PR	TL	Credits	Category
0716-MVS&A-101	Recognize steering & brake system of bulldozer	3	4	16	20	2	Technical
0716-MVS&A-102	Disassemble and assemble steering clutch of bulldozer	3	4	26	30	3	Technical
0716-MVS&A-103	Disassemble and assemble the steering control valve of bulldozer	3	4	16	20	2	Technical
0716-MVS&A-104	Test and adjust the steering and brake system of bulldozer	5	4	26	30	3	Technical
0716-MVS&A-105	Analyze hydrostatic steering system of Bulldozer	5	4	26	30	3	Technical
0716-MVS&A-106	Analyze steering system of wheeled machines	4	8	32	40	4	Technical



National Competency Standards Level-5 in Construction Machinery



0716-MVS&A-107	Test and adjust TOE-IN of motor grader	4	2	18	20	2	Technical
0716-MVS&A-108	Test and adjust of steering system of wheel loader	5	2	18	20	2	Technical
0716-MVS&A-109	Recognize hydro vacuum brake used in motor grader	4	4	16	20	2	Technical
0716-MVS&A-110	Analyze air brake system for wheeled vehicles	5	6	24	30	3	Technical

Hydraulic System

Code	Competency Standards	Level	TH	PR	TL	Credits	Category
0716-MVS&A-111	Demonstrate Hydraulic System	4	4	16	20	2	Technical
0716-MVS&A-112	Recognize components of Hydraulic System	3	4	16	20	2	Technical
0716-MVS&A-113	Draw Hydraulic Circuits (Schematics)	3	8	22	30	3	Technical
0716-MVS&A-114	Maintain Hydraulic Pump	4	6	24	30	3	Technical
0716-MVS&A-115	Recognize Hydraulic Tank	5	4	16	20	2	Technical
0716-MVS&A-116	Demonstrate components of Hydraulic Cylinder	4	4	16	20	2	Technical
0716-MVS&A-117	Maintain HSS (Hydro Static Steering) Pump And Motor	5	4	16	20	2	Technical
0716-MVS&A-118	Troubleshoot Hydraulic System	5	4	16	20	2	Technical

Planning and Management

Code	Competency Standards	Level	TH	PR	TL	Credits	Category
0716-MVS&A-119	Prepare CPM	5	6	14	20	2	Technical
0716-MVS&A-120	Calculate depreciation of Construction Machinery	5	6	14	20	2	Technical
0716-MVS&A	Calculate the cost of owning for Construction Machinery	5	6	14	20	2	Technical



National Competency Standards Level-5 *in Construction Machinery*



-121							
0716-MVS&A-122	Calculate the operation cost for Construction Machinery	5	6	14	20	2	Technical
0716-MVS&A-123	Determine the productivity of Construction Machinery	5	6	14	20	2	Technical
0716-MVS&A-124	Calculate the effect of grade on tractive effort of vehicles	5	4	6	10	1	Technical

Generic

Code	Competency Standards	Level	TH	PR	TL	Credits	Category
0716-MVS&A-125	Work effectively in a customer service/ sales environment		2	8	10	1	Generic
0716-MVS&A-126	Develop Professionalism		2	8	10	1	Generic

Transmission of Construction Machinery

Code	Competency Standards	Level	TH	PR	TL	Credits	Category
0716-MVS&A-127	Demonstrate main Clutches	4	6	24	30	3	Technical
0716-MVS&A-128	Perform Mechanical Transmission	4	6	24	30	3	Technical
0716-MVS&A-129	Demonstrate The Torque Converter	4	4	26	30	3	Technical
0716-MVS&A-130	Perform Different Tests Of Torque Converter	5	6	24	30	3	Technical
0716-MVS&A-131	Demonstrate Torque flow transmission	5	8	32	40	4	Technical
0716-MVS&A-132	Demonstrate control valve assembly of torque flow transmission	5	4	26	30	3	Technical
0716-MVS&A-133	Analyze hydro shift transmission	5	6	24	30	3	Technical
0716-MVS&A-134	Analyze Hydrostatic Transmission (HST)	5	8	22	30	3	Technical

Hydraulic Excavator



National Competency Standards Level-5 *in Construction Machinery*



Code	Competency Standards	Level	TH	PR	TL	Credits	Category
0716-MVS&A-135	Demonstrate Hydraulic Excavator	4	4	16	20	2	Technical
0716-MVS&A-136	Analyze Hydraulic Pump Of Excavator	5	8	32	40	4	Technical
0716-MVS&A-137	Maintain Control Valves Of Excavator	5	2	8	10	1	Technical
0716-MVS&A-138	Maintain Hydraulic Motors	5	8	32	40	4	Technical
0716-MVS&A-139	Analyze Hydraulic Cylinders	5	4	16	20	2	Technical
0716-MVS&A-140	Maintain Hydraulic Control Circuit	5	8	32	40	4	Technical
0716-MVS&A-141	Maintain Air Conditioning System	4	6	24	30	3	Technical
0716-MVS&A-142	Analyze Heating system	4	6	24	30	3	Technical
0716-MVS&A-143	Analyze Ventilation system	4	6	24	30	3	Technical

Final Drive, under Carriage and Power Line

Code	Competency Standards	Level	TH	PR	TL	Credits	Category
0716-MVS&A-144	Recognize The Power Train And Track Group Of Bulldozer	3	2	18	20	2	Technical
0716-MVS&A-145	Perform Inspection of Track Group	4	2	18	20	2	Technical
0716-MVS&A-146	Adjust The Track Chain Tension	4	2	18	20	2	Technical
0716-MVS&A-147	Disassemble And Assemble The Final Drive	3	2	18	20	2	Technical
0716-MVS&A-148	Recognize Cutaway & Differential Model Of A Wheeled Vehicle	5	4	16	20	2	Technical
0716-MVS&A-149	Disassemble & Assemble Inter-Axle Differential Assembly	5	2	18	20	2	Technical
0716-MVS&	Recognize structure and types of OFF Road Tires	3	6	14	20	2	Technical



A-150

Entrepreneur

Code	Competency Standards	Level	TH	PR	TL	Credits	Category
0716-MVS&A-151	Investigate micro business opportunities		4	6	10	1	Entrepreneur
0716-MVS&A-152	Develop a micro business proposal		4	6	10	1	Entrepreneur
0716-MVS&A-153	Develop a marketing plan		4	6	10	1	Entrepreneur
0716-MVS&A-154	Develop and review a business plan		4	6	10	1	Entrepreneur
0716-MVS&A-155	Organize finances for the micro business		4	6	10	1	Entrepreneur
0716-MVS&A-156	Manage human resources		4	6	10	1	Entrepreneur
0716-MVS&A-157	Market the products and services		4	6	10	1	Entrepreneur
0716-MVS&A-158	Monitor and review business performance		4	6	10	1	Entrepreneur
0716-MVS&A-159	Negotiate for resolving business issues		4	6	10	1	Entrepreneur
Total			310	1170	1480	148	

4. Date of validation

The level 5 of National DAE qualification on Construction Technology has been validated by the Qualifications Development Committee (QDC) members on and will remain in currency for 10 years until

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:



National Competency Standards Level-5 in Construction Machinery



ISCED Classification for DAE Construction Technology level-5

Code	Description
0716-MVS&A	1 st Level National Certificate of level-5, in “ Construction Technology”
0716-MVS&A	2 nd Level National Certificate of level-5, in “ Construction Technology”
0716-MVS&A	3 rd Level National Certificate of level-5, in “ Construction Technology”
0716-MVS&A	4 th Level National Certificate of level-5, in “ Construction Technology”
0716-MVS&A	5 th Level National Certificate of level-5, in “ Construction Technology”

6. Qualifications Development Committee

The following members participated in the qualifications development workshop 18th March 2019

To 22nd March 2019 at Grand Palm Hotel, Lahore:

S.No.	Name & Designation	Organization
1.	Muhammad Ishaq, Dy Director (TE)	NAVTTC, HQ
2.	Muzammal Hussain, Instructor (Auto & Diesel)	GCT, Rawalpindi, TEVTA
3.	Muhammad Ejaz, HOD, Mechanical Department	C.T.T.I, Islamabad
4.	Hassan Raza, Jr. Instructor	C.T.T.I, Islamabad
5.	Umer Farooq, Instructor, Mechanical	G.S.P.C.T Gujrat
6.	Muhammad Rizwan Sarwar, Sr. Instructor (Auto Mechanic)	G.T.T.I, Shiekhupura
7.	Hafiz Ghulam Mohyudin, Asst. Manager Services	Dynamic Equipment & Control, Lahore
8.	Mehr Ali Qureshi, Sr. Service Engineer	Murshid Builders (PVT) Limited, Lahore
9.	Syed Hussein-el-Edroos, Sr. Service Engineer	Independent Consultant
10.	Waqar Ahmed, Service Manager	Jaffer Brothers (PVT) Limited, Lahore
11.	Ghulam Dastgir, Incharge Projects	Ex-DESCON Engineering, Lahore
12.	Zain-ul-Abideen, Instructor	G.T.T.I, Mughalpura, Lahore
13.	Atif Waheed Abbasi, Heavy Machine Operator	National Logistic Cell Mandra, Islamabad
14.	Sikander Mehmood Jr. Instructor	C.T.T.I, Islamabad
15.	Engr. Mohsin Jahanzeb Instructor	GSTC, Faisalabad
16.	Muhammad Amjad Iqbal Service Engineer	Greaves Pakistan Ltd, Lahore
17.	Sayed Fayyaz Mustafa Naqvi J. Instructor Civil	GSTC, Faisalabad



18.	Saba Sadiq , MS Mechanical Engineer/ DACUM Facilitator,	University of Lahore, Lahore
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7. Qualifications Validation Committee

The following members participated in the qualifications development and validation workshop on:

S.No.	Name & Designation	Organization
1.	Mr. Muhammad Ejaz	HOD, CTTI, Islamabad
2.	Mr. Hassan Raza	Instructor, CTTI, Islamabad
3.	Mr. Muzammal Hussain	Instructor(Auto & Diesel) , GCT, Rawalpindi
4.	Mr. Sikandar Masood	Director, NAVTTC, Islamabad
5.	Mr. Abdur Rehman	Representative from PBTE, Lahore
6.	Mr.Zafar Iqbal	Representative from KP-TEVTA
7.	Mr. Rafique Ahmed Shaikh	Representative from Singh-TEVTA
8.	Mr. Naveed Ahmed Ajmal	Representative from P-TEVTA
9.	Mr. Irfan Khalil	Representative from Sector Skill Council/ ABAD Karachi
10.	Saba Sadiq	DACUM, Facilitator, Lahore (UOL)

8. Entry Requirements

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

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



9. Packaging of Qualifications

The National Vocational Qualifications have been packaged as detailed below:

Level	Name of Occupation/Nomenclature	Generic Competencies	Allied competencies require	Core /Technical Competencies required
1. Diesel Engine Technician				
Level-2	Pro Diesel Mechanic	150,151,152,153,154		1,2,3,4,5,6,7
Level-3	Engine Rebuilder	150,151,152,153,154		44,45,46,47,48,49,50,51,52
Level-3	Generator Technician	150,151,152,153,154		61,62,63,64,65,66
Level-3	Engine Technician	149,150,151,152,153,154		53,54,55,56,57,58,59,60
Level-3	Pro Technician Diesel Pump	149,150,151,152,153,154		67,68,69,70,71,72
Level-4	Diesel Pump Technician	140,141,142,143,144,145,146,147,148,149,150,151,152,153,154		128,129,130,131,132,133
Level-4	CNC Machine operator	150,151,152,153,154		15,16,17,18,19,20,21,22,23,24,25,26,27
Level-4	Thermo Man	150,151,152,153,154		39,40,41,42,43
2. Electrician				
Level-2	Auto Electrician	150,151,152,153,154		28,29,30,31,32,33,34,35,36,37,38
3. Engineering Drawing				
Level-3	Draft Man	152,153,154		8,9,10,11,12,13,14
4. Heavy Machine Operator				
Level-3	Excavator Operator	149,150,151,152,153,154		73,74,75,76,77,78
Level-3	Bulldozer Operator	149,150,151,152,153,154		73,74,75,76,77,80
Level-3	Dump truck Operator	149,150,151,152,153,154		73,74,75,76,77,79
Level-3	Wheel Loader Operator	149,150,151,152,153,154		73,74,75,76,77,81
Level-3	Wheel Mounted Loading Crane Operator	149,150,151,152,153,154		73,74,75,76,77,83
Level-4	Master operator(Excavator, Bulldozer, Dump truck, Wheel Loader, Grader, Crane and asphalt	149,150,151,152,153,154,155		73,74,75,76,77,78,79,80,81,82,83,84,85



National Competency Standards Level-5 *in Construction Machinery*



paver)			
5. Heavy Machinery Mechanic			
Level-5	Construction Machinery Transmission Technician	149, 150,151,152,153,154	86,87,88,89,90,91,92,93
Level-5	Steering and Brake Mechanic of Construction Machinery	149, 150,151,152,153,154	94,95,96,97,98,99,100,101,102,103
level-5	Under Carriage Mechanic of Construction Machinery	149, 150,151,152,153,154	104,105,106,107,108,109,110
Level-5	Hydraulic Mechanic of Construction Machinery	149, 150,151,152,153,154	111,112,113,114,115,116,117,118
Level-5	Hydraulic Excavator Mechanic of Construction Machinery	140,141,142,143,144,145,146,147,148,149, 150,151,152,153,154	119,120,121,122,123,124,125,126,127
Level-5	Construction field Manager	140,141,142,143,144,145,146,147,148,149, 150,151,152,153,154	134,135,136,137,138,139



10. Detail of Competency Standards

Workshop Practice-I

0716-MVS&A-01: Maintain Tools & Equipment.

Overview: This competency standard covers the skills and knowledge required to Arrange Tools and Equipment, Maintain Tool Box, Insulate Tools and Equipment Calibrate measuring tools and Manage Inventory of tools and equipment.

Competency Units	Performance Criteria
CU1. Arrange Tools and Equipment	<ul style="list-style-type: none">P1. Identify tools and equipmentP2. Interpret job cardP3. Prepare list of tools and equipment as per requirementP4. Collect tools and equipment from store
CU2. Maintain Toolbox	<ul style="list-style-type: none">P1. Check physical conditions of tools and equipment before useP2. Perform preventive maintenance as per standardsP3. Perform corrective maintenance of tools as per requirements.P4. Clean tools and equipment after useP5. Place tools and equipment at appropriate place.
CU3. Insulate Tools and Equipment	<ul style="list-style-type: none">P1. Select insulated tools and equipmentP2. Adopt insulated tools and equipment as per standards
CU4. Calibrate measuring tools	<ul style="list-style-type: none">P1. Check calibration status of the measuring toolsP2. Perform calibration of measuring tools as per standardsP3. Record calibration test results
CU5. Manage Inventory of tools and equipment	<ul style="list-style-type: none">P1. Check tools and equipment as per recordP2. Report for faulty tools and equipment to supervisorP3. Generate demand for deficit tools and equipmentP4. Maintain all records of tools and Equipment

Knowledge & Understanding

K1. Describe basic measurement



National Competency Standards Level-5 *in Construction Machinery*



- 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.** Define Marking tools.
- K6.** Describe the safety procedure using marking tools.
- K7.** Describe different type of measuring tools.
- K8.** Describe Proper Usage of Measuring Tools
- K9.** Describe maintenance and its types.
- K10.** Describe the safety procedure during maintenance.



0716-MVS&A-02: Apply technique of Hand and Power Tools

Overview: This competency standard covers the skills and knowledge required to determine job requirements, sequence of operations and apply technique of hand and power tool.

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



principles and techniques.

- P6.** Store power tools safely in appropriate location according to standard operational procedures and manufacturers' recommendations.

Knowledge & Understanding

- K1.** Applications of different hand and power tools.
- 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

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 and Pin grinder.



0716-MVS&A-03: Perform Metal/Bench Work

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

Competency Units	Performance Criteria
CU1. Develop Name Plate manually	<p>P1. Select marking tools</p> <p>P2. Hold the sheet in vice.</p> <p>P3. Cut sheet as per drawing</p> <p>P4. Perform surface finishing with file</p> <p>P5. Level the surface with tri-square</p> <p>P6. Mark the plate as per name requirements</p> <p>P7. Punch the marked area</p> <p>P8. Perform finishing with sand paper</p>
CU2. Prepare Dovetail Joint	<p>P1. Select marking tools</p> <p>P2. Cut sheet as per drawing</p> <p>P3. Perform surface finishing with file</p> <p>P4. Level the surface of both work pieces with tri-square</p> <p>P5. Mark both work pieces according to drawing</p> <p>P6. Create outer notch on work piece using flat file and hacksaw</p> <p>P7. Create inner notch using hacksaw and chisel</p> <p>P8. Compare both pieces by inserting outer notch into inner notch.</p> <p>P9. Perform finishing with sandpaper</p>
CU3. Cut Threads on Work Piece with tap and die	<p>P1. Identify different kind of taps & die according to requirement</p> <p>P2. Identify the work piece clamping method.</p> <p>P3. Apply tap and die alignment.</p> <p>P4. Apply lubricants while threading.</p> <p>P5. Avoid unwanted engraving and slips.</p> <p>P6. Use proper threading procedure</p>
CU4. Cut Pipe Threads	<p>P1. Select marking tools</p> <p>P2. Cut pipe as per drawing</p>



	<p>P3. Select die as per pipe size</p> <p>P5. Set die into die holder</p> <p>P6. Select relevant vice for pipe clamping</p> <p>P7. Perform pipe threading using appropriate method</p> <p>P8. Perform finishing with sand paper</p>
CU5. Prepare Funnel	<p>P1. Select marking tools</p> <p>P2. Cut sheet as per drawing</p> <p>P3. Perform surface finishing with file</p> <p>P5. Mark the sheet according to drawing</p> <p>P6. Cut the sheet with hand shear</p> <p>P7. Create radius of funnel using appropriate tools</p> <p>P8. Perform flat lock seam bend using bench vice</p> <p>P9. Perform finishing with sand paper.</p>

Knowledge & Understanding

- K1.** Applications of different hand tools.
- K2.** Common faults and/or defects in hand tools.
- K3.** Describe cutting tools.

Tools and Equipment

Punching tools, Work bench, Bench vice, Pipe vice, Tri-square, Vernier calliper, Hammer, Die handle, Lubricant, Scriber, Flat File, Round file, Hand shear



0716-MVS&A-04: Perform cutting on Metal using Circular/Power Heck Saw

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

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

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.

Tools and Equipment



Work bench, Bench vice, Tri-square, Hand hacksaw with blade, Scriber, Flat File, Vernier caliper, punching tools

0716-MVS&A-05: Perform grinding operations

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

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



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

CU6 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.

Knowledge & Understanding

- K1. Define types of grinding wheels
- K2. Describe basic measuring
- K3. Describe the Grinding machine types.
- K4. Describe clamping/holding methods.
- K1. Type and size of wheels and abrasive.
- K2. Method of dressing of grinding wheel.
- K3. Work holding methods which include:
 - Magnet Table
 - Vice
 - Angle Plate
 - 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
- K1. Describe basic measurement
- K2. Describe basic measuring /Marking /cutting tools
- K3. Describe clamping/holding methods



K4. Knowledge of different cutting tool materials.

K5. Describe safety during handling the angle grinder

Tool and Equipment

Offhand Grinding Machine

Bench vices

Hammer

Scriber

Vernier caliper

Set of spanners

Angle Grinding Machine

Grinding

Machine

Holding Devices

Wheel Dresser

Grinding Wheels

Wheel Dresser Stand

Measuring Tools

Adjustable Wrench

Allen Key Set



0716-MVS&A-06: 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	<p>P1. Select the right tool for job</p> <p>P2. Remove the safety guard of grinding wheel.</p> <p>P3. Select the wheel type according to material/speed.</p> <p>P4. Mount the wheel on the spindle.</p> <p>P5. Balance the wheel</p> <p>P6. Put back the safety covers.</p> <p>P7. Ensure that wheel is properly mounted.</p>
CU2 Adjust tool Rest	<p>P1. Select the right tool for job</p> <p>P2. Remove the safety guard of grinding wheel.</p> <p>P3. Mount the tool rest.</p> <p>P4. Balance the wheel</p> <p>P5. Put back the safety covers</p> <p>P6. Ensure that tool rest is properly mounted and levelled.</p>
CU3 Operate the Tool and cutter grinding	<p>P1. Select the suitable size, type and shape of grinding wheel.</p> <p>P2. Mount work piece onto correct attachment for required procedure.</p> <p>P3. Adjust the attachments according to different types of tools and cutter grinding.</p> <p>P4. Perform grinding on damaged drill bit to make it right.</p> <p>P5. Perform grinding on damaged cutter of milling Machine to make it right.</p> <p>P6. Follow procedure for sharpening of tools and cutter that is safe and appropriate.</p> <p>P7. Observe personal and safety precautions.</p>

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 types of grinding wheels
- K6.** Define safe distance from grinding wheel for tool rest
- K7.** Types, sizes and shapes of grinding wheels.
- K8.** Types of attachments and their use.
- K9.** Procedure of mounting of work-piece on to related attachments.
- K10.** Different tools and cutter angles.
- K11.** Procedure of sharpening of tools and cutters.

Tool and Equipment

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



0716-MVS&A-07: Perform Lathe Machine Operations

Overview: This competency standard covers the skills and knowledge required to perform centering, turning, facing and knurling operations.

Competency Units	Performance Criteria
CU1. Perform centering operations	<p>P1. Select facing tools according to job requirement.</p> <p>P2. Mount and set the required work-holding devices, work piece and cutting tools.</p> <p>P3. Follow the correct specifications for the part or component to be produced.</p> <p>P4. Select safe procedures and tools to accomplish the work.</p> <p>P5. Adjust the operating parameters (e.g. speed and feed) of machine tool for centering the job.</p> <p>P6. Ensure all safety mechanisms are in place.</p>
CU2. Perform facing Operations	<p>P1. Select facing tools according to job requirement.</p> <p>P2. Mount and set the required work-holding devices, work piece and cutting tools.</p> <p>P3. Follow the correct specifications for the part or component to be produced.</p> <p>P4. Select safe procedures and tools to accomplish the work.</p> <p>P5. Adjust the operating parameters (e.g. speed and feed) of machine tool to achieve the work specification.</p> <p>P6. Ensure all safety mechanisms are in place.</p>
CU3. Perform turning Operations	<p>P1. Obtain and follow work specifications, drawings or sketches to accomplish the work.</p> <p>P2. Set up and adjust the machine as per work specifications and procedures.</p> <p>P3. Ensure the components produced have the required quality and within the specified dimensional accuracy by turning operation.</p> <p>P4. Shut down the machine and equipment on conclusion of the machining activities.</p>



CU4. Perform drilling or boring operations	<p>P1. Select drill or boring tools according to drawings.</p> <p>P2. Mount and set the required work-holding devices, work piece and cutting tools.</p> <p>P3. Adjust the RPM of machine according to the cutting speed.</p> <p>P4. Perform the boring operation according to the drawing.</p> <p>P5. Check quality of the component produced at different intervals.</p> <p>P6. Observe personal and workplace safety.</p>
CU5. Perform step turning operations	<p>P1. Mount and set the required work-holding devices, work piece and cutting tools.</p> <p>P2. Select and adjust appropriate speeds and feeds of turning machine.</p> <p>P3. Produce a component which matches the work specifications using step turning methods and techniques.</p> <p>P4. Check quality of the component produced at different intervals.</p> <p>P5. Follow safety precautions to ensure safe work and to avoid any injury.</p>
CU6. Perform knurling Operations	<p>P1. Select the knurling tool according to drawing.</p> <p>P2. Set the tool and work piece in the machine according to procedure.</p> <p>P3. Adapt right methods and techniques to produce proper knurling on work piece.</p> <p>P4. Select and adjust appropriate speeds and feeds of lathe machine. Use coolants during knurling to achieve smooth impression on work piece.</p> <p>P6. Observe personal and workplace safety.</p>
CU7. Taper turning by tail stock off-set method	<p>P1. Loosen tailstock clamp out.</p> <p>P2. Offset tailstock required amount.</p> <p>P3. Centre cutting tool.</p> <p>P4. Setup cutting tool for parallel turning.</p> <p>P5. Starting at small diameter take excessive cuts until the taper is .05 to .06 in oversize.</p>



	<p>P6. Check taper for accuracy using a taper ring gauge.</p> <p>P7. Finish turn the taper to size and fit required.</p>
CU8. Taper turning by plain taper turning attachment	<p>P1. Remove the binding screw that cross slide to cross feed screw nut.</p> <p>P2. Tighten the lock screw and set cutting tool on center.</p> <p>P3. Set workpiece in lathe and mark length of taper.</p> <p>P4. Use binding screw to connect sliding block to side of taper attachment.</p> <p>P5. Select depth of feed cut by compound rest feed handle.</p> <p>P6. Take a light cut and recheck taper fit.</p> <p>P7. Finish turn and fit the taper to gauge.</p>
CU9. Taper turning by telescopic taper turning attachment	<p>P1. Clean and oil the guide bar.</p> <p>P2. Loose lock screws and offset end of guide bar,</p> <p>P3. Set the bar to required taper in degrees.</p> <p>P4. Tighten the lock screw and set cutting tool on center.</p> <p>P5. Set workpiece in lathe and mark length of taper and tighten connecting screw on sliding block.</p> <p>P6. Move carriage until center of attachment is opposite to length of taper.</p> <p>P7. Lock anchor bracket to lathe bed.</p> <p>P8. Take a cut and select depth of cut.</p> <p>P8. Readjust the taper attachment, Take a light cut and recheck taper fit.</p> <p>P9. Finish turn and fit the taper to gauge.</p>
CU10. Perform Internal and External threading Operations	<p>P1. Mount and set the required work-holding devices, work piece and cutting tools.</p> <p>P2. Select and adjust appropriate speeds and feeds of turning machine.</p> <p>P3. Produce a component which matches the work specifications using appropriate methods and techniques.</p> <p>P4. Check quality of the component produced at different intervals.</p>



- P3. Use Proper cutting tool to cut the threads with required dimensions.
- P5. Follow safety precautions to ensure safe work and to avoid any injury.

Knowledge & Understanding

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

Tool and Equipment



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



0716-MVS&A-08: Perform Shaper Machining Operations

Overview: This competency standard covers the skills and knowledge required to Produce a squared shape work piece, Produce V shaped work piece and Machine Irregular Surfaces.

Competency Units	Performance Criteria
CU1. Produce a squared shape work piece	<p>P1. Identify the parts and their functions of shaper Machine.</p> <p>P2. Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident.</p> <p>P3. Leveled the machine vice according to job requirement.</p> <p>P4. Select point cutting tool and set machine as per requirements.</p> <p>P5. Mount cutting tool and work piece in the machine.</p> <p>P6. Check quality of the component at suitable intervals.</p> <p>P7. Shut down the machine at safe position after finishing the work.</p>
CU2. Produce V shaped work piece	<p>P1. Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident.</p> <p>P2. Dial the machine vice according to job requirement.</p> <p>P3. Select point cutting tool and set machine according to job requirements.</p> <p>P4. Mount cutting tool and work piece in the machine.</p> <p>P5. Check quality of the component at suitable intervals.</p> <p>P6. Shut down the machine in safe position after finishing the work</p>
CU3. Perform T-slot Machining	<p>P1. Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident.</p> <p>P2. Dial the machine vice according to job requirement.</p> <p>P3. Select point cutting tool and set machine according to job requirements.</p> <p>P4. Mount cutting tool and work piece in the machine.</p>



	P5. Check quality of the component at suitable intervals. P6. Shut down the machine in safe position after finishing the work
CU4. Machine 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 Instructions. P6. Check quality of the component at suitable intervals. P7. 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.
- K11. Interpreting information given in the engineering drawings and job specifications.
- K12. List safety hazards related with the shaper machine operations.

Tool and Equipment

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



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0716-MVS&A-09: 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 and Perform CNC Lathe Operations.

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



	<p>for checking the tool gouge according to safety measures</p> <p>P2. Run simulation and verify movements of tool/cutter to get same results as per defined sequence</p> <p>P3. Identify occurrence of errors and modify the program as per defined procedure</p>
CU4. Feed the Program	<p>P1. Ensure proper synchronization between machine control unit and part program file as per standard operating procedure</p> <p>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</p> <p>P3. Select the desired part program file for execution as per standard operating procedure</p>
CU5. Perform CNC Lathe Operations	<p>P1. Ensure to control the safe operation of working on CNC machines before executing part program according to the safety measures</p> <p>P2. Control the feeds, speeds and override of machine before operating according to the prescribed procedure</p> <p>P3. Switch machine to execution mode (single block or auto) and press cycle start to run the machining sequence as per prescribed method</p> <p>P4. Compare the block-wise movements of machining sequence thoroughly during operating of machine according to the part program file</p> <p>P5. Complete the job and inspect its accuracy and precision according to the drawing/design</p>



K1. Work place safety and health considerations

- Use of Personal Protective Equipment
- Reading Drawing
- 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

K14. Feed and speed concepts in Lathe Machine

Tools and Equipment

1. CNC Lathe Machine or Turning Centre along with Standard Accessories
2. Lathe Tooling (Assorted Range)
3. CNC Programming Manual
4. CAM Software with Simulation Module
5. Measuring Instruments (Vernier, Inside/Outside Calipers, Micrometer, Steel Rule, Tri-Square, Bevel Protractor etc.)
6. Work Holding Devices
7. Measuring Gauges
8. Tooling Catalogue
9. CNC Manual
10. Complete Set of Computer System with Multimedia Projector
11. Personal Protective Equipment (PPE)



0716-MVS&A-10: Perform Pre-Welding Operations

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

Competency Units	Performance Criteria
CU1 Set Welding Equipment	<p>P1. Adjust pressure of both gas cylinders with the help of regulator</p> <p>P2. Open acetylene gas knob of welding torch Make carburizing flame by increasing acetylene gas quantity</p> <p>P3. Make neutral flame by adjusting both gases at same quantity</p> <p>P4. Make oxidizing flame by increasing oxygen gas quantity</p> <p>P5. Adjust pressure of both gas cylinders with the help of regulator</p> <p>P6. Select the correct size of the nozzle</p> <p>P7. Set the both gas flame of welding torch as per standard</p>
CU2 Prepare materials for welding	<p>P1. Select and obtain required material/s as per job requirements</p> <p>P2. Select appropriate marking tools as per job requirements</p> <p>P3. Mark the area to be cut as per drawing/job requirements</p>



CU3 Cut and Prepare Edge/s of Base Materials	<p>P1. Select appropriate cutting equipment as per job requirements</p> <p>P2. Set-up cutting equipment as per manufacturer's instructions/job requirements</p> <p>P3. Cut the base material as per job specifications and dimensions provided in the drawing</p> <p>P4. Prepare edges of the base materials as per drawing/WPS</p> <p>P5. Check dimensions of the prepared edges as per drawing/WPS</p> <p>P6. Select proper tools and chemicals for cleaning</p> <p>P7. Clean the edges of the base materials as per job requirements.</p>
CU4 Prepare Welding Consumables	<p>P1. Select relevant welding consumables as per job requirements/WPS</p> <p>P2. Prepare consumables in accordance with required specifications</p>

Knowledge & Understanding

- 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

Tools and Equipment

- Oxygen cylinder
- Acetylene gas cylinder



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- Pressure regulators
- Cylinder key
- Welding torch
- Rubber house pipe
- Back fire arrester
- Flash back arrester
- Spark lighter
- Steel wire brush
- Welding electrode

- Metal Filler rod

- Welding flux

- Work bench
- Bench vice
- Hammer
- Tri-square
- Hand hacksaw
- Scriber
- Vernier calliper
- Flat File
- Pedestal grinder

- Disk grinder

- Pin grinder



0716-MVS&A-11: Perform Shielded Metal Arc Welding (SMAW)/electric welding

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	<p>P1. Identify welding requirements from the job, welding procedure specifications and technical drawings</p> <p>P2. Prepare SMAW welding machine in accordance with welding procedure specifications/ manufacturer instructions</p> <p>P3. Set up welding machine accessories and consumables as per job requirements, welding procedure specifications and/or manufacturer’s instructions</p> <p>P4. Connect welding machine to an independent power supply</p> <p>P5. Set polarity indicated in the welding procedure specifications.</p>
CU2 . Make Fillet Welds on Steel Plate	<p>P1. Adjust welding parameters (current, voltage etc.) as per welding procedure specifications/job requirements to produce acceptable weld</p> <p>P2. Maintain gap between electrode and base metal as per standard practices</p> <p>P3. Carry out welding in Flat (1F) and Flat (1G) positions following standard procedures</p> <p>P4. Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects.</p>



CU3. Make Groove Welds on 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 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



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



Knowledge & Understanding

- 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

Critical Evidence(s) Required

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

- Perform SMAW fillet weld at 1F, 2F positions, groove weld at 1G, 2G positions as per given job specification



0716-MVS&A-12: Perform different welding joints

Overview: This Competency Standard is designed to gain basic knowledge and skills required to Practice of Making Butt Joint, Practice of making Lap Joint and Practice of making Tee Joint.

Competency Units	Performance Criteria
C1. Practice of Making Butt Joint	<p>P1. Take M.S Flat as per drawing</p> <p>P2. Straiten it with the help of hammer and anvil</p> <p>P3. Place the work piece on welding table</p> <p>P4. Hold the electrode in electrode holder</p> <p>P5. Set the current on welding machine as per standard</p> <p>P6. Hold the electrode at right angle</p> <p>P7. Set the current at 120-125 ampere</p> <p>P8. Tack both pieces of M.S Flat for Butt Joint</p> <p>P9. Prepare the arc by touching the end of electrode with the base metal and withdrawing it to proper gap</p> <p>P10. Lean the electrode at 70° to the base metal and complete the bead to form a square butt joint</p>
C2. Practice of making Lap Joint	<p>P1. Take M.S Flat as per drawing</p> <p>P2. Straiten it with the help of hammer and anvil</p> <p>P3. Mark parallel line on both pieces with the help of scribe for positioning of lap joint</p> <p>P4. Place the work piece on welding table</p> <p>P5. Place the Bottom piece on work table and place the Top plate along the marked line</p> <p>P6. Hold the electrode in electrode holder</p> <p>P7. Set the current on welding machine as per standard</p> <p>P8. Tack both work pieces of M.S Flat</p> <p>P9. Complete the bead by back hand welding technique as per standard</p>
C3. Practice of making Tee Joint	<p>P1. Take M.S Flat as per drawing</p> <p>P2. Straiten it with the help of hammer and anvil</p> <p>P3. Grind the work pieces on grinding machine to prepare the edges flat and parallel to each other</p> <p>P4. Place the Bottom piece on work table and place the Top plate at 90° to each other as per drawing</p> <p>P5. Hold the electrode in electrode holder</p> <p>P6. Set the current on welding machine as per standard</p> <p>P7. Tack both work pieces of M.S Flat</p> <p>P8. Lean the electrode and move along traverse direction</p> <p>P9. Complete the bead as per standard</p>



Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the 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.



0716-MVS&A-13: Perform Forging Operations

Overview: This Competency Standard is designed to gain basic knowledge and skills required to Perform main operation of forging (Drawing down and Swaging).The standard covers specific knowledge of performing Of Forging in drawing down and swaging.

Competency Units	Performance Criteria
CU-1: Practice of drawing	P-1. Make fire in available forge furnace P-2. Put the stock in forge furnace. P-3. Heat the stock up to bright red condition (Plastic State) P-4. Grip the heated stock by tong and put on anvil. P-5. Apply firm blows of sledge hammer on both sides of stock. P-6. Put the stock again in forge furnace and repeat process P-7. Always wear safety dress before start the performance.
CU-2: Practice of Swaging	P-1. Make fire in forge furnace P-2. Put the round stock in forge furnace. P-3. Heat the stock up to bright red condition. P-4. Fix the bottom swage in hardy hole. P-5. Put the red-hot round bar in the bottom swage. P-6. Put the top swage over round bar with the help of handle. P-7. Apply firm blows of sledge hammer and move round bar longitudinally and circumferentially. P-8. Always wear safety dress before start the performance.

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:

- K-1.** Understanding of techniques of drawing down
- K-2.** Proper preparation and selection of stock.
- K-3.** Understand the use of proper equipment.
- K-4.** Using proper safety dress before starting performance.
- K-5.** Complete the drawing down and swaging process rapidly.

Critical Evidence(s) Required

The candidate needs to produce following critical evidence(s) in order to be competent in

- Prepare the job through drawing down process.



- Prepare the job through Swaging process

Tools and equipment required

- 1 Hacksaw
- 2 Drill set
- 3 Drill Machine
- 4 Welding Machine
- 5 Lathe Machine
- 6 Milling Machine



Basic Engineering Drawing and CAD/CAM

0716-MVS&A-14: 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 Centre lines, centres, 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. Practice of Lettering 5 mm height	P1. Prepare Drawing sheet. P2. Select the tools. P3. Use Proper pencil for lettering with holding techniques. P4. Draw Boundary lines as per standards. P5. Make title bar P6. Draw upper and lower lines for lettering on distance of 5mm P7. Start Writing Vertical Lettering with different style like Gothic, Roman and free hand lettering
CU2. Practice of Lettering 3 mm height	P1. Prepare Drawing sheet. P2. Select the tools. P3. Use Proper pencil for lettering with holding techniques. P4. Draw Boundary lines as per standards. P5. Make title bar P6. Draw upper and lower lines for lettering on distance of 3mm P7. Start Writing Vertical Lettering with different style like Gothic, Roman and free hand lettering
CU3. Use Tee Square and Set Squares for drawing horizontal, vertical and inclined lines	P1. Prepare Drawing sheet. P2. Select the tools. P3. Draw Boundary lines as per standards. P4. Make title bar P5. Divide the sheets in different equal parts. P6. Draw horizontal lines at 0 degree using standard



	<p>tools</p> <p>P7. Draw inclined lines at 30, 45, 60 and 120 degree angles using standard tools</p> <p>P8. Draw vertical lines at 90 degree using standard tools</p>
<p>CU4. Carry out use of Tee square and for drawing centres, crossing of lines</p>	<p>P1. Prepare Drawing sheet.</p> <p>P2. Select the tools.</p> <p>P3. Draw Boundary lines as per standards.</p> <p>P4. Make title bar</p> <p>P5. Divide the sheets in different equal parts.</p> <p>P6. Make different angle curves.</p> <p>P7. Sketch Centre line according to standard.</p> <p>P8. Draw crossing line</p>
<p>CU5. Draw circles, half circles and radius</p>	<p>P1. Prepare Drawing sheet.</p> <p>P2. Select the tools.</p> <p>P3. Draw Boundary lines as per standards.</p> <p>P4. Make title bar</p> <p>P5. Divide the sheets in different equal parts.</p> <p>P6. Make different dia meter circles and half circles using compass</p> <p>P7. Make different Radius using Compass and Protector</p>
<p>CU6. Draw round corners, figure inside and outside circle</p>	<p>P1. Prepare Drawing sheet.</p> <p>P2. Select the tools.</p> <p>P3. Draw Boundary lines as per standards.</p> <p>P4. Make title bar</p> <p>P5. Divide the sheets in different equal parts.</p> <p>P6. Make different dia circles.</p> <p>P7. Make diagrams inside the circle that touch the circle at the tangent points</p> <p>P8. Make diagrams outside the circle that touch the circle at the tangent points</p>



CU7. Draw Plane geometry angles and triangles	P1. Prepare Drawing sheet. P2. Select the tools. P3. Draw Boundary 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.
CU8. Sketch Plane Geometry quadrilateral, square, rhombus and parallelogram	P1. Prepare Drawing sheet. P2. Select the tools. P3. Draw Boundary lines as per standards. P4. Make title bar P5. Divide the sheets in different equal parts. P6. Draw Square and Rectangle as per drawing P7. Draw Rhombus using protector and set square as per drawing P8. Draw Parallelogram as per drawing
CU9. Plane Geometry parallel-lines, perpendicular, bisect line and angle	P1. Prepare Drawing sheet. P2. Select the tools. P3. Draw Boundary lines as per standards. P4. Make title bar P5. Divide the sheets in different equal parts. P6. Draw parallel-lines of different length P7. Draw perpendicular lines as per drawing P8. Draw bisect lines as per drawing
CU10. Sketch Plane geometry equal division of line and some radio with the help of compass and set square	P1. Prepare Drawing sheet. P2. Select the tools. P3. Draw Boundary lines as per standards. P4. Make title bar P5. Draw lines of different lengths as per drawing P6. Open compass more than one half of drawn line P7. Use compass to draw an arc from one end of drawn line P8. Repeat this step on other end of line P9. Draw a perpendicular line where both arc meets P10. Check the half of line using tri square



Knowledge & Understanding

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

- 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.** Introduction to geometry
- K10.** Introduction to sketching techniques.
- K11.** Techniques of sketching straight lines in different directions.
- K12.** Define Triangles, Quadrilateral, and Polygons

Tool and Equipment.

Graph and drawing sheet, Drawing Board/table, T-Square, Set Square, Templets and Geometry Box.



0716-MVS&A-15: 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 Draw inscribe and circumscribe figures.	<p>P1. Prepare Drawing sheet.</p> <p>P2. Select the tools.</p> <p>P3. Draw Boundaries lines as per standards.</p> <p>P4. Make title bar</p> <p>P5. Divide the sheets in different equal parts.</p> <p>P6. Draw square, triangle and hexagon according to dimension.</p>
CU2 Draw a pentagon, Hexagon and Octagon by circumscribe method.	<p>P1. Prepare Drawing sheet.</p> <p>P2. Select the tools.</p> <p>P3. Draw Boundaries lines as per standards.</p> <p>P4. Make title bar</p> <p>P5. Divide the sheets in different equal parts.</p> <p>P6. Draw pentagon, Hexagon and Octagon .</p>
CU3 Draw pentagon, Hexagon and Octagon by inscribe method	<p>P1. Prepare Drawing sheet.</p> <p>P2. Select the tools.</p> <p>P3. Draw Boundaries lines as per standards.</p> <p>P4. Make title bar</p> <p>P5. Divide the sheets in different equal parts.</p> <p>P6. Draw pentagon, Hexagon and Octagon.</p>
CU4 Draw Tangents of circles (Inside & Outside)	<p>P1. Prepare Drawing sheet.</p> <p>P2. Select the tools.</p> <p>P3. Draw Boundaries lines as per standards.</p> <p>P4. Make title bar</p> <p>P5. Divide the sheets in different equal parts.</p>



	<p>P6. Draw Tangents Inside of a circle When the centre of the circle is known.</p> <p>P7. Draw Tangents Inside of a circle When the centre of the circle is unknown</p> <p>P8. Draw Tangents outside of a circle When the centre of the circle is known</p> <p>P9. Draw Tangents outside of a circle When the centre of the circle is unknown</p>
CU5 Construct Ellipse	<p>P1. Prepare Drawing sheet.</p> <p>P2. Select the tools.</p> <p>P3. Draw Boundaries lines as per standards.</p> <p>P4. Make title bar</p> <p>P5. Divide the sheets in different equal parts.</p> <p>P6. Draw an Ellipse by Concentric Circle.</p> <p>P7. Draw an Ellipse by Rectangle Method</p> <p>P8. Draw an Ellipse by Oblong Method</p> <p>P9. Draw an Ellipse by Arcs of Circle Method</p> <p>P10. Draw an Ellipse by Rhombus Method.</p> <p>P11. Draw an Ellipse by Basic Locus Method</p>
CU6 Draw parabola curve	<p>P1. Prepare Drawing sheet.</p> <p>P2. Select the tools.</p> <p>P3. Draw Boundaries lines as per standards.</p> <p>P4. Make title bar</p> <p>P5. Divide the sheets in different equal parts.</p> <p>P6. Draw a parabola curve by Rectangle</p> <p>P7. Draw a parabola curve by Method of Tangents(Triangle Method)</p> <p>P8. Draw a parabola curve by Basic Locus Method</p>
CU7 Draw hyperbola curve	<p>P1. Prepare Drawing sheet.</p> <p>P2. Select the tools.</p> <p>P3. Draw Boundaries lines as per standards.</p> <p>P4. Make title bar</p> <p>P5. Divide the sheets in different equal parts.</p> <p>P6. Draw a hyperbola curve.</p>
CU8 Make Archimedean Spiral curve	<p>P1. Prepare Drawing sheet.</p> <p>P2. Select the tools.</p> <p>P3. Draw Boundaries lines as per standards.</p>



	<p>P4. Make title bar</p> <p>P5. Divide the sheets in different equal parts.</p> <p>P6. Draw spiral curve.</p>
CU9 Make involute curve	<p>P1. Prepare Drawing sheet.</p> <p>P2. Select the tools.</p> <p>P3. Draw Boundaries lines as per standards.</p> <p>P4. Make title bar</p> <p>P5. Divide the sheets in different equal parts.</p> <p>P6. Draw involute curve by square</p> <p>P7. Draw involute curve by rectangle</p> <p>P8. Draw involute curve by hexagon</p> <p>P9. Draw involute curve by circle.</p>
CU10 Draw cycloid, epicycloid, and hypocycloid	<p>P1. Prepare Drawing sheet.</p> <p>P2. Select the tools.</p> <p>P3. Draw Boundaries lines as per standards.</p> <p>P4. Make title bar</p> <p>P5. Divide the sheets in different equal parts.</p> <p>P6. Draw the generating circle and the base line equal to the circumference of the generating circle</p> <p>P7. Divide the circle and the base line in to equal number of parts</p> <p>P8. Complete the cycloid, epicycloids, and hypocycloid.</p>

Knowledge & Understanding

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

- 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



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- 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 spiral curve

Tool and Equipment.

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



0716-MVS&A-16: 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 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

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



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- 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, T-Square, Set Square, Templets, Geometry Box



0716-MVS&A-17: Install CAD software.

Overview: This competency standard covers the skills and knowledge required to create new file and create basic drawing, Practice loading CAD software into computer memory and Practice CAD abbreviations.

Competency Units	Performance Criteria
CU1. Practice loading CAD software into computer memory	<p>P1. Download the installer files based on the download methods available for your product.</p> <p>P2. Find and double-click the setup file to start the installation</p> <p>P3. Click Install/Uninstall on this Computer</p> <p>P4. Select any one of the following options</p> <ul style="list-style-type: none">• Typical• Full• Compact• Custom <p>P5. Perform necessary steps to Install CAD software</p>
CU2. Practice CAD abbreviations, auto CAD release 12 of latest (e.g. A for Arc, C for circle, E for Erase etc.).	<p>P1. Create New Template</p> <p>P2. Save the File</p> <p>P3. Create Drawing</p> <p>P4. Select units as per requirements</p> <p>P5. Select drawing Limits</p> <p>P6. Click on command window</p> <p>P7. Type alphabet A and select method of arc to be used</p> <p>P8. Type alphabet C and select method of circle to be used</p> <p>P9. Type alphabet E and select erase method to be used</p>



- CU3. Practice function keys for shortcuts**
- P1. Create New Template**
 - P2. Save the File**
 - P3. Create Drawing**
 - P4. Select units as per requirements**
 - P5. Select drawing Limits**
 - P6. Select function key F1 to display help**
 - P7. Select function key F3 to turn on/off Object Snap**
 - P8. Select function key F4 to turn on/off 3D Object Snap**
 - P9. Select function key F7 to turn on/off Grid Display**
 - P10. Select function key F8 to lock cursor movement to Horizontal/Vertical**

Knowledge and skills

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

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



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K18. Modify dimension style and text size according to paper size

K19. Backup file

Tool and Equipment.

Computer with all accessories, AutoCAD software disk and Models



0716-MVS&A-18: Manage display in CAD software

Overview: This competency standard covers the skills and knowledge required to Practice to draw two points using Cartesian Notation on graph paper and Set-up drawing area using CAD software.

Competency Units	Performance Criteria
CU1. Practice to draw two points using Cartesian Notation on graph paper	P1. Create New Template P2. Save the File P3. Create Drawing P4. Select units as per requirements P5. Select drawing Limits P6. Draw A1,1 point on x and y axis keeping origin as reference P7. Draw B4,2 point on x and y axis keeping origin as reference
CU2. Practice to draw straight line using polar coordinates on graph paper	P1. Create New Template P2. Save the File P3. Create Drawing P4. Select units as per requirements P5. Select drawing Limits P6. Select line command from draw tool bar P7. Select point 1,1 on graph paper P8. Type @5<30 in command prompt and press enter P9. Type @60<0 in command prompt and press enter P10. Type @20<90 in command prompt and press enter P11. Press ESC to exit command
CU3. Set-up drawing area using CAD software	P1. Create New Template P2. Save the File P3. Create Drawing P4. Select units as per requirements P5. Select drawing Limits P6. Set-up drawing area as per standard operating procedure



CU4. Practice for Turning GRID ON and Off and SNAP ON and OFF

- P1.** Create New Template
- P2.** Save the File
- P3.** Create Drawing
- P4.** Select units as per requirements
- P5.** Select drawing Limits
- P6.** Select Status Bar and click on GRID icon to turn on or turn off grid
- P7.** Select Status Bar and click on SNAP icon to turn on or turn off snap

Knowledge & Understanding

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

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



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Tool and Equipment.

Computer with all accessories, AutoCAD software disk Models



0716-MVS&A-19: Perform function of CAD general commands

Overview: This competency standard covers the skills and knowledge required to Draw a line with LINE command, Widen Border lines with PEDIT and Create layers and move border to its own layer.

Competency Units	Performance Criteria
CU1. Draw a line with LINE command	<p>P1. Create New Template</p> <p>P2. Save the File</p> <p>P3. Create Drawing</p> <p>P4. Select units as per requirements</p> <p>P5. Select drawing Limits</p> <p>P6. Click on LINE icon from draw tool bar</p> <p>P7. Give dimension of line in Command window</p> <p style="text-align: center;">OR</p> <p>P8. Specify Start Point and End Point</p>
CU2. Widen Border lines with PEDIT	<p>P1. Create New Template</p> <p>P2. Save the File</p> <p>P3. Create Drawing</p> <p>P4. Select units as per requirements</p> <p>P5. Select drawing Limits</p> <p>P6. Draw border lines</p> <p>P7. Type the command PEDIT</p> <p>P8. Select Width and type a width factor</p>
CU3. Save Border Template (QSAVE)	<p>P1. Create New Template</p> <p>P2. Save the File</p> <p>P3. Create Drawing</p> <p>P4. Select units as per requirements</p> <p>P5. Select drawing Limits</p> <p>P6. Draw border lines</p> <p>P7. Type the command CNTL+S to quickly save border template</p>
CU4. Create layers and move border to its own layer	<p>P1. Create New Template</p> <p>P2. Save the File</p> <p>P3. Create Drawing</p> <p>P4. Select units as per requirements</p>



	<p>P5. Select drawing Limits</p> <p>P6. Draw different layers as per standard</p> <p>P7. Draw border as per standard</p> <p>P8. Select MOVE command</p> <p>P9. Select border as per standard</p> <p>P10. Draw border on selected layer</p>
CU5. Create a layer for Title Block	<p>P1. Create New Template</p> <p>P2. Save the File</p> <p>P3. Create Drawing</p> <p>P4. Select units as per requirements</p> <p>P5. Select drawing Limits</p> <p>P6. Draw border lines</p> <p>P7. Create a layer as per standard</p> <p>P8. Draw title block using lines as per standard</p>
CU6. Create Title Block	<p>P1. Create New Template</p> <p>P2. Save the File</p> <p>P3. Create Drawing</p> <p>P4. Select units as per requirements</p> <p>P5. Select drawing Limits</p> <p>P6. Draw border lines</p> <p>P7. Create title block as per standard</p> <p>P8. Specify cell alignment of title block</p> <p>P9. Specify scale of title block</p>
CU7. Practice for Zoom command	<p>P1. Create New Template</p> <p>P2. Save the File</p> <p>P3. Create Drawing</p> <p>P4. Select units as per requirements</p> <p>P5. Select drawing Limits</p> <p>P6. Type ZOOM in command bar</p> <p>P7. Select required zoom type for example</p> <ul style="list-style-type: none">• All• Center• Dynamic



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- Extents
- Previous
- Scale
- Window
- Object



0716-MVS&A-20: Perform Different Cad operations

Overview: This competency standard covers the skills and knowledge required to Practice of 3D commands, Practice for filling Title Block, Start a New drawing and practice different shapes.

Competency Units	Performance Criteria
CU1. Practice of 3D commands	<ul style="list-style-type: none">P1. Create New TemplateP2. Save the FileP3. Create DrawingP4. Select units as per requirementsP5. Select drawing LimitsP6. Draw border linesP7. Draw objects as per standardP8. use 3D commands to convert objects into 3D as per standards
CU2. Practice for filling Title Block	<ul style="list-style-type: none">P1. Create New TemplateP2. Save the FileP3. Create DrawingP4. Select units as per requirementsP5. Select drawing LimitsP6. Draw border linesP7. Create title block as per standardP8. Specify cell alignment of title blockP9. Specify scale of title blockP10. Select edit command to fill title block
CU3. Practice for plotting the drawing on plotter or printer	<ul style="list-style-type: none">P1. Create New TemplateP2. Save the FileP3. Create DrawingP4. Select units as per requirementsP5. Select drawing LimitsP6. Draw border linesP7. Select print commandP8. Select available plotter or printer as per standard
CU4. Start a New drawing	<ul style="list-style-type: none">P1. Start auto cad programP2. Press CTRL+ N or select New in file menuP3. Select units as per requirements



	P4. Select drawing limits
CU5. Practice with edit command to make changes in the drawing	P1. Create New Template P2. Save the File P3. Create Drawing P4. Select units as per requirements P5. Select drawing Limits P6. Draw border lines P7. Type command DEDIT P8. Select line whose dimension needs to be edited
CU6. Draw an Angled line	P1. Create New Template P2. Save the File P3. Create Drawing P4. Select units as per requirements P5. Select drawing Limits P6. Draw border lines P7. Type command ALIGNED LINE and type magnitude and angle of line P8. Type LINE command and type @20<45 in command bar P9. Select LINE icon and specify first and second point with mouse cursor on desired angle
CU7. Practice with Undo Command and Redo command	P1. Create New Template P2. Save the File P3. Create Drawing P4. Select units as per requirements P5. Select drawing Limits P6. Select CIRCLE command and draw a circle of desired dia P7. Press CTRL+Z to undo that circle P8. Press CTRL+Y to redo that circle



CU8. Draw a circle with circle command

- P1. Create New Template**
- P2. Save the File**
- P3. Create Drawing**
- P4. Select units as per requirements**
- P5. Select drawing Limits**
- P6. Select CIRCLE command**
- P7. Select circle type e.g. center radius, center diameter, 2-point, 3-point and draw a circle of desired dia or radius**

Knowledge & Understanding

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

- K-1. Basic Drawing Settings**
- K-2. Unit setting**
- K-3. Limits setting**
- K-4. User coordinate system Workspace setting**
- K-5. Object Snap Settings**
- K-6. Basic Commands and Concepts Angles and lines in AutoCAD.**
- K-7. Knowledge of LINE command**
- K-8. Knowledge of CIRCLE command**
- K-9. Knowledge of POLYLINE command**
- K-10. Knowledge of RECTANGLE command**
- K-11. Knowledge of ELLIPSE command**
- K-12. Knowledge of POLYGON command**
- K-13. Knowledge of MODIFYING commands**
- K-14. Knowledge of absolute coordinates system**
- K-15. Knowledge of relative coordinates system**
- K-16. Knowledge of polar coordinates system**
- K-17. Command windows**
- K-18. The ribbon**
- K-19. Quick access toolbar**
- K-20. View cube**



Occupational Health, Safety and Environment

0716-MVS&A-21: Read and Develop Career Professionalism

Overview

This unit covers the knowledge, skills and attitudes in promoting career growth and advancement

Unit of Competency	Performance Criteria
CU-1: Integrate personal objectives with organizational goals	P-1 Personal growth and work plans are pursued towards improving the qualifications set for the profession P-2 Maintain the Intra- and interpersonal relationships in the course of managing oneself based on performance evaluation. P-3 Demonstrate the commitment to the organization and its goal in the performance of duties.
CU-2: Set and meet work priorities	P-1 Competing demands are prioritized to achieve personal, team and organizational goals and objectives. P-2 Manage work priorities and commitments in order to utilize the resources efficiently and effectively. P-3 Practices along economic use and maintenance of equipment and facilities are followed as per established procedures
CU-3: Maintain professional growth and development	P-1 Identify the trainings and career opportunities and avail on the bases of job requirements. P-2 Recognitions are sought/received and demonstrated as proof of career advancement P-3 Obtained and renewed the licenses and/or certifications relevant to job and career.

Knowledge & Understanding

- K-1 Evaluation:** Performance Appraisal, Psychological Profile, Aptitude Tests.
- K-2 Resources:** Human, Financial, Technology, Hardware, Software
- K-3** Trainings and career opportunities: Participation in training programs, Technical, Supervisory, Managerial, Continuing Education, Serving as Resource Persons in conferences and workshops.
- K-4 Recognitions:** Recommendations, Citations, Certificate of Appreciations, Commendations, Awards, Tangible and Intangible Rewards.



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K-5 Licenses and/or certifications: National Certificates, Certificate of Competency, Support Level Licenses, Professional Licenses

Knowledge & Understanding

- K-1.** Describe the different hydraulic symbol
- K-2.** Describe the different hydro pneumatic symbol.
- K-3.** Describe the pneumatic symbol.
- K-4.** Describe the different electro pneumatic symbols.

Critical Evidence(s) Required

- Capable to identify the hydraulic symbol.
- Capable to identify the pneumatic symbol.



0716-MVS&A-22: Apply basic Occupational Health & Safety regarding heavy machinery

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 Heavy 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 Heavy 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.
CU5. 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
CU6. Judge Dangerous trees.	P1. Identify Snags.(Snag is any dry standing Tree) P2. Down all snags. P3. Flagg Huge snag if left standing.
CU7. Protect wildlife	P1. Identify Osprey-nest. P2. Mark nest on the map. P3. Leave the trees around for animals / bear in a den.
CU8. Adopt Safety during fire season	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.
CU9. Perform Map orientation	P1. Identify hazards on map like Rocks, construction, pipelines, boundaries, power lines, soft ground, quarries and tree lines. P2. Follow map and evaluate all the issues like terrain of an area, slope percentage.

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:

- Define Worksite hazards.
- Enlist various types of hazardous materials.
- Enlist various types of personal protective equipment.
- Define Material Safety Data Sheets (MSDS).
- Describe Workplace Hazardous Materials Information System. (WHMIS)

Critical Evidence(s)

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

- Adopt Health & Safety regulations.
- Ensure Personal protective equipment (PPE)
- Ensure Safety documentation common to Heavy Machines.
- Assess Worksite hazards
- Judge Dangerous Trees.
- Protect wildlife
- Adopt Safety during fire season
- Perform Map orientation



0716-MVS&A-23: 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	P1. Locate relevant section and legislation



legislation	P2. Seek clarification of legislation P3. Adopt regulation of the area
CU9. Attain health & safety training	P1. Take required health and safety training P2. Implement work place hazardous materials information system (WPHMIS) P3. Adopt first aid, cardio for respiratory, resuscitation, and CPR
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 P2. Collect relevant data for evidences P3. Analyze the accident and plan a control measure P4. Implement the plan

Knowledge & Understanding

- K1.** Define Hazard.
- K2.** Describe types of hazard.
- K3.** Knowledge and proper use of Personal Protective Equipment (PPE).
- K4.** Describe 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,
16. WHMIS book,

Critical Evidence(s) Required

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

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



Internal Combustion Engine

0716-MVS&A-24: Identify Engine Types, their Component and Specifications

Overview: This competency standards will cover to Identify Petrol Engine, Identify Diesel Engine, Analyze the functioning of Diesel Engine and Analyse the CI engine Ignition system.

Unit of Competency	Performance Criteria
CU1. Identify Petrol Engine	P-1. Locate spark plugs and its functions P-2. Point out distributor and its function P-3. Identify ignition coil and its functions P-4. Identify plug leads and its functions P-5. Identify carburetor and its function P-6. Locate EFI system and its main components
CU2. Identify Diesel Engine	P-1. Identify the typical diesel engines and function of their main components. P-2. Locate fuel injectors and its function P-3. Point out high pressure fuel pump and its functions P-4. Identify heater plug and its function P-5. Identify the Common rail fuel system. P-6. Identify HEUI fuel system.
CU3. Point out the main components of Diesel Engine	P1. Locate the cylinder ,cylinder head and its basic function P2. Identify the function of piston. P3. Identify the function of connecting rod, crank shaft and valves. P4. Locate the flywheel, camshaft, timing gears and its function.
CU4. Analyse the diesel engine Ignition system.	P1. Inject oil into the combustion chamber P2. Atomize the oil jet droplets P3. Evaporate the droplets. P4. Mix the vapors with hot air and form combustible mixture.

Knowledge & Understanding

- K-1.** Describe the vehicle engines in a variety of forms and locations as following:
- Types (Petrol four stroke, diesel four stroke, and rotary/Wankel).
 - Aspirated (Natural, turbocharged, supercharged)
 - Cylinder layout (single, multi, in-line, V shape, horizontally opposed).



- d. Location of engine (front, rear, transverse, longitudinal)

Critical Evidences Required

- Capable to identify petrol/diesel engine.
- Capable to differentiate petrol EFI and carburetor engine.
- Capable to explain different parts in petrol/diesel engine.

List of Tools and Equipment

- Measuring tools (Vernier caliper, micrometer, Cylinder bore gauge)
- Hand tools trolley
- Special tools (ring compressor, belt tensioner, torque wrench)
- Engine Petrol/ diesel
- Vehicle



0716-MVS&A-25: Disassemble and assemble Basic Engine Parts

Overview: These competency standards designed to provide skills and knowledge for engines their understanding the working principles, construction, types, components and their relationship between different components, system of vehicle by heavy machinery, in accordance with the manufacturer's Manual.

Unit of Competency	Performance Criteria
CU-1: Perform Engine block disassembly procedure.	P-1. Select appropriate tools. P-2. Perform disassembly of engine according to manufacturing shop manual. P-3. Inspect the disassemble components
CU-2: Carry out Engine block assembly procedure.	P-1. Select appropriate tools and perform crankshaft assembly in the engine block with all related components. P-2. Select appropriate tools and perform piston ring assembly in the block under the specified procedure. P-3. Assembly of the all engine components as specified procedure in the manual.
CU-3: Perform Engine head Disassembly procedure.	P-1. Select appropriate tools. P-2. Remove Head Gasket. P-3. Carry out disassembly of engine camshaft according to specified procedure in the manual. P-4. Carry out disassembly of engine head valve train according to specified procedure in the manual. P-5. Disassemble Retainer Plate and Rotter coil P-6. Inspect the disassemble components
CU-4: Carry out Engine head assembly procedure.	P1. Assemble Retainer Plate and Rotter coil P2. Assembly of engine head valve train according to specified procedure in the manual. P3. Assembly of engine camshaft according to specified procedure in the manual. P4. Place the Head Gasket.

Knowledge & Understanding

K-1. Describe the engine terms as following:

Top dead Centre (TDC), bottom dead Centre (BDC), bore, stroke, engine capacity, clearance volume, swept volume, compression ratio, single overhead cam, double overhead cam, overhead valve,

K-2. Describe the main engine components and functions:



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Components: cylinder heads, cylinder blocks, liners(wet/dry), manifolds, valve operating mechanisms, timing, gears, camshafts, pistons, pushrods, connecting rods, crankshafts, flywheels, machined faces, securing devices, journals/ bearings, seals.

K-3. Describes the faults in engine as following:

White smoke, black smoke, engine oil level decreasing, incorrect adjustment of tappets, incorrect adjustment of ignition timing, incorrect adjustment of engine timing.

Critical Evidences Required

- Capable to assemble the engine components
- Capable to adjust engine timing and ignition timing
- Capable to service air filter and spark plugs

List of Tools and Equipment

- Measuring tools (Vernier caliper, micrometer, Cylinder bore gauge)
- Hand tools trolley
- Special tools (ring compressor, belt tensioner, torque wrench)
- Engine Petrol/ diesel
- Vehicle

Consumable Items:

- Engine Oil, Gasket Set, Piston Rings, Oil Seals, Valve Seats, Silicon, Emery Paste and Stick, Cotton Waste.



0716-MVS&A-26: Maintain Engine Cooling System Components and Their Relationship

Overview: This Learning Module is designed to provide skills and knowledge for understanding the working principles, construction, types, components and their relationship between different components to service and repair air- and water-cooled engine cooling systems and to diagnose fault/s and other maintenance issues by Auto Mechanic, in accordance with the manufacturer's Manual.

Unit of Competency	Performance Criteria
CU-1: Identify Cooling system in the vehicle.	P1. Demonstrate main components of cooling system and their functions. P2. Locate the water pump and understand the function of its components. P3. Point out the thermostat Valve. P4. Identify the radiator, its types and understand the function of the components. P5. Demonstrate the radiator fan and understand its drive types including fan motor and its pump.
CU-2: Demonstrate Antifreeze/Inhibitors	P1. Identify the antifreeze its compositions and types. P2. Identify the rust corrosion in the engine and preventions.
CU-3: Perform Flushing of Cooling system	P1. Remove the Coolant from engine. P2. Add the solution of water and Cleaning agents (Freshers) P3. Start the engine for specified hours. P4. Remove the solution P5. Add new coolant.

Knowledge & Understanding

- K-1.** Describe the operating principles and terminologies of cooling system as following:
Air cooled engine, liquid cooled engine, operating temperature, thermal efficiency, pressurized system, heat exchange method (conduction, radiation, and convection), corrosion, and inhibitors/antifreeze)
- K-2.** Describe the functions and purpose of engine cooling system components as:
Electrical motor operated fan with thermo switch, belt operated fan, temperature controlled/viscous coupling fan, pressure cap, water body/pump, drive belt, thermostat, radiator, core plug, hoses/clamps, and gasket/ seals.



Critical Evidence(s) Required

- Capable of diagnose, adjust and rectify the cooling system faults.

List of Tools and Equipment

- Hand tools trolley
- Radiator leak tester
- Vehicle/ simulator with a cooling system
- Drive belt tensioner gauge

Consumable Items:

- Coolants, Sealant/gasket, Hose Pipe, Thermostat Valve



0716-MVS&A-27: Inspect Engine Lubrication System and working of its Components

Overview: This Learning Module is designed to provide skills and knowledge for understanding the working principles, construction, types, components and their relationship between different components to repair different types of engine lubricating systems by Auto Mechanic, in accordance with the manufacturer's Manual.

Units of Competency	Performance Criteria
CU-1: Identify the Lubrication system	P-1. Identify the main components of engine lubrication system. P-2. Identify types of oil pumps. P-3. Identify the main relief valve. P-4. Identify the Temperature, pressure and level sensor of oil. P-5. Identify Oil filter. P-6. Identify the Oil cooler P-7. Identify oil coolers for the high-performance engine (air cooled/ Water cooled type)
CU-2: Analyze different Lubricants in the Engine.	P-1. Identify the types of engine oil used in the engine with respect to viscosity. P-2. Identify the function of oil filter and its components. P-3. Identify the oil sump and its components.
CU-3: Sketch Lubrication system diagram	P1. Draw The lubrication system diagram with EGR P2. Draw The lubrication system diagram without EGR

Knowledge & Understanding

- K-1.** The functions/operating principle and main components of engine lubrication system as following.
- K-2.** Wet sump, dry sump, total loss, Oil pumps and its types, pressure relief valves, oil filter, oil cooler, ventilation/ PCV Valve, hoses, and oil level indicators.
- K-3.** Lubricant (oils viscosity, viscosity index, oil classifications, Reduction of frictional forces, cooling effect, cleaning effect, corrosion resistance, and noise reduction).
- K-4.** The (Law of friction, static/dynamic friction (difference), coefficient of friction).
- K-5.** Explain flow of oil in Lubrication system diagram with EGR.
- K-6.** Explain flow of oil in Lubrication system diagram without EGR.
- K-7.** Define Micron rating of Oil Filters.
- K-8.** Define Oil Grades and multi grade oil.

Critical Evidence(s) Required

- Capable of explain the lubrication system components.



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- Capable to know the engine oil and filter.

List of Tools and Equipment

- Hand tools trolley
- Car Lift
- Vehicle/ simulator with a cooling system
- Sealant/gasket



0716-MVS&A-28: Locate Diesel Engine's Fuel System Components

Overview: These competency standards designed to enable the work on vehicle fuel system to understand the faults in diesel engines.

Unit of Competency	Performance Criteria
CU-1: Identify PT (pressure time) fuel system	<p>P-1. Locate the diesel tank.</p> <p>P-2. Demonstrate the primary fuel filters.</p> <p>P-3. Identify the PT pump.</p> <p>P-4. Identify the priming pump.</p> <p>P-5. Identify the secondary fuel filters.</p> <p>P-6. Identify the PT injectors.</p> <p>P-7. Identify the pressure regulator valve.</p> <p>P-8. Identify the return line.</p> <p>P-9. Draw the block diagram of PT pump fuel system.</p>
CU-2: Locate Inline fuel injection (BOSCH) system.	<p>P1. Identify the diesel tank.</p> <p>P2. Identify the primary fuel filters.</p> <p>P3. Identify the transfer pump.</p> <p>P4. Identify the priming pump.</p> <p>P5. Identify the secondary fuel filters</p> <p>P6. Identify the BOSCH pump.</p> <p>P7. Identify the nozzle</p> <p>P8. Identify the return line.</p> <p>P9. Draw the block diagram of BOSCH pump fuel system.</p>
CU-3: Inspect Common rail injection (CRI) fuel system.	<p>P1. Identify the ECM.</p> <p>P2. Identify the Transfer pump.</p> <p>P3. Identify the primary pump.</p> <p>P4. Identify the secondary fuel filters</p> <p>P5. Identify the main pump.</p> <p>P6. Identify the Common Rail.</p> <p>P7. Identify the injectors.</p> <p>P8. Identify the return line.</p> <p>P9. Draw the block diagram of CRI system.</p>



CU-4: Demonstrate Hydraulic electronic unit injection (HEUI) system	P1. Identify the transfer pump. P2. Identify the secondary fuel filters P3. Identify the injectors. P4. Identify the pressure regulator valve. P5. Identify the oil pan P6. Identify the oil pump. P7. Identify the oil cooler. P8. Identify the oil filter P9. Identify the unit injection pump P10. Identify the injector
CU-5: Locate Mechanical Electronic Unit Injection (MEUI) system	P1. Identify the ECM (main pump). P2. Identify the MEUI injector. P3. Identify the MEUI regulator valve P4. Identify the MEUI return line. P5. Draw the block diagram of PT pump fuel system.

Knowledge & Understanding

K-1. Describe the features of main components of engine fuel system as following.

Fuel tanks, filler cap/ security, venting, fuel level sender, lines/ filters, carburetor, and fuel lift pumps (mechanical/ electrical), fuel (octane rating, Octane number , cetane Number ,cetane rating, leaded, unleaded).

K-2. Describe the Diesel injection systems main components as following.

Single/ multi-hole injectors, inline fuel injection pump, rotary fuel injection pump, fuel injection pressure, bleed points, fuel cutoff switch, governor operation, in Combustion chamber types, main features of pressure/ volume diagrams/ effects of advanced/ retarded/ no fuel injection

K-3. Describe the as following statements.

Diesel fuel composition, effects of low temperature, viscosity, volatility, calorific value, cetane rating.

Critical Evidence(s) Required

- Capable understanding the diesel engine fuel system
- Capable understanding the diesel EFI engine fuel system

List of Tools and Equipment

- Toll trolley (Complete set)



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- Diesel engine vehicle or simulator
- Safety wears



0716-MVS&A-29: Maintain the Engine intake and Exhaust System Components

Overview: These competency standards designed to enable the work on vehicle fuel system to diagnose and rectify the faults in petrol and diesel engines.

Unit of Competency	Performance Criteria
CU-1: Maintain Intake system components	P-1. Inspect the performance of main components of Intake manifold P-2. Remove and assemble intake manifold from engine P-3. Remove the pre cleaner and air filter P-4. Identify the impeller of turbo charger. P-5. Identify After cooler. P-6. Identify inter-cooler.
CU-2: Maintain Exhaust system components	P-1. Inspect the performance of main components of exhaust manifold P-2. Remove and assemble exhaust manifold from engine P-3. Replace the muffler and EGR under the specified procedure. P-4. Replace the gasket of muffler under the specified procedure. P-5. Remove and assemble turbocharger. P-6. Inspect the performance of main components of Turbocharger.
CU-3: Identify Emission control system	P-1. Identify EGR and its function. P-2. Identify the positive crankcase ventilation (PCV). P-3. Identify the exhaust gas recirculation system. P-4. Identify the main components of Evaporative control system of fuel system.

Knowledge & Understanding

- K-1.** Describe the purpose of exhaust system and its functions.
- K-2.** Describe the muffler assembly operation.
- K-3.** Describe the exhaust gas regulator (EGR).
- K-4.** Describe the positive crank case ventilation PCV system and it operation
- K-5.** Describe the exhaust gas recirculation and its operation
- K-6.** Describe function of inter-cooler and after-cooler.
- K-7.** Describe the operation of turbocharger.

Critical Evidence(s) Required



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- Capable of understanding the exhaust system
- Capable of understanding EGR.
- Capable of understanding Catalytic converter.

List of Tools and Equipment

- Vehicle
- Tools trolley (Complete set of hand tools)
- Gas analyzer
- Vacuum pump



0716-MVS&A-30: Perform Overhauling of Four Stroke Engine

Overview: This competency standard is designed to provide skills and knowledge to Overhauling, in accordance with the Manufacturer's Manual.

Unit of Competency	Performance Criteria
CU-1: Perform Overhauling of Four stroke engine cylinder head.	<p>P-1. Arrange proper tools, equipment and shop manual.</p> <p>P-2. Disconnect cables, wires, and muffler, Air filter from cylinder head for dismantling cylinder head.</p> <p>P-3. Remove cylinder head assembly.</p> <p>P-4. Clean cylinder head and its components to identify the damage parts.</p> <p>P-5. Install Repaired cylinder head and its attachments according to shop manual.</p> <p>P-6. Test engine performance to verify servicing of cylinder head.</p>
CU-2: Service the cylinder block, Piston and Piston Rings	<p>P-1. Arrange proper tools and equipment to service cylinder block, piston and piston rings.</p> <p>P-2. Remove cylinder head assembly from the cylinder block to service cylinder block piston and piston Rings as per shop manual.</p> <p>P-3. Clean cylinder block, piston and its components to remove dust.</p> <p>P-4. Remove cylinder block, piston and inspect its components to identify the damage parts as per Shop manual.</p> <p>P-5. Install Cylinder Block, piston, piston rings, and cylinder head and connect all the wires, cables to the engine as per shop manual.</p> <p>P-6. Test engine performance to verify servicing of cylinder block, piston and piston rings as per shop manual.</p>

Knowledge & Understanding

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

This includes the knowledge of:



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- K-1. Knowledge about PPE (personal protection equipment).
- K-2. Different types of fire extinguishers
- K-3. Safe work environment
- K-4. Safety measures and precautions
- K-5. First Aid
- K-6. Proper use and handling of equipment
- K-7. Knowledge about securing measuring tools
- K-8. Types of engines
- K-9. Schedule of Motorcycle Maintenance
- K-10. Different parts of Motorcycle
- K-11. Working principles and comparison of 2 and 4 Stroke Engine
- K-12. Types and procedure of Oiling & greasing
- K-13. Inspections and Measurements
- K-14. Cleaning process of different Motorcycle parts / Components.
- K-15. Replacement of Parts / Components
- K-16. Adjustment of parts /Components
- K-17. Working principles of engine and its terminologies
- K-18. Different systems of engine
- K-19. Parts of engine
- K-20. Diagnostic procedure of Engine
- K-21. Engine dismantling procedure
- K-22. Engine inspection and repair procedure
- K-23. Engine assembling procedure
- K-24. Engine oil circuits
- K-25. Engine Timing
- K-26. Manufacturers and workshop manual of given vehicle
- K-27. Working principle Fuel system
- K-28. Exhaust system
- K-29. Euro standards
- K-30. Driving tips and safety

Critical Evidence(s) Required

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

- Remove and install single cylinder engine.

List of Tools and Equipment



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- Tools trolley (complete set of tools)
- Compression tester
- Measuring tools (Complete set for engine overhauling)
- Fuel pressure Tester
- Special Service Tools

Consumable Items:

Piston ring, Engine oil, Silicon, Oil sump Jain, oil filter, head Gasket, grease, cotton waste.



Automotive Electrics and Electronics

0716-MVS&A-31: Perform Basic Electricity Measurements

Overview: These competency standards designed to enable the learner to perform electrical related calculations and measurements, as well as conceptualize different automotive functions related to the electrical operations.

Unit of Competency	Performance Criteria
CU-1: Basic Electricity	P-1. Prepare series circuit on work bench using appropriate tools. P-2. Prepare parallel circuit on work bench using appropriate tools. P-3. Prepare series parallel circuit on work bench using appropriate tools.
CU-2: Basic Electricity Measurement	P-1. Measure/ record voltage by using Digital Multi METER (DMM) P-2. Measure/ record current by using Digital Multi Meter (DMM) P-3. Measure/ record resistance by using Digital Multi Meter. P-4. Measure/ record continuity by using Digital Multi Meter.

Knowledge & Understanding

K-1. Describe the following terms:

Atom and its particles (electron, neutrons & protons), EMF, current, voltage, resistance, magnetism, electro magnetism, flux, inductance, mutual inductance, capacitance, and diode.

K-2. Calculation of ohm law, ($V= IR$) calculation of power law ($P= VI$).

Critical Evidence(s) Required

- Calculation involving the series, parallel, and series parallel circuits
- Correct use of Digital multi meter (DMM)
- Point out electromagnets in the vehicle.

List of Tools and Equipment

S No.	Descriptions
1	Digital Multi meter (DMM).
2	Load (resistors)
3	Wires
4	Test bench (Complete accessories)
5	Lamps

Consumable Items:



- Wires, Bulb and Bulb Holder, Thimble (Male & Female), Circuit Board, Wire Clumps, Battery

0716-MVS&A-32: Identify the Electromagnetism and its application

Overview: These competency standards designed to enable the learner to perform electrical related calculations and measurements, as well as conceptualize different automotive functions related to the electrical operations.

Unit of Competency	Performance Criteria
CU-1: Basic Electricity	<p>P-1. Prepare series circuit on work bench using appropriate tools.</p> <p>P-2. Prepare parallel circuit on work bench using appropriate tools.</p> <p>P-3. Prepare series parallel circuit on work bench using appropriate tools.</p>
CU-2: Basic Electricity Measurement	<p>P-1. Measure/ record voltage by using Digital Multi Meter</p> <p>P-2. Measure/ record current by using Digital Multi Meter</p> <p>P-3. Measure/ record resistance by using Digital Multi Meter.</p> <p>P-4. Measure/ record continuity by using Digital Multi Meter</p>

Knowledge & Understanding

K-1. Describe the following components:

Electricity generation, storage, types of current, circuits (open/close), switches, relay, fuses, circuit breaker, motors(DC/AC), generator (DC/AC), and resistors/color coding.

Critical Evidence(s) Required

- Calculation involving the series, parallel, and series parallel circuits
- Correct use of Digital Multi meter (DMM)
- Point out electromagnets in the vehicle.

List of Tools and Equipment

- 1 Digital Multi meter (DMM).
- 2 Load (resistors)
- 3 Wires
- 4 Test bench (Complete accessories)
- 5 Lamps

Consumable Items:



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- Wires, Bulb and Bulb Holder, Thimble (Male & Female), Circuit Board, Wire Clumps, Battery



0716-MVS&A-33: Perform Battery Service of Vehicle

Overview: These competency standards designed to enable the learner to diagnose the problem related to the battery and starting system and enable the learner to troubleshoot the system if not working

Unit of Competency	Performance Criteria
CU-1: Service of battery	P-1. Perform the battery test by use of hydrometer, Terminal clean, tight, and insulated, secure with battery holder as per given specification. P-2. Inspect and change the Ground (Earth) cable from the vehicle body. P-3. Test battery by using the load tester/battery tester and assess the battery performance.
CU-2: Battery replacement	P-1. Perform Safe removal and installation of Battery from the vehicle Inspect/service the battery and assess safety fitting and correctness under specified procedure. P-2. Carry out safe procedure to charge the battery using an external charger.

Knowledge & Understanding

K-1. Lead Acid battery and its internal components:

Material, acid and water ratio, plates, cells, ampere hour rating, voltage drop, corroded/ lose terminals, maintenance free batteries.

K-2. Describe the chemical activities in Lead Acid Battery while charging and discharging.

Critical Evidence(s) Required

- Troubleshoot the problems related to the vehicle battery.

List of Tools and Equipment

- 1 Vehicle or simulator.
- 2 Tool box
- 3 Safety goggles
- 4 Gloves
- 5 Battery External charger
- 6 Battery load tester
- 7 DMM
- 8 Wires





0716-MVS&A-34: Repair Engine Starting System

Overview: These competency standards designed to enable the learner to diagnose the problem related to the battery and starting system and enable the learner to troubleshoot the system if not working

Unit of Competency	Performance Criteria
CU-1: Repair starting system	<p>P-1. Inspect the vehicle starting system and troubleshoot the following: Low cranking speed/ not cranking, Ignition switch operation malfunctioning.</p> <p>P-2. Inspect the vehicle starting system and troubleshoot the following: Unusual noise during operation, corrosive battery terminals, safety neutral switch, incorrect pinion engagement/ disengagement, blown fuse/ relay, lose/ corroded main starting wire.</p>
CU-2: Service Starter Motor.	<p>P-1. Carryout safe procedure to replace the starter motor from the vehicle.</p> <p>P-2. Service/ replace components of starter motor and perform bench testing.</p>

Knowledge & Understanding

K-1. Short circuits and battery related hazards.

Wrong battery installation, touch the positive terminal with the body, un-insulated wire touches with the vehicle body, battery size not matches with the maker, battery acid injury (human eye/ body), disposal of faulty batteries.

K-2. Describe the Wiring diagram associated with the electrical/electronic symbols.

Circuit protection device (Fuse, fusible link, circuit breaker) Circuit switching device (manual switches, electromagnet switch/relay normal open and normal close, pressure switch, temperature switch) Resister (Rating, identification method, effect of change of temperature) Electronic devices (Diode, Zener diode, bipolar transistor, Thyristor, thermistor, heat sink, LED)

K-3. Distinguish between increase/decrease cranking current consumption, voltage drop in a system, electrical load, and reason of high ampere draw from a system/overload.



K-4. Describe the Lenz's law of motor principle, single phase, three phase motor, AC Motor, DC Motor.

Critical Evidence(s) Required

- Troubleshoot the problems related to the vehicle battery.
- Capable to describe the fault related to the battery and take appropriate decisions.
- Capable to troubleshoot the vehicle starting system.
- Service the starter motor.

List of Tools and Equipment

- 1 Vehicle or simulator.
- 2 Toolbox
- 3 Safety goggles
- 4 Gloves
- 5 Battery External chargers
- 6 Battery load testers
- 7 DMM
- 8 Wires
- 9 Hydrometer



0716-MVS&A-35: Repair Battery Charging System

Overview: These competency standards designed to enable the learner to troubleshoot battery charging related problems and conceptualize electronics used in the system.

Unit of Competency	Performance Criteria
CU-1: Repair charging system	P-1. Inspect vehicle charging system and diagnose the following. Battery warning light indication on instrument panel, test output voltage of alternator, drive belt condition, alternator bearing noise, wire harness, fuse, and proper insulated wires. P-2. Dismantle/ service of alternator as following; Repair connector, replace carbon brushes, Replace Rectifier Bridge, replace voltage regulator and replace stator winding.
CU-2: Replace alternator	P-1. Perform safe working practice to remove the alternator from the vehicle and refit under the specified procedure. P-2. Perform test bench of alternator to confirm the operation.

Knowledge & Understanding

K-1. Describe the Purpose and function of Alternator's following parts.

Rotor, stator windings, Voltage regulator, Rectifier Bridge, Internal cooling fan, Bearings, carbon brush, mounting/ adjustment bolts), drive belt and its types, ratio alternator/ crank pulleys, RPM, Alternator input/ output voltages.

K-2. Describe the functions and uses of the following.

Semiconductor and its types, Rectification (Half wave/ full wave), transformer and its types, capacitor and its types.

Critical Evidence(s) Required

- Capable to troubleshoot the vehicle charging system
- Capable to describe the fault related to the alternator and take appropriate decisions.
- Capable to Service the alternator

List of Tools and Equipment

1. Vehicle/simulator
2. Test lamp
3. DMM



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4. Tool kit
5. Ampere meter
6. Fuses
7. Relay



0716-MVS&A-36: Repair Spark Ignition System of Internal Combustion Engine

Overview: These competency standards designed to diagnose and troubleshoot conventional spark ignition system as well as conceptualize the ignition system mechanism in the engine.

Unit of Competency	Performance Criteria
CU-1: Repair Ignition System	<p>P-1. Inspect vehicle Ignition system and diagnose the following: Crank engine and test presence of spark in a system, identify faulty fuse in fuse box (Note: follow safe working procedure).</p> <p>P-2. Inspect vehicle Ignition system and diagnose following: Test performance of plug cable (high tension leads) and plugs, inspect distributor cap/rotor for performance, assess correct ignition timing, inspect vacuum advancer, assess C.B. Point condition/gap and test condenser. (Note: follow safe working procedure).</p>
CU-2: Repair Ignition System (CDI System)	<p>P-1. Inspect the vehicle Ignition system and diagnose the ignition coil performance, (Note: follow safe working procedure).</p> <p>P-2. Inspect the vehicle Ignition system and diagnose the CDI of distributor. (Note: follow safe working procedure).</p>

Knowledge & Understanding

K-1. Describe the Purpose and function of ignition system's following parts in Spark ignition system contact breaker type, spark ignition system breaker less type. Ignition switch, Ignition coil, resistor, plug cable, distributor cap, rotor arm, vacuum advancer, centrifugal advancer, contact breaker assembly, condenser, high tension leads/ connectors, suppression, spark plug (construction, heat range type, size), Magnetic Reflector, Hall Effect trigger/ amplifier, differentiate the performance of contact breaker and contact breaker less type.

Critical Evidence(s) Required

- Troubleshoot the vehicle ignition system (Non EFI engines)
- Capable to adjust the ignition timing
- Capable to service the ignition system.

List of Tools and Equipment

1. Vehicle/ Simulator



2. Digital Multi meter (DMM).
3. Tools box
4. Test Lamp
5. Timing gun

0716-MVS&A-37: Adjust Ignition Timing of Spark Ignition Engine

Overview: These competency standards designed to diagnose and troubleshoot conventional spark ignition system as well as conceptualize the ignition system mechanism in the engine

Unit of Competency	Performance Criteria
CU-1: Adjust Ignition Timing	P-1. Installation of distributor assembly under specified procedure and start the engine, adjust ignition timing with the help of timing gun. P-2. Inspect/ Replace ignition switch, inspect/ replace ignition coil, and Repair/ replace electrical connectors under specified procedure.
CU-2: Repair Ignition System	P-1. Inspection of crank position sensor under specified procedure and starts the engine. P-2. Inspection/replace of ignition fuse under specified procedure and starts the engine.

Knowledge & Understanding

- K-1.** Describe primary circuit, secondary circuit of ignition system, identifies change in the spark timing in accordance to the load and speed of the engine.
- K-2.** Explain Faradays law of mutual induction and calculate the primary and secondary voltages and current.

Critical Evidence(s) Required

- Troubleshoot the vehicle ignition system (Non EFI engines)
- Capable to adjust the ignition timing
- Capable to service the ignition system.

List of Tools and Equipment

1. Vehicle/ Simulator
2. Digital Multi meter (DMM).
3. Tools Box
4. Test Lamp
5. Timing Gun



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0716-MVS&A-38: Repair Distributer-Less Ignition System

Overview: These competency standards designed to enable the learner to troubleshoot the electronic ignition related problems in the vehicle.

Unit of Competency	Performance Criteria
CU-1: Troubleshoot Distributer Less Systems	P-1. Use of scanner and find out the fault related to the ignition coil and reset the trouble code by use of scanner. P-2. Use of scanner and find out the fault related to the crank sensor and reset the trouble code by use of scanner. P-3. Use of scanner and find out the fault related to the crank sensor and reset the trouble code by use of scanner.
CU-2: Repair Distributor Less Systems	P-1. Use test lamp and identify the faulty fuse in the fuse box under the specified procedure. P-2. Replace the faulty fuse with the same color and start the engine under the specified procedure. P-3. Replace the faulty ignition coil and faulty sensor under the specified procedure.

Knowledge & Understanding

K-1. Ignition advance mechanism in Distributor less system, Dual coil system, Coil on plug system, crank sensor signals,

Critical Evidence(s) Required

- Capable to diagnose and troubleshoot the electronic ignition system.
- Capable to replace faulty parts of electronic ignition system.

List of Tools and Equipment

- 1 Tools trolley (Complete set of hand tools)
- 2 Scanner
- 3 Test lamp
- 4 DMM (Multi meter)



0716-MVS&A-39: Repair Lightning System of Vehicle

Overview: These competency standards designed to enable the learner to rectify electrical related troubles IN the vehicle and understand the Wiring of the vehicle.

Unit of Competency	Performance Criteria
CU-1: Troubleshoot The Lightening System	P-1. Inspect vehicle lightening system and diagnose following; under specified testing instructions, Blown fuse finding from interior or exterior fuse box. (Note: follow safe working procedure). P-2. Inspect vehicle lightening system and diagnose following; under specified testing instructions, faulty relay and faulty flasher. (Note: follow safe working procedure).
CU-2: Repair Lights	P-1. Inspect vehicle lightening system and diagnose following under specified testing instructions. Inspect/ Replace head lamp, parking bulb and indicator bulb (Note: follow safe working procedure). P-2. Inspect vehicle lightening system and diagnose following under specified testing instructions. Back light bulb, reverse light bulb. (Note: follow safe working procedure).

Knowledge & Understanding

K-1. Identify the terms used and calculations associated with the electricity. Definitions (magnetism, self/ mutual induction). Laws (amperes rule, Fleming's rule) Switch (manual, magnet, pressure, temperature) sender (fuel level, temperature)

Critical Evidence(s) Required

- Capable to troubleshoot the vehicle lightening system

List of Tools and Equipment

- 1 Tools trolley (Complete set of hand tools)
- 2 Scanner
- 3 Test lamp
- 4 DMM (Multi meter)



0716-MVS&A-40: Repair Cooling System and Vehicle Accessories

Overview: These competency standards designed to enable the learner to rectify electrical related troubles IN the vehicle and understand the Wiring of the vehicle.

Unit of Competency	Performance Criteria
CU-1: Repair Cooling System and Vehicle Accessories	<p>P-1. Inspects the Radiator fan operation for correct operation under specified testing instructions.</p> <p>P-2. Inspects the thermal switch for correct operation under specified testing instructions.</p> <p>P-3. Inspects the temperature sender for correct operation under specified testing instructions.</p>
CU-2: Repair Electrical Accessories	<p>P-1. Inspects the oil warning switch operation for correct operation under specified testing instructions.</p> <p>P-2. Inspects fuse, relay operation for correct operation under specified testing instructions.</p> <p>P-3. Inspects the fuel sender operation for correct operation under specified testing instructions.</p> <p>P-4. Inspects the wiper motor, washer motor for correct operation under specified testing instructions.</p> <p>P-5. Inspects heating Elements for correct operation under specified testing instructions</p>

Knowledge & Understanding

- K-1.** Identify terms used and calculations associated with the electricity. Definitions (magnetism, self/mutual induction). Laws (amperes rule, Fleming's rule)
- K-2.** Describe the use of following materials in vehicle with example. Conductor (Good/bad), Insulator, semiconductors, electrical Cable (Color coding, ampere rating, wire harness, cross sectional area, cable identification method).
- K-3.** Differentiates each in following. Switch (manual, magnet, pressure, temperature) sender (fuel level, temperature)

Critical Evidence(s) Required

- Capable to troubleshoot the vehicle lightening system
- Capable to describe the fault related to the electrical lights and cooling system, and take appropriate decisions.

List of Tools and Equipment

- 1 Vehicle/ simulator, 2 Digital Multi Meter (DMM).
- 3 Tools box, 4 test lamp



0716-MVS&A-41: Recognize Electrical system of Vehicle

Overview: This Competency Standard identifies the competencies required to identify machine electrical system, Inspect machine electrical system,

Competency Units	Performance Criteria
CU1 Identify machine electrical system	P-1. Identify the wiring P-2. Identify the sensors P-3. Identify the solenoids P-4. Identify the switches P-5. Identify the fuse P-6. Identify the relay P-7. Identify the alternator P-8. Identify the starting motor P-9. Identify the battery P-10. Identify the motors P-11. Identify the resistors, diodes P-12. Identify lights, horn
CU2 Inspect machine electrical system	P-1. Inspect the wiring P-2. Inspect the sensors P-3. Inspect the solenoids P-4. Inspect the switches P-5. Inspect the fuse P-6. Inspect the relay P-7. Inspect the alternator P-8. Inspect the starting motor P-9. Inspect the battery P-10. Inspect the motors P-11. Inspect the resistors, diodes P-12. Inspect lights, horn

CU3. Troubleshoot of machine electrical system	P-1. Troubleshoot the wiring
	P-2. Troubleshoot the sensors
	P-3. Troubleshoot the solenoids
	P-4. Troubleshoot the switches
	P-5. Troubleshoot the fuse
	P-6. Troubleshoot the relay
	P-7. Troubleshoot the alternator/
	P-8. Troubleshoot the starting motor
	P-9. Troubleshoot the battery
	P-10. Troubleshoot the motors
	P-11. Troubleshoot the resistors, diodes
	P-12. Troubleshoot the lights, horn

CU4. Repairing of machine electrical system	P1. Repair the wiring
	P2. Repair the alternator
	P3. Repair the starting motor
	P4. Repair the motors

Knowledge & Understanding

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

- K-1.** Describe Electrical wiring
- K-2.** Describe the sensors
- K-3.** Describe the solenoids
- K-4.** Describe the switches
- K-5.** Describe the fuse
- K-6.** Describe the relay
- K-7.** Describe the alternator
- K-8.** Describe the starting motor
- K-9.** Describe the battery
- K-10.** Describe the motors
- K-11.** Describe the resistors, diodes
- K-12.** Describe the lights, horn

Critical Evidence(s) Required

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

- Capable to repair Electrical wiring
- Capable to check the sensors
- Capable to check the solenoids
- Capable to check switches

- Capable to check fuse
- Capable to check relay
- Capable to check and repair alternator
- Capable to check and repair starting motor
- Capable to check battery
- Capable to check motors
- Capable to check resistors, diodes
- Capable to check lights, horn

List of Tools and Equipment's

- 1 Tools trolley (Complete set of Hand Tools)
- 2 Special Service tools

0716-MVS&A-42: Participate In Workplace Communication

Overview

This unit covers the knowledge, skills and attitudes required to gather, interpret and convey information in response to workplace requirements

Unit of Competency	Performance Criteria
CU-1: Obtain and convey Workplace information	<p>P-1 Assess the Specific and relevant information from the appropriate sources</p> <p>P-2 Convey and gather the information of Effective questioning, active listening and speaking skills.</p> <p>P-3 Transfer the information using the appropriate medium and ideas.</p> <p>P-4 Use appropriate non- verbal communication.</p> <p>P-5 Identify and follow appropriate lines of communication with supervisors and colleagues.</p> <p>P-6 Use the defined workplace procedures for the location and storage of information.</p> <p>P-7 Carry out Personal interaction clearly and concisely.</p>
CU-2: Participate in workplace meetings and discussions	<p>P-1 Attend the team meetings on time</p> <p>P-2 Clearly express your own opinions and listen other's point of view without interruption.</p> <p>P-3 Established the protocols in the courteous manner of meeting inputs with the meeting purpose and Workplace interactions.</p> <p>P-4 Questions about simple routine workplace procedures and matters concerning working conditions of employment are asked and responded to Meetings outcomes are interpreted and implemented</p>
CU-3: Complete relevant work related documents	<p>P-1 Range of forms relating to conditions of employment are completed accurately and legibly</p> <p>P-2 Workplace data is recorded on standard workplace forms and documents</p> <p>P-3 Perform the basic mathematical processes that are used for routine calculations</p> <p>P-4 Identify the errors in recording information on forms/ documents and properly acted upon</p> <p>P-5 Reporting requirements to supervisor are completed according to organizational guidelines</p>

Knowledge & Understanding

Describe the following.

- K-1 Appropriate sources:** Team members, Suppliers, Trade personnel, Local government, Industry bodies
- K-2 Medium:** Memorandum, Circular, Notice, Information discussion, Follow-up or verbal, instructions, Face to face communication.
- K-3 Storage:** Manual filing system, Computer-based filing system.
- K-4 Forms:** Personnel forms, telephone message forms, safety reports.
- K-5 Workplace interactions:** Face to face, Telephone, Electronic and two way radio, Written including electronic, memos, instruction, and forms, non-verbal including gestures, signals, signs and diagrams
- K-6 Protocols:** Observing meeting, Compliance with meeting decisions, Obeying meeting instructions

Knowledge & Understanding

- K-5.** Describe the different hydraulic symbol
- K-6.** Describe the different hydro pneumatic symbol.
- K-7.** Describe the pneumatic symbol.
- K-8.** Describe the different electro pneumatic symbols.

Critical Evidence(s) Required

- Capable to identify the hydraulic symbol.
- Capable to identify the pneumatic symbol.

0716-MVS&A-43: Practice Occupational Health and Safety Procedures

Overview

This unit covers the outcomes required to comply with regulatory and organizational requirements for occupational health and safety

<i>Unit of Competency</i>	<i>Performance Criteria</i>
CU-1: Identify hazards and risks	P-1 Identify the safety regulations and workplace safety and hazard control practices and procedures are clarified and explained based on organization procedures P-2 Identify the hazards/risks in the workplace and their corresponding indicators to minimize or eliminate risk to co-workers, workplace and environment in accordance with organization procedures. P-3 Contingency measures during workplace accidents, fire and other emergencies are recognized and established in accordance with organization procedures

CU-2: Evaluate hazards and risks	<p>P-1 Identify the terms of maximum tolerable limits which when exceeded will result in harm or damage are identified based on threshold limit values (TLV)</p> <p>P-2 Identify the effects of the hazards.</p> <p>P-3 Identify the OHS issues and/or concerns and safety hazards are reported to designated personnel in accordance with workplace requirements and relevant workplace OHS legislation.</p>
CU-3: Control hazards and risks	<p>P-1 Identify the occupational Health and Safety (OHS) procedures for controlling hazards/risks in workplace are consistently followed</p> <p>P-2 Procedures for dealing with workplace accidents, fire and emergencies are followed in accordance with organization OHS policies</p> <p>P-3 Use of Personal protective equipment (PPE) in accordance with organization OHS procedures and practices.</p> <p>P-4 Provide the appropriate assistance in the event of a workplace emergency in accordance with established organization protocol.</p>
CU-4: Maintain OHS awareness	<p>P-1 Practice the emergency-related drills and trainings as per established organization guidelines and procedures.</p> <p>P-2 Update and complete the OHS personal records in accordance with workplace requirements.</p>

Knowledge & Understanding

- K-1 Safety regulations:** May include but are not limited to: Clean Air Act, Building code, National Electrical and Fire Safety Codes, Waste management statutes and rules, Philippine Occupational Safety and Health Standards, DOLE regulations on safety legal requirements, ECC regulations.
- K-2 Hazards/Risks:** May include but are not limited to: Physical hazards – impact, illumination, pressure, noise, vibration, temperature, radiation, Biological hazards- bacteria, viruses, plants, parasites, mites, molds, fungi, insects, Chemical hazards – dusts, fibers, mists, fumes, smoke, gasses, vapors Ergonomics, Psychological factors – over exertion/ excessive force, awkward/static positions, fatigue, direct pressure, varying metabolic cycles Physiological factors – monotony, personal, relationship, work out cycle.
- K-3 Contingency measures:** May include but are not limited to: Evacuation, Isolation, Decontamination, (Calling designed) emergency personnel.
- K-4 PPE:** May include but are not limited to: Mask, Gloves, Goggles, Hair Net/cap/bonnet, Face mask/shield, Ear muffs, Apron/Gown/coverall/jump suit, Anti-static suits.

K-5 Emergency-related drills and training: Fire drill, Earthquake drill, Basic life support/CPR, First aid, Spillage control, Decontamination of chemical and toxic, Disaster, preparedness/management.

K-6 OHS personal records: Medical/Health records, Incident reports, Accident reports, OHS-related training completed.

Knowledge & Understanding

K-9. Describe the different hydraulic symbol

K-10. Describe the different hydro pneumatic symbol.

K-11. Describe the pneumatic symbol.

K-12. Describe the different electro pneumatic symbols.

Critical Evidence(s) Required

- Capable to identify the hydraulic symbol.
- Capable to identify the pneumatic symbol.

0716-MVS&A-44: Perform Work In Team Environment

Overview

This unit covers the skills, knowledge and attitudes to identify role and responsibility as a member of a team

<i>Unit of Competency</i>	<i>Performance Criteria</i>
CU-1: Describe team role and scope	P-1 Identify the role and objective of the team from available sources of information. P-2 Identify team parameters, reporting relationships and responsibilities from team discussions and appropriate external sources.
CU-2: Identify own role and responsibility within team	P-1 Identify the individual role and responsibilities within the team environment. P-2 Identify and recognize the roles and responsibility of other team members. P-3 Reporting relationships within team and external to team are identified
CU-3: Work as a team member	P-1 Effective and appropriate forms of communications used and interactions undertaken with team members who contribute to known team activities and objectives P-2 Effective and appropriate contributions made to complement team activities and objectives, based on individual skills and competencies and workplace context P-3 Observed protocols in reporting using standard operating procedures P-4 Contribute to the development of team work plans based on an understanding of team's role and objectives and

Knowledge & Understanding:

- K-1 Role and objective of team:** Work activities in a team environment with enterprise or specific sector, Limited discretion, initiative and judgment maybe demonstrated on the job, either individually or in a team environment.
- K-2 Sources of information:** Standard operating and/or other workplace procedures, Job procedures, Machine/equipment manufacturer's specifications and instructions, Organizational or external personnel, Client/supplier instructions, Quality standards, OHS and environmental standards.
- K-3 Workplace context:** Work procedures and practices, Conditions of work environments, Legislation and industrial agreements, Standard work practice including the storage, safe handling and disposal of chemicals, Safety, environmental, housekeeping and quality guidelines.

Knowledge & Understanding

- K-13.** Describe the different hydraulic symbol

K-14. Describe the different hydro pneumatic symbol.

K-15. Describe the pneumatic symbol.

K-16. Describe the different electro pneumatic symbols.

Critical Evidence(s) Required

- Capable to identify the hydraulic symbol.
- Capable to identify the pneumatic symbol.

Problems in IC Engines

0716-MVS&A-45: Diagnose and Adjust Engine Fault

Overview

These competency standards designed to enable the learner to find out the faults and rectify accordingly, learner will be able to overhaul the engine under the specified format in the service manual.

Unit of Competency	Performance Criteria
CU-1: Engine fault diagnosing	P1. Start the engine and identify the condition of engine rpm fluctuating, stalling, and lack of power, excessive smoke (Black, blue and white), excessive fuel consumption, excessive oil consumption, and leakages. P2. Use the compression tester and test engine compression to diagnose fault in piston rings or valve seats/burnt valve under specified procedure.
CU-2: Engine fault adjustment	P-1. Perform engine adjustment/setting of Engine Timing, fuel injector problem, valve adjustment, drive belt/fan belt adjustment. P-2. Change the engine cylinder head gasket, Crankshaft oil seals, Engine timing belt, manifold gasket, and exhaust muffler. P-3. Check Lubricating systems. P-4. Check fuel systems P-5. Check cooling systems.

Knowledge & Understanding

K1. Describe the following.

Valve timing, Injector advanced timing and retard timing, overlap, timing diagrams, valve, clearances/ adjustment/ adjustment methods.

K2. Terms: Top Dead Centre (TDC), Bottom Dead Centre (BDC), Bore, Stroke, Capacity, Clearance Volume, Swept Volume, Compression Ratio, Crank Throw, Torque at Revs/Min, Brake power at Revs/min, Specific fuel consumption (SFC), Volumetric Efficiency, OHV, and OHC.

K3. Understand different troubleshooting chart of different problem of engine

Critical Evidence(s) Required

- Capable of adjustments.
- Capable of changing faulty components.

List of Tools and Equipment

S No.	Descriptions
1	Tools trolley (complete set of tools)
2	Compression tester, compression gauge)
3	Measuring tools (Vernier caliper, micrometer, bore gauge, dial gauge, Steel rule, filler gauge, try square)
4	Torque wrench
5	Impact gun
6	Oil can
7	Belt tensioner
8	Spray gun
9	Valve lapping tool
10	Timing gun
11	Engine analyzer

12	Tachometer
13	Scraper

Consumable Items:

S No.	Descriptions
1	Fuel (petrol/diesel)
2	Cotton rag
3	WD 40 spray
4	Carb cleaner spray
5	Kerosene oil
6	Engine oil
7	Engine coolant
8	fan belt
9	Timing belt
10	oil seals
11	Gasket
12	Silicone
13	Emery paste

0716-MVS&A-46: Diagnose and adjust faults of engine exhaust system

Overview

These competency standards designed to enable the learner to find Trace Faults of exhaust system and adjust faults exhaust system.

Unit of Competency	Performance Criteria
CU1. Trace Faults of exhaust system	P1. Inspect exhaust manifold. P2. Inspect diesel particulate filter. P3. Inspect exhaust pipe. P4. Inspect muffler assembly. P5. Inspect tail pipe. P6. Identify the factors influencing power of engine
CU2. Adjust faults exhaust system	P1. Troubleshoot exhaust manifold. P2. Troubleshoot diesel particulate filter. P3. Troubleshoot exhaust pipe. P4. Troubleshoot muffler assembly. P5. Troubleshoot tail pipe.

Knowledge & Understanding

- K1.** Describe exhaust system components.
- K2.** Describe exhaust system problems.
- K3.** Describe influencing power of engine.

Critical Evidence(s) Required

- Capable inspect exhaust system components
- Capable to troubleshoot exhaust system components

List of Tools and Equipment

S No.	Descriptions
1	Tools trolley (complete set of tools)
2	Special service tool

0716-MVS&A-47: Diagnose faults of engine cylinder head

Overview

These competency standards designed to enable the learner to inspect cylinder head components and troubleshoot cylinder head components.

Unit of Competency	Performance Criteria
CU1. Inspect cylinder head components	P1. Inspect cylinder valve P2. Measure clearance of valve guide. P3. Measure clearance of valve seat. P4. Measure tension of valve spring P5. Inspect rocker arm P6. Inspect rocker arm shaft. P7. Inspect push rod P8. Measure tappets cover clearance. P9. Inspect cam shaft P10. Inspect cam lob. P11. Inspect cylinder head intake port. P12. Inspect cylinder head exhaust port.
CU2. Troubleshoot cylinder head components	P1. Troubleshoot/replace cylinder valve P2. Replace valve guide. P3. Replace valve seat. P4. Replace valve spring P5. Troubleshoot/replace rocker arm P6. Troubleshoot/replace rocker arm shaft. P7. Troubleshoot/replace push rod P8. Troubleshoot/replace tappet cover P9. Troubleshoot/replace cam shaft P10. Troubleshoot cylinder head intake port. P11. Troubleshoot cylinder head exhaust port.

Knowledge & Understanding

- K1. Describe valve problems.
- K2. Describe camshaft problems.
- K3. Describe engine sounds
- K4. Describe cylinder head problems
- K5. Describe cylinder head gasket problems.

Critical Evidence(s) Required

- Capable of inspect cylinder head components.
- Able to troubleshoot cylinder head components.
- Able to replace cylinder head components.

List of Tools and Equipment

S No.	Descriptions
1	Tools trolley (complete set of tools)
2	Engine

0716-MVS&A-48: Diagnose faults of engine cylinder block

Overview

These competency standards designed to enable the learner to inspect cylinder block components and troubleshoot cylinder block components.

Unit of Competency	Performance Criteria
CU1. Inspect cylinder block components	P1. Inspect crank shaft P2. Measure crank shaft end play P3. Measure crank shaft ovality P4. Inspect connecting rod P5. Inspect piston pin P6. Inspect piston head P7. Inspect piston skirt P8. Inspect compression rings P9. Inspect oil ring P10. Inspect cylinder sleeve P11. Measure cylinder sleeve dia P12. Measure cylinder sleeve ovality P13. Measure cylinder sleeve tapperness
CU2. Troubleshoot cylinder block components	P1. Rebuild/Replace crank shaft P2. Rebuild/Replace connecting rod P3. Replace piston pin P4. Replace piston P5. Replace compression rings P6. Replace oil ring P7. Replace cylinder sleeve

Knowledge & Understanding

- K1. Describe piston problems.
- K2. Describe piston ring problems
- K3. Describe sleeves problems.
- K4. Describe connecting rod problems.
- K5. Describe crank shaft problems.
- K6. Describe piston pin problems.

Critical Evidence(s) Required

- Capable of inspect cylinder block components.
- Able to replace cylinder block components.
- Able to rebuild cylinder head components.

List of Tools and Equipment

S No.	Descriptions
1	Tools trolley (complete set of tools)

0716-MVS&A-49: Perform Complete Overhauling of Diesel Engine

Overview

These competency standards designed to enable the learner to find out the faults and rectify accordingly, learner will be able to overhaul the engine under the specified format in the service manual.

Unit of Competency	Performance Criteria
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CU-1: Engine sub-assemblies	<p>P-1. Make the engine sub-assemblies and inspect the performance for (setting piston rings, piston pin and connecting rod),</p> <p>P-2. Make the engine sub-assemblies and inspect the performance for (valve train and test for the leakage from valve seats),</p> <p>P-3. Make the engine sub-assemblies and inspect the performance for (fitting crankshaft with main bearings and pistons with the big end bearings),</p> <p>P-4. Perform the straightness inspect of engine head and block straightness/warpage level and make decision for correctness.</p>
CU-2: Engine measurement	<p>P-1. Use appropriate measuring tool and Measure piston bore, measure crankshaft main journals (dia and ovality), crankshaft big end journals,</p> <p>P-2. Use appropriate measuring tool and Measure Camshaft main journals (dia and ovality), Cam loops,</p> <p>P-3. Use appropriate measuring tool and Measure engine thrust washer, and piston connecting pin.</p> <p>P-4. Assemble the engine block with the engine head and adjust tappets, engine timing, and injector distributor of diesel in engine under specified procedure.</p> <p>P-5. Check cylinder liners ovality.</p>

Knowledge & Understanding

K-1. The possible causes of high fuel consumption as following.

Overload the engine, excessive oil reducing, faulty air filter, carburetor poor setting, engine over cooled and hard/jam running of engine, faulty fuel injectors, faulty fuel pump/fuel filter.

Critical Evidence(s) Required

- Capable to take decision for engine overhauling.
- Capable of knowing the engine faults
- Capable to assemble the engine.
- Capable to measure the engine components

List of Tools and Equipment

S No.	Description
1	Tools trolley (complete set of tools)
2	Compression tester, compression gauge)
3	Measuring tools (Vernier caliper, micrometer, bore gauge, dial indicator gauge, Steel rule, filler gauge, try square, mercer gauge)
4	Torque wrench
5	Impact gun
6	Oil can
7	Belt tensioner
8	Spray gun
9	Valve lapping tool
10	Timing gun
11	Engine analyzer
12	Tachometer
13	Scraper

Consumable Items:

S No.	Description
1	Fuel (petrol/diesel)
2	Cotton rag
3	WD 40 spray
4	Carb cleaner spray
5	Kerosene oil
6	Engine oil
7	Engine coolant
8	fan belt
9	Timing belt
10	oil seals
11	Gasket
12	Silicone
13	Emery paste

0716-MVS&A-50: Diagnose Engine Cooling System Faults and Repair

Overview

These competency standards designed to enable the learner to diagnose the fault related to the vehicle cooling system and troubleshoot accordingly.

Unit of Competency	Performance Criteria
CU-1: Cooling system service	<p>P-1. Inspect engine cooling system's main components and diagnose the performance of (Radiator cap, Radiator fan, water body/ pump, drive belt/ fan belt, thermostat Valve, radiator, Drain plug, hoses/ clamps, and gasket/ seals)</p> <p>P-2. Flush the cooling system.</p> <p>P-3. Clean the radiator core with air by revising the direction of rotation of fan motor.</p> <p>P-4. Inspect/ service the radiator and top up with the coolant/ antifreeze as per specified ratio in the manual.</p>
CU-2: Repair Cooling system	<p>P-1. Change the water body under specified procedure and start the engine to confirm correct operation.</p> <p>P-2. Adjust fan belt tension under specified procedure and start the engine to confirm correct operation.</p>

Knowledge & Understanding

- K-1.** Describe the operating principles and terminologies of cooling system as following.
Air cooled engine, liquid cooled engine, operating temperature, thermal efficiency, pressurized system, heat exchange method (conduction, radiation, and convection), corrosion, and inhibitors/ antifreeze)
- K-2.** Describe the functions and purpose of engine cooling system components as following.
Electrical motor operated fan with thermo switch, belt operated fan, temperature controlled/viscous coupling fan, pressure cap, water body/pump, drive belt, thermostat, radiator, core plug, hoses/clamps, and gasket/ seals.

Critical Evidence(s) Required

- Capable of diagnose, adjust and rectify the cooling system faults.

List of Tools and Equipment

S No.	Description
1	Hand tools trolley
2	Radiator leak tester

3	Vehicle/ simulator with a cooling system
5	Drive belt

Consumable Items:

S No.	Description
1.	Sealant
2.	Hose pipe
3.	Thermostat valve

0716-MVS&A-51: Diagnose Engine Lubrication System Faults and Repair

Overview

These competency standards designed to enable the learner to diagnose the fault related to the lubrication system and troubleshoot accordingly.

Units of Competency	Performance Criteria
CU-1: Lubrication system	<p>P-1. Inspect engine lubrication system's main components and check (engine oil level)</p> <p>P-2. Inspect engine lubrication system's main components and check (oil leakage)</p> <p>P-3. Inspect engine lubrication system's main components and check (oil warning switch)</p> <p>P-4. Inspect engine lubrication system's main components and check (PCV valve)</p> <p>P-5. Check the remaining hours of engine oil and filter from monitor screen.</p>
CU-2: Repair Lubrication system	<p>P-1. Inspect/replace of oil warning switch, PCV valve, oil sump, oil sump seal/gasket, and oil pump under the specified procedure.</p> <p>P-2. Carryout safe procedure to change the engine oil and oil filter.</p>

Knowledge & Understanding

K-1. Describe the functions/operating principle and main components of engine lubrication system as following.

Wet sump, dry sump, total loss, Oil pumps and its types, pressure relief valves, oil filter, oil cooler, ventilation/ PCV Valve, hoses, and oil level indicators.

Lubricant (oils viscosity, viscosity index, oil classifications, Reduction of frictional forces, cooling effect, cleaning effect, corrosion resistance, and noise reduction).

K-2. Describes the procedure to change the engine oil and oil filter.

Critical Evidence(s) Required

- Capable of diagnose, adjust and rectify the lubrication system faults.
- Capable to change the engine oil and filter.

List of Tools and Equipment

S No.	Description
1	Hand tools trolley
2	Lifter
3	Vehicle/ simulator with a cooling system
4	Sealant/gasket

0716-MVS&A-52: Perform testing of engine with the help of Work Bench

Overview These competency standards designed to diagnose and troubleshoot different types of engines as well as conceptualize the fuel injection system mechanism in the engine.

Unit of Competency	Performance Criteria
CU1. Work bench of 200 HP engine	<p>P-1. Check the Engine Torque, oil Temperature, coolant temperature, fuel temperature and fuel pressure.</p> <p>P-2. Check the periodic duration of fuel filter, oil filter and air filter.</p>

	P-3. Diagnose the electrical faults related to engine.
CU2. Work bench of C9 engine	<p>P1. Attach the ET (Electronic Technician) with the Engine with the described in the manual.</p> <p>P2. Check the Engine Torque, oil Temperature, coolant temperature, fuel temperature and fuel pressure.</p> <p>P3. Check the periodic duration of fuel filter, oil filter and air filter.</p> <p>P4. Diagnose the electrical faults related to engine.</p> <p>P5. Diagnose the fault of fuel injectors.</p> <p>P6. Check the Fuel delivery amount.</p> <p>P7. Perform calibration of injector.</p>

Knowledge & Understanding

- K-1.** Describe the Purpose and function of workbench.
- K-2.** Describe Nomenclature of engine.
- K-3.** Micron rating of fuel filter, air filter and oil filter.
- K-4.** Describe the function of TECH-2.
- K-5.** Describe the Purpose and function of ET tester.
- K-6.** Describe Temperature, pressure, velocity and torque

Critical Evidence(s) Required

- Troubleshoot the vehicle Electrical system.
- Capable to adjust the injector timing
- Capable to service the fuel system.
- Capable to use TECH_2 Tester
- Capable to use ET Tester.

List of Tools and Equipment

S No.	Description
	1. Engine/ Simulator
	2. TECH-2 tester
	3. ET Tester
	4. Digital Multimeter (DMM).
	5. Tools Box

Workshop Practice – II

0716-MVS&A-53: Recognize Types of tools

Overview: This competency standard identifies the competencies you need to identify standard tools and identify special service tools.

Competency Units	Performance Criteria
CU1. Identify standard tools	<p>P1. Identify different types of spanners.</p> <p>P2. Identify different types of sockets.</p> <p>P3. Identify different types of wrenches.</p> <p>P4. Identify different types of screw drivers.</p> <p>P5. Identify different types of pillars.</p> <p>P6. Identify different types of snap ring extractors.</p>

P7. Identify different types of snap ring installers.
P8. Identify different types of hammers.
P9. Identify different types of bars.
P10. Identify different types of hexagonal Wrenches.

CU2. Identify special service tools	P1. Identify different types of pullers. P2. Identify different types of cranes. P3. Identify different types of hydraulic jacks. P4. Identify different components of flaring tools.
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Knowledge & Understanding

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

- K1.** Describe different sizes of spanners.
- K2.** Describe different sizes of sockets.
- K3.** Describe different sizes of wrenches.
- K4.** Describe different sizes of screw drivers.
- K5.** Describe different sizes of pillars.
- K6.** Describe different sizes of snap ring extractors.
- K7.** Describe different sizes of snap ring installers.
- K8.** Describe different sizes of hammers.
- K9.** Describe different sizes of bars.
- K10.** Describe different sizes of hexagonal Wrenches.
- K11.** Describe different types of Cranes.

Critical Evidence(s) Required

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

- Capable to understand Spanners.
- Capable to understand sockets.
- Capable to understand wrenches.
- Capable to understand screw drivers.
- Capable to understand pillars.
- Capable to understand snap ring extractors and installers.
- Capable to understand hammers.
- Capable to understand bars
- Capable to understand flaring Tools.
- Capable to understand cranes.

List of Tools and Equipment

S No.	Descriptions
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1	Tools trolley (Complete set of Hand Tools)
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0716-MVS&A-54: Identify Gauges

Overview: This competency standard identifies the competencies you need to maintain Compression Gauge, vacuum gauge and mercer gauge.

Competency Units		Performance Criteria
CU1. Maintain Compression Gauge		P1. Identify different types of Compression gauge. P2. Remove Spark Plug/glow plug. P3. Select the adopter as per requirement. P4. Install compression gauge on engine. P5. Crank the engine. P6. Get three reading and get average. P7. Compare reading with chat.
CU2. Maintain Gauge	Vacuum	P1. Remove take of port adopter from intake manifold. P2. Select the adopter as per requirement. P3. Install vacuum gauge on intake manifold. P4. Crank the engine. P5. Get three reading and get average. P6. Compare reading with chat.
CU3. Maintain Gauge	Mercer	P1. Identify rod. P2. Identify dial indicator. P3. Identify extension. P4. Identify extension rod. P5. Identify adopter. P6. Identify shims. P7. Identify contact point. P8. Check cylinder bore Dia. P9. Check cylinder bore ovality. P10. Check cylinder bore tapperness.

Knowledge & Understanding

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

- K-1. Describe compression gauge.
- K-2. Describe tests of compression gauge.
- K-3. Describe vacuum gauge.
- K-4. Describe procedure of vacuum gauge.
- K-5. Describe mercer gauge.
- K-6. Describe procedure to check cylinder bore dia.
- K-7. Describe procedure to check cylinder bore ovality.
- K-8. Describe procedure to check cylinder bore tapperness.

Critical Evidence(s) Required

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

- Capable to check the compression of engine.

- Capable to check the vacuum of engine.
- Capable to check the cylinder bore dia.
- Capable to check the cylinder bore ovality.
- Capable to check the cylinder bore tapperness.

List of Tools and Equipment

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Compression Gauge
3	Vacuum Gauge
4	Mercer Gauge
5	Dial Indicator

0716-MVS&A-55: Demonstrate Gas Analyser

Overview: This competency standard identifies the competencies you need to maintain four gas analyse and handy smoke tester.

Competency Units		Performance Criteria
CU1. Demonstrate Gas Analyzer	Four	P1. Identify transformer. P2. Identify primary filters. P3. Identify secondary filters. P4. Identify probe. P5. Point out main screen. P6. Connect probe with gas analyzer. P7. Connect transformer with gas analyzer. P8. Plug in transformer wire in electric socket. P9. Put probe in tail pipe of vehicle. P10. Start the engine. P11. Get readings.
CU2. Demonstrate Handy Smoke Tester	Handy	P1. Identify main feed pump. P2. Identify paper filters. P3. Identify probe. P4. Identify handle. P5. Identify suction holes. P6. Put probe in tail pipe. P7. Put the paper in taster. P8. Start the engine. P9. Put engine on high idle. P10. Pull the handle of tester to suck the exhaust gasses. P11. Remove the filter. P12. Match the color of filter paper with chat.

Knowledge & Understanding

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

- K-1.** Describe four gas analyzer.
- K-2.** Describe the procedure to use four gas analyzer.
- K-3.** Describe handy smoke tester.
- K-4.** Describe the procedure to use handy smoke tester.

Critical Evidence(s) Required

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

- Capable to use four gas analyzer.
- Capable to use handy smoke tester.

List of Tools and Equipment

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Four Gas Analyzer
3	Handy Smoke Tester

0716-MVS&A-56: Carry out operation of Head surface grinding machine

Overview: This competency standard identifies the competencies you need to perform Identify the machine and operate the machine.

Competency Units	Performance Criteria
CU1. Identify the machine	<p>P1. Point out Magnetic Table</p> <p>P2. Locate Grinding Wheel</p> <p>P3. Locate Wheel Flange</p> <p>P4. Point out Balancing Mill</p> <p>P5. Point out Dressing Apparatus</p> <p>P6. Point out Extracting Device</p> <p>P7. Locate Parallel Stands</p> <p>P8. Locate Clamping device</p> <p>P9. Locate Lightening Lamp</p> <p>P10. Point out Cooling Unit</p> <p>P11. Point out Hydraulic Unit</p> <p>P12. Locate Tool Set</p>
CU2. Operate the machine	<p>P1. Clamp/Bolt the head on the machine</p> <p>P2. Set the Dial Gauge to Zero for alignment of head</p> <p>P3. Fix the grinding stone</p> <p>P4. Switch on the Cooling unit</p> <p>P5. Set the desired grinding depth</p>

Knowledge & Understanding

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

K-1. Knowledge of electrically simulating faults

Critical Evidence(s) Required

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

- Capable to perform daily checkups
- **List of Tools and Equipment**

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Head Surface Grinding Machine
3	Grinding Tools

0716-MVS&A-57: Carry out operation of Honing Machine

Overview: This Competency Standard identifies the competencies required to Identify and operate the honing machine.

Competency Units	Performance Criteria
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C1. Identify the machine	P1. Locate Honing head P2. Point out Head Extension Spindle & Sleeve P3. Point out Hydraulic Clamping apparatus P4. Locate Bore Centring flange P5. Locate Moveable Head Holder P6. Point out Control Levers P7. Point out Lubrication Tank P8. Locate On-Off Switches
C2. Operate the machine	P1. Centring of sleeve P2. Select grinding/Honing stone according to dia of sleeve P3. Fit the grinding/Honing stone in machine P4. Switch on lubrication oil circulation P5. Operate Tool UP/Down P6. Operate tool in circular motion

Knowledge & Understanding

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

- K1.** Engine , Its system & fault rectification
- K2.** Describe working principle of Alternator & fault rectification
- K3.** Control Panel operation & how to perform the task
- K4.** Describe function & operation of AVR(automatic voltage regulator)
- K5.** Describe function & operation of ATS(auto transfer switch)
- K6.** Identify the cables/harnesses with respect to Voltage.

Critical Evidence(s) Required

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

- Capable to identify the main parts of the generator
- Capable to inspect the generator
- Capable to troubleshoot the generator

List of Tools and Equipment

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Honing Machine
3	Honing Tool

0716-MVS&A-58: Carry out operation of Main line boring machine

Overview: This competency standard identifies the competencies you need to perform identify and operate the boring machine.

Competency Units	Performance Criteria
D1. Identify the machine	<p>P1. Point out Spindle P2. Locate Joint P3. Point out Cutter adjusting micrometer P4. Identify Centering apparatus P5. Point out Parallel Support P6. Point out Leveling apparatus P7. Locate Block clamping apparatus</p>
D2. Operate the machine	<p>P1. Setting of the machine P2. Fasten the Cylinder Block to the machine P3. Fix & centre the cutting tool P4. Align the Cylinder Block P5. Set the cutting depth P6. Set the desired speed P7. Switch on the machine</p>

Knowledge & Understanding

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

- K-1.** Use of measuring tools & knows the troubleshooting procedures to measure the resistance of winding.
- K-2.** Operation of AVR, its function, adjusting & troubleshooting.
- K-3.** Replacement of Fan & Coupling

Critical Evidence(s) Required

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

- Capable to identify the Alternator
- Capable to Inspect the Alternator
- Capable to troubleshoot the Alternator

- **List of Tools and Equipments**

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Main Line Boring Machine
3	Boring Tools

0716-MVS&A-59: Carry out operation of Connecting Rod Boring Machine

Overview: This Competency Standard identifies the competencies required to identify and operate the machine.

Competency Units	Performance Criteria
B1. Identify the machine	P1. Identify the spindle P2. Identify the clamping apparatus P3. Identify the work piece centring apparatus P4. Identify the feed apparatus P5. Identify the Lubrication Pump P6. Identify the drive motor
B2. Operate the machine	P1. Setting of the machine P2. Fasten the connecting rod on the machine P3. Fix & centre the cutting tool P4. Centring of Connecting Rod P5. Set the cutting depth P6. Switch on the machine

Knowledge & Understanding

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

- K-13.** Knowledge of machine component
- K-14.** Knowledge of machine operation

Critical Evidence(s) Required

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

- Capable to perform work on connecting rod boring machine

List of Tools and Equipments

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Connecting Rod Boring Machine
3	Cutting Tools

0716-MVS&A-60: Carry out operation of Crankshaft grinding machine

Overview: This competency standard identifies the competencies you need to identify and operate the machine.

Competency Units	Performance Criteria
E1. Identify the machine	P1. Point out Crankshaft measuring device P2. Locate Wheel dresser apparatus P3. Point out Crankshaft resetting device P4. Point out Shaft Centering Apparatus P5. Locate Steady Supporting base P6. Locate Wheel balancing Plate & Shaft

	P7. Locate Grinding Wheel P8. Point out Cooling Unit P9. Identify Hydraulic System P10. Point out Steady Tail Stock P11. Point out Front Weight P12. Locate Rear Weight P13. Locate Wheel Extracting Key P14. Locate Chuck Key
E2. Operate the machine	P1. Fasten the crankshaft on the machine P2. Balancing & setting of crankshaft on the machine P3. Fix grinding wheel & set the distance. P4. Fix the sand paper for polishing P5. Change lever position for desired working direction

Knowledge & Understanding

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

K-1. Knowledge of Safety Protection

Critical Evidence(s) Required

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

- Capable to operate the Module

List of Tools and Equipments

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Crack Shaft Grinding Machine
3	Grinding Tools

0716-MVS&A-61: Recognize NLINE FUEL SYSTEM

Overview: This Competency Standard identifies the competencies required to Identify and inspect inline fuel Pump Circuit.

Competency Units	Performance Criteria
<p>A1. Identify Inline fuel Pump Circuit</p>	<p>You must be able to:</p> <p>P-13. Locate the fuel tank.</p> <p>P-14. Point out fuel priming pump.</p> <p>P-15. Point out Fuel injection pump.</p> <p>P-16. Locate fuel filters, high pressure lines, return line.</p> <p>P-17. Point out Fuel Injection Nozzles.</p> <p>P-18. Locate adaptors.</p> <p>P-19. Identify different types of Inline Pump.</p> <p>P-20. Figure out different components of hand priming pump.</p> <p>P-21. Identify different components of feed pump.</p> <p>P-22. Point out internal components of pumping element of Inline Pump from cut away model.</p> <p>P-23. Identify different types of inline pump governors.</p> <p>P-24. Point out different components of inline pump Governor from cut away model.</p>
<p>A2. Inspect Inline Fuel Pump Circuit</p>	<p>You must be able to:</p> <p>P1. Analyze fuel tank</p> <p>P2. Analyze fuel tank cap.</p> <p>P3. Disassemble primary pump.</p> <p>P4. Analyze primary fuel pump as per standards.</p> <p>P5. Disassemble fuel injection pump.</p> <p>P6. Analyze Fuel injection pump according to set standards.</p> <p>P7. Inspect fuel filter, high pressure Lines and return line.</p> <p>P8. Remove injection nozzles.</p> <p>P9. Disassemble injection nozzle.</p> <p>P10. Analyze Injection nozzles.</p> <p>P11. Inspect adaptors.</p> <p>P12. Disassemble inline pump governor.</p> <p>P13. Inspect the governor of Inline Fuel Pump.</p>

Knowledge & Understanding

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

- K-15.** Describe of Inline Fuel system.
- K-16.** Describe of Priming Pump
- K-17.** Describe of Feed Pump.
- K-18.** Describe of Governor.
- K-19.** Describe of Inline Pump
- K-20.** Describe of Fuel Injectors/Nozzles. State the micron rating of Fuel Filter
- K-21.** State the cetane rating of Diesel.
- K-22.** Harmful substances in Exhaust gases and their effect on environment.
- K-23.** Sulphur contents in Fuel.

K-24. Fuel internal chemical composition.

K-25. Types of fuels.

K-26. Emission control standards.

Critical Evidence(s) Required

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

- Capable to point out/inspect Inline fuel system fuel lines.
- Capable to identify/inspect Inline Fuel Components.
- Capable to identify/inspect priming pump.
- Capable to identify/inspect feed pump.
- Capable to identify/inspect pumping element.
- Capable to identify/inspect governor of inline pump.

List of Tools and Equipment

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Fuel Filter
3	Inline pump
4	Inline pump injection nozzle

0716-MVS&A-62: Recognize PT (Pressure Time) FUEL SYSTEM

Overview: This Competency Standard identifies the competencies required to identify and inspect PT (Pressure Time) Pump circuit.

Competency Units	Performance Criteria
A1. Identify PT (Pressure Time) Pump circuit	You must be able to: P1. Identify the Main fuel tank P2. Point out Float tank P3. Point out fuel filters and fuel lines. P4. Locate magnetic strainer. P5. Point out pulsation damper. P6. Locate PT pump P7. Point out return line. P8. Point out fuel Injectors. P9. Identify different types of PT Pump. P10. Point out PT pumps governors. P11. Point out shut off solenoid. P12. Identify the internal components of PT Pump from cut away model. P13. Identify the AFC (Air Fuel Control Unit) Unit.
A2. Inspect PT Fuel Pump circuit	You must be able to: P1. Analyze main fuel tank P2. Analyze Float tank. P3. Analyze fuel filter and fuel Lines. P4. Disassemble PT pump. P5. Inspect Gear pump as per standards. P6. Inspect PTG (pressure time gear) Governor. P7. Analyze MVS (Mechanical variable speed) Governor. P8. Analyze VS (variable speed) Governor. P9. Analyze Strainer of PT pump. P10. Inspect the AFC (Air Fuel Control Unit) Unit P11. Analyze Fuel Shut OFF valve. P12. Remove fuel injector. P13. Disassemble fuel injector. P14. Inspect Fuel Injectors. P15. Analyze fuel Return Line

Knowledge & Understanding

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

- Describe of PT Fuel system.
- Describe of PT Pump.
- Describe PTG Governor.
- Describe MVS Governor.
- Describe VS Governor.
- Describe of PT Fuel Injectors.

Critical Evidence(s) Required

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

- Capable to point out/inspect PT fuel system fuel lines.
- Capable to identify/inspect PT Fuel pump Components.

- Capable to point /analyze the PT Injectors.

List of Tools and Equipments

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	PT Pump
3	Fuel filter
4	PT injector

0716-MVS&A-63: Recognize DPA (Distributor Pump Assembly) FUEL SYSTEM

Overview: This Competency Standard identifies the competencies required to Identify and inspect DPA (Distributor Pump Assembly) Fuel Circuit.

Competency Units	Performance Criteria
A1. Identify of DPA (Distributor Pump Assembly) Fuel Circuit	<p>You must be able to:</p> <ul style="list-style-type: none">P1. Locate the Main fuel tankP2. Point out fuel supply pumpP3. Locate Fuel FiltersP4. Point out Pressure Regulator Valve and fuel Lines.P5. Locate DPA fuel pumpP6. Point out Fuel Cut OFF solenoidP7. Locate Return Line.P8. Identify the components of DPA Pump from cut away model.P9. Locate electric circuit for supply pump.P10. Point out the different components of DPA Pump Governor from cut away model.P11. Locate the injection nozzles.P12. Identify different types of injection nozzles.
A2. Inspect of DPA (Distributor Pump Assembly) Fuel Circuit	<p>You must be able to:</p> <ul style="list-style-type: none">P1. Analyze the fuel tank.P2. Analyze Fuel tank cap.P3. Inspect fuel supply pump connectors.P4. Inspect fuel supply pump.P5. Analyze Fuel Filters and Pressure Regulator ValveP6. Inspect high pressure fuel LinesP7. Disassemble DPA pumpP8. Inspect DPA pump components.P9. Inspect Fuel Cut OFF solenoid and connectorP10. Analyze fuel Return Line.P11. Inspect the components of DPA Pump Governor.P12. Remove injection nozzle.P13. Disassemble fuel injection nozzle.P14. Inspect the injection nozzle.

Knowledge & Understanding

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

- Describe of DPA Fuel System.
- Describe Fuel Filter.
- Describe of Fuel Supply Pump.
- Describe of DPA Pump.
- Describe DPA Pump Governor.
- Describe Fuel Cut OFF Solenoid and valve.
- Describe of Fuel Injection Nozzles.

Critical Evidence(s) Required

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

- Capable to identify/inspect DPA fuel system.
- Capable to identify/inspect DPA Fuel Pump components.

- Capable to point out/analyze Fuel Supply pump.
- Capable to point out/inspect DPA pump Governor Components.
- Capable to identify/analyze the DPA Injection Nozzles components.

List of Tools and Equipment

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools
3	DPA Pump
4	Injection nozzles
5	Fuel filter

0716-MVS&A-64: Recognize CRI (Common Rail Injection) Fuel System

Overview: This Competency Standard identifies the competencies required to Identify and inspect CRI (Common Rail injection) Fuel Circuit.

Competency Units	Performance Criteria
A1. Identify of CRI (Common Rail injection) Fuel Circuit	<p>You must be able to:</p> <ul style="list-style-type: none">P1. Locate the fuel tank.P2. Point out Electromagnetic fuel pump.P3. Point out main CRI Pump.P4. Locate feed pumpP5. Locate fuel filters and fuel lines.P6. Locate common rail and pressure regulate valve.P7. Point out injection nozzle sensor and electrical circuit.P8. Locate fuel Injection Nozzles.P9. Point out ECM (Electronic Control Module)P10. Point out crank shaft position, cam shaft position, Fuel temperature, Fuel pressure and limit sensor.P11. Point out the Main components of CRI Pump from cut away model.P12. Locate SCV (Suction control valve) Sensor.P13. Locate SCV(Suction control valve)P14. Locate fuel return line.
A2. Inspect of CRI (Common Rail injection) Fuel Circuit	<p>You must be able to:</p> <ul style="list-style-type: none">P1. Analyze the fuel tank.P2. Inspect fuel tank Cap.P3. Inspect Electromagnetic fuel pump.P4. Analyze main CRI Pump.P5. Analyze feed pumpP6. Inspect fuel filters and fuel lines.P7. Analyze common rail and pressure regulate valve.P8. Identify the injection nozzle sensor and electrical circuit.P9. Inspect Electrical Grips/connectors.P10. Remove injection nozzle.P11. Disassemble injection nozzle.P12. Inspect Injection Nozzles.P13. Analyze ECM (Electronic Control Module).P14. Inspect crank shaft position, cam shaft position, Fuel temperature, Fuel pressure and limit sensor.P15. Disassemble main CRI pump.P16. Analyze the Main components of CRI PumpP17. Inspect SCV (Suction control valve) Sensor.P18. Analyze SCV(Suction control valve)P19. Analyze return line

Knowledge & Understanding

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

- K-1.** Describe of CRI Fuel system.
- K-2.** Describe of Electromagnetic Pump
- K-3.** Describe of CRI Pump.
- K-4.** Describe of Common rail.
- K-5.** Describe of injection nozzle.
- K-6.** Describe different sensors.

Critical Evidence(s) Required

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

- Capable to identify/inspect CRI fuel system fuel lines.
- Capable to identify/inspect CRI Fuel system Components.
- Capable to point out/inspect electromagnetic pump.
- Capable to identify/inspect common rail.
- Capable to identify/inspect solenoids.
- Capable to point out/inspect injection nozzles.
- Capable to identify/inspect sensors.

List of Tools and Equipment

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools
3	Multi meter
4	Tech-2 and Doctor ZX
5	CRI Pump
6	Common Rail
7	Injection Nozzle

0716-MVS&A-65: Recognize MEUI (mechanical electrical unit injector) fuel system

Overview: This Competency Standard identifies the competencies required to Inspect of MEUI (MECHANICAL ELECTRICAL UNIT INJECTOR) Fuel System.

Competency Units	Performance Criteria
A1. Identify of MEUI(MECHANICAL ELECTRICAL UNIT INJECTOR) Circuit	<p>You must be able to:</p> <ul style="list-style-type: none"> P1. Point out main fuel tank. P2. Point out primary fuel pump P3. Locate Fuel injection pump. P4. Point out fuel filters and fuel lines. P5. Locate fuel return line. P6. Locate regulator valve and Solenoids. P7. Point out fuel Injectors. P8. Locate fuel injector connectors. P9. Identify different types of MEUI Pump. P10. Identify the components of MEUI Pump from cut away model.
A2. Inspect of MEUI (MECHANICAL ELECTRICAL UNIT INJECTOR) Fuel System	<p>You must be able to:</p> <ul style="list-style-type: none"> P1. Analyze fuel tank. P2. Inspect fuel tank cap. P3. Analyze primary fuel pump. P4. Analyze Fuel injection pump P5. Inspect fuel filter and fuel Lines. P6. Analyze regulator valve and Solenoid. P7. Remove fuel injector. P8. Disassemble fuel injector. P9. Analyze fuel Injectors. P10. Dissemble MEUI Pump. P11. Inspect MEUI pump according to set standards. P12. Inspect connectors of fuel injector. P13. Inspect the solenoids of fuel Injector. P14. Inspect the electrical circuit of fuel Injector.

Knowledge & Understanding

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

- Describe of MEUI Fuel system.
- Describe of Priming Pump.
- Describe of MEUI Pump.
- Describe of Fuel Injectors.

Critical Evidence(s) Required

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

- Capable to identify/analyze MEUI fuel system fuel lines.
- Capable to identify/analyze MEUI Fuel Components.
- Capable to s identify/analyze MEUI pump.
- Capable to identify/analyze the MEUI Injectors.

List of Tools and Equipment

S No.	Descriptions
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1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools
3	MEUI Pump
4	MEUI Fuel Injector

0716-MVS&A-66: Recognize HEUI (hydraulic electrical unit injector) fuel system

Overview: This Competency Standard identifies the competencies required to Inspect HEUI (mechanical electrical unit injector) fuel system.

Competency Units	Performance Criteria
1. Identify HEUI(hydraulic electrical unit injector) fuel circuit	You must be able to: P1. Locate the fuel tank P2. Point out primary fuel pump P3. Point out HEUI pump. P4. Point out fuel filters and fuel lines. P5. Locate regulator valve. P6. Locate Solenoids and ECM (Electronic control Module). P7. Point out Injectors. P8. Identify the Main components of HEUI Pump from cut away model. P9. Identify the oil Pump. P10. Identify the oil cooler. P11. Identify the oil filter. P12. Identify the components of HEUI Injector from cut away model.
A2. Inspect of HEUI (hydraulic electrical unit injector) fuel circuit	You must be able to: P1. Inspect the fuel tank. P2. Inspect fuel tank cap. P3. Disassemble primary fuel tank. P4. Inspect primary fuel pump. P5. Disassemble HEUI pump. P6. Inspect HEUI pump. P7. Inspect fuel filters and fuel lines. P8. Inspect regulator valve. P9. Inspect Solenoids and ECM (Electronic control Module). P10. Remove Injectors from engine. P11. Disassemble Injectors. P12. Inspect Injectors. P13. Inspect the oil Pump. P14. Inspect the oil cooler. P15. Inspect the oil filter.

Knowledge & Understanding

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

- Describe of HEUI Fuel system.
- Describe of Priming Pump.
- Describe of HEUI Pump.
- Describe of Lubrication system.
- Describe of Fuel Injectors.

Critical Evidence(s) Required

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

competency standard:

- Capable to identify and inspect HEUI fuel system fuel lines.
- Capable to identify and inspect HEUI Fuel Components.
- Capable to identify and inspect priming pump.
- Capable to identify and inspect HEUI pump.
- Capable to identify and inspect the HEUI Injectors.
- Capable to identify and inspect the electrical harness of injector and solenoid.

List of Tools and Equipments

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools
3	Multi meter
4	ET Tester

Generic

0716-MVS&A-67: Lead Small Teams

Overview

This unit covers the knowledge, skills and attitudes to lead small teams including setting and maintaining team and individual performance standards.

Unit of Competency	Performance Criteria
CU-1: Provide team leadership	P-1 Identify the work requirements and present it to team members P-2 Communicate the reasons for instructions and requirements to team members. P-3 Deal with the team members and discuss the queries and concerns.

<p>CU-2: Assign responsibilities</p>	<p>P-1 Identify the duties, and responsibilities are allocated having regard to the skills, knowledge and aptitude required to properly undertake the assigned task and according to company policy</p> <p>P-2 Identify the duties are allocated having regard to individual preference, domestic and personal considerations, whenever possible</p>
<p>CU-3: Set performance expectations for team members</p>	<p>P-1 Understand the performance expectations are established based on client needs and according to assignment requirements</p> <p>P-2 Demonstrate the Performance expectations are based on individual team members duties and area of responsibility</p> <p>P-3 Demonstrate Performance expectations are discussed and disseminated to individual team members</p>
<p>CU-4: Supervised team performance</p>	<p>P-1 Demonstrate the monitoring of performance takes place against defined Performance Criteria and/or assignment instructions and corrective action taken.</p> <p>P-2 Provide a feedback by the Team members, positive support and advice on strategies to overcome any deficiencies</p> <p>P-3 Identify the performance issues which cannot be rectified or addressed within the team are referenced to appropriate personnel according to employer policy</p> <p>P-4 Inform the team members and keep informed of any changes in the priority allocated to assignments or tasks which might impact on client/customer needs and</p> <p>P-5 satisfaction</p> <p>P-6 identify the team operations are monitored to ensure that employer/client needs and requirements are met</p> <p>P-7 Follow-up communication is provided on all issues affecting the team</p> <p>P-8 Identify the all relevant documentation is completed in accordance with company procedures</p>

Knowledge & Understanding

- K-1 Work requirements:** Client Profile, Assignment instructions.
- K-2 Team member's concerns:** Roster/shift details.
- K-3 Monitor performance:** Formal process, Informal process.
- K-4 Feedback:** Formal process, Informal process.

K-5 Performance issues: Work output, Work quality, Team participation, Compliance with workplace protocols, Safety, Customer service.

Knowledge & Understanding

K-17. Describe the different hydraulic symbol

K-18. Describe the different hydro pneumatic symbol.

K-19. Describe the pneumatic symbol.

K-20. Describe the different electro pneumatic symbols.

Critical Evidence(s) Required

- Capable to identify the hydraulic symbol.
- Capable to identify the pneumatic symbol.

0716-MVS&A-68: Develop Negotiation Skills

Overview

This unit covers the skills, knowledge and attitudes required to collect information in order to negotiate to a desired outcome and participate in the negotiation.

<i>Unit of Competency</i>	<i>Performance Criteria</i>
CU-1: Plan negotiations	<p>P-1 Identify the Information on preparing for negotiation and included in the plan.</p> <p>P-2 Perform positive negotiating and create Information of nonverbal environments and included in the plan.</p> <p>P-3 Identify the information on active listening is identified and included in the plan</p> <p>P-4 Identify the information on different questioning techniques and included in the plan</p> <p>P-5 Check the Information to ensure it is correct and up-to-date.</p>
CU-2: Participate in negotiations	<p>P-1 Identify the criteria for successful outcome are agreed upon by all parties</p> <p>P-2 Considered Appropriate language is used on desired outcome of all parties throughout the negotiation.</p> <p>P-3 Use a variety of questioning techniques are used The issues and processes are documented and agreed upon by all parties</p> <p>P-4 Assess possible solutions that are discussed and their viability.</p> <p>P-5 Identify the areas for agreement is confirmed and recorded Follow-up action is agreed upon by all parties.</p>

Knowledge & Understanding

- K-1 Preparing for negotiation:** Background information on other parties to the
- K-2 Negotiation:** Good understanding of topic to be negotiated, Clear understanding of desired outcome/s,
- K-3 Personal attributes,** (self-awareness, self-esteem, objectivity, empathy, respect for others)
- K-4 Interpersonal skills,** (listening/reflecting, nonverbal communication, assertiveness, behavior labeling, testing understanding, seeking information, self-disclosing
- K-5 Analytic skills** (observing differences between content and process, identifying bargaining information, applying strategies to manage process, applying steps in negotiating process, strategies to manage conflict, steps in negotiating process, options within organization and externally for resolving conflict.
- K-6 Nonverbal environments:** Friendly reception, Warm and welcoming room, Refreshments offered, lead in conversation before negotiation begins.

K-7 Active listening: Attentive, Don't interrupt, Good posture, Maintain eye contact, Reflective listening.

K-8 Questioning techniques: Direct, Indirect, Open-ended

Knowledge & Understanding

K-21. Describe the different hydraulic symbol

K-22. Describe the different hydro pneumatic symbol.

K-23. Describe the pneumatic symbol.

K-24. Describe the different electro pneumatic symbols.

Critical Evidence(s) Required

- Capable to identify the hydraulic symbol.
- Capable to identify the pneumatic symbol.

0716-MVS&A-69: Solve Problems Related To Work Activities

Overview

This unit covers the skills, knowledge and attitudes required to collect information in order to solve problems to a desired outcome and participate in the work activities.

<i>Unit of Competency</i>	<i>Performance Criteria</i>
CU-1: Identify the problem	P-1 Identify the Variances from normal operating parameters; and product quality Extent, P-2 Identify the cause and nature are of the problem are defined through observation, investigation and analytical techniques P-3 Demonstrate the Problems are clearly stated and specified
CU-2: Determine fundamental causes of the problem	P-1 Identify the Possible causes that are based on experience and the use of problem solving tools / analytical techniques. P-2 Develop possible cause statements based on findings P-3 Identify the fundamental causes as per results of investigation conducted.
CU-3: Determine corrective action	P-1 Report on recommendations are prepared P-2 Recommendations are presented to appropriate personnel. P-3 Recommendations are followed-up, if required

Knowledge & Understanding

- K-1 Analytical techniques:** Brainstorming, Intuitions/Logic, Cause and effect diagrams, Pareto analysis, SWOT analysis, Gant chart, Pert CPM and graphs, Scatter grams.
- K-2 Problem:** Non – routine process and quality problems, Equipment selection, availability and failure, Teamwork and work allocation problem, Safety and emergency situations and incidents.
- K-3 Action plans:** Priority requirements, Measurable objectives, Resource requirements, Timelines, Co-ordination and feedback requirements, Safety requirements, Risk assessment, Environmental requirements

Knowledge & Understanding

- K-25.** Describe the different hydraulic symbol
- K-26.** Describe the different hydro pneumatic symbol.
- K-27.** Describe the pneumatic symbol.
- K-28.** Describe the different electro pneumatic symbols.

Critical Evidence(s) Required

- Capable to identify the hydraulic symbol.
- Capable to identify the pneumatic symbol.

0716-MVS&A-70: Maintain inline fuel system

Overview: This Competency Standard identifies the competencies required to troubleshoot inline fuel pump system.

Competency Units		Performance Criteria
A1. Troubleshoot Fuel Pump system	Inline	<p>P1. Troubleshoot fuel tank</p> <p>P2. Troubleshoot Fuel Tank cap.</p> <p>P3. Replace primary fuel pump.</p> <p>P4. Replace fuel filter.</p> <p>P5. Troubleshoot/replace fuel Lines.</p> <p>P6. Remove Fuel injection pump from engine.</p> <p>P7. Disassemble Fuel injection pump.</p> <p>P8. Troubleshoot pumping element components as per requirement.</p> <p>P9. Troubleshoot governor components as per requirement.</p> <p>P10. Remove injection nozzles from engine.</p> <p>P11. Disassemble injection nozzle.</p> <p>P12. Troubleshoot/replace Injection nozzles.</p> <p>P13. Assemble injection nozzle.</p> <p>P14. Troubleshoot the feed pump as per requirement.</p> <p>P15. Assembling of Inline Pump.</p>
A2. Adjust Inline Fuel Pump		<p>P1. Perform Phasing of Inline Pump.</p> <p>P2. Perform Calibration of Inline Pump.</p> <p>P3. Perform Idling Spring Adjustment.</p> <p>P4. Perform full Load stopper Adjustment.</p> <p>P5. Mount Inline Pump on Engine.</p>

Knowledge & Understanding

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

- K-1.** Describe of troubleshoot/adjustment of Inline Fuel system.
- K-2.** Describe of troubleshoot/adjustment Priming Pump
- K-3.** Describe of troubleshoot/adjustment Feed Pump.
- K-4.** Describe of troubleshoot/adjustment Governor.
- K-5.** Describe of troubleshoot/adjustment Inline Pump

Critical Evidence(s) Required

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

- Capable to service Inline fuel system fuel lines.
- Capable to service Inline Fuel Components.

- Capable to service priming pump.
- Capable to service feed pump.
- Capable to service pumping element.
- Capable to service governor of inline pump.
- Capable to adjust the inline pump.

List of Tools and Equipments

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools
3	Inline Pump test Bench
4	Injector Tester

0716-MVS&A-71: Maintain PT (pressure time) fuel system

Overview: This Competency Standard identifies the competencies required to troubleshoot of PT fuel pump system.

Competency Units	Performance Criteria
CU1. Troubleshoot of PT Fuel Pump system	<p>P1. Troubleshoot fuel tank.</p> <p>P2. Troubleshoot/replace Float valve from float tank.</p> <p>P3. Replace fuel filter.</p> <p>P4. Trouble shoot/replace fuel Lines</p> <p>P5. Remove PT pump from engine.</p> <p>P6. Disassemble PT pump.</p> <p>P7. Disassemble PTG (Pressure Time Gear) Governor.</p> <p>P8. Disassemble MVS (Mechanical Variable Speed) governor or VS (Variable speed) Governor.</p> <p>P9. Troubleshoot/replace Components of PT Pump as per standards.</p> <p>P10. Disassemble AFC (Air Fuel Control) Unit.</p> <p>P11. Troubleshoot/replace AFC Unit.</p> <p>P12. Troubleshoot/replace Fuel cut off solenoid.</p> <p>P13. Assemble PT Pump.</p> <p>P14. Remove PT Injectors from Engine.</p> <p>P15. Disassemble PT Injectors.</p> <p>P16. Troubleshoot/replace PT injectors.</p> <p>P17. Assembling of PT Pump.</p> <p>P18. Troubleshoot/replace Fuel Return Line.</p>
CU2. Adjust of PT pump and Injector	<p>P1. Place dial Indicator on injector.</p> <p>P2. Check the tension of injector spring.</p> <p>P3. Adjust the height test of injector.</p> <p>P4. Adjust the components of PT pump.</p>

Knowledge & Understanding

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

- Describe disassembling/troubleshoot of PT Fuel system.
- Describe of replace Priming Pump.
- Describe disassembling/troubleshoot of PT Pump.
- Describe of disassembling/troubleshoot of Fuel Injectors.
- Describe Height test of injector.

Critical Evidence(s) Required

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

- Capable to service PT fuel system fuel lines.
- Capable to service PT Fuel Components.
- Capable to service priming pump.
- Capable to service PT pump.
- Capable to adjust the PT Injectors.

List of Tools and Equipments

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools
3	PT test bench
4	PT injector tester

0716-MVS&A-72: Maintain DPA (distributor pump assembly) fuel system

Overview: This Competency Standard identifies the competencies required to troubleshoot DPA (distributor pump assembly) fuel system.

Competency Units	Performance Criteria
CU1. Troubleshoot DPA (Distributor Pump Assembly) Fuel System	P1. Troubleshoot/replace Fuel Filters. P2. Troubleshoot/replace Pressure Regulator Valve. P3. Troubleshoot/replace Fuel Cut OFF solenoid, P4. Troubleshoot/replace Return Line. P5. Troubleshoot/replace fuel supply pump. P6. Disassemble DPA Pump. P7. Troubleshoot/replace the Main components of DPA Pump as per standards. P8. Troubleshoot of DPA Pump Governor as per standards. P9. Remove Injection Nozzle from engine. P10. Disassemble Injection nozzle. P11. Troubleshoot/replace the injection nozzles as per standers.
CU2. Adjust DPA pump and Injector	P1. Adjust governor components of DPA pump. P2. Adjust plunger of DPA Pump. P3. Adjust pressure of Injection Nozzle. P4. Adjust the spring tension of Injection Nozzle. P5. Install Injection Nozzles on Engine.

Knowledge & Understanding

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

- Describe disassemble/replace of DPA Fuel System.
- Describe disassemble/replace of Fuel Supply Pump.
- Describe disassemble/replace of DPA Pump.
- Describe disassemble/replace of DPA Pump Governor.
- Describe disassemble/replace of Fuel Injection Nozzles.
- Describe the adjustment of injection nozzles.

Critical Evidence(s) Required

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

- Capable to service DPA fuel system.
- Capable to service DPA Fuel Pump.
- Capable to service Fuel Supply pump.
- Capable to service DPA pump Governor.
- Capable to service the DPA Injection Nozzles.

List of Tools and Equipments

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools
3	DPA Pump Test Bench
4	Injector Tester

0716-MVS&A-73: MAINTAIN CRI (Common Rail Injection) Fuel System

Overview: This Competency Standard identifies the competencies required to Troubleshoot CRI (Common Rail injection)Fuel System.

Competency Units		Performance Criteria
A1. Troubleshoot (Common injection)Fuel System	CRI Rail	<p>P1.Troubleshoot the fuel tank. P2.Troubleshoot/replace fuel Tank cap. P3.Troubleshoot / replace Electromagnetic fuel pump. P4.Troubleshoot/replace feed pump. P5.Troubleshoot/replace fuel filters and fuel lines. P6.Troubleshoot/replace common rail and pressure regulate valve. P7.Troubleshoot Injection Nozzles. P8.Replace ECM (Electronic Control Module). P9.Replace crank shaft position, cam shaft position. P10. Replace Fuel temperature, Fuel pressure, Mass air Flow and limit sensor. P11. Disassemble CRI pump. P12. Troubleshoot/replace the Main components of CRI Pump as per standers. P13. Troubleshoot / replace SCV (Suction control valve) Sensor. P14. Troubleshoot /replace SCV (Suction control valve). P15. Troubleshoot/replace return line. P16. Assemble CRI Pump. P17. Replace injection nozzle sensor. P18. Disassemble Injection nozzle. P19. Troubleshoot/Replace injection nozzle.</p>
A2. Adjust CRI (Common Rail injection)Fuel System		<p>P1.Enter injection nozzle model number/QR Code in ECM (Electronic control module) by using specific tool. P2.Adjust/Check the injection timing. P3.Adjust/Check the fuel pressure. P4.Adjust/Check the fuel pressure. P5.Adjust CRI Pressure.</p>

Knowledge & Understanding

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

- K-7.** Describe problems of CRI Fuel system.
- K-8.** Describe troubleshoot of Electromagnetic Pump
- K-9.** Describe disassemble/troubleshoot CRI Pump.
- K-10.** Describe troubleshoot of Common rail.
- K-11.** Describe disassemble/troubleshoot of injection nozzle.
- K-12.** Describe different sensors.

Critical Evidence(s) Required

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

- Capable to service CRI fuel system fuel lines.
- Capable to service CRI Fuel system Components.
- Capable to service electromagnetic pump.
- Capable to service common rail.
- Capable to service solenoids.
- Capable to service injection nozzles.
- Capable to replace sensors.

List of Tools and Equipments

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools
3	Multi meter
4	Tech-2 and Doctor ZX

0716-MVS&A-74: MAINTAIN MEUI (mechanical electrical unit injector) fuel system

Overview: This Competency Standard identifies the competencies required to troubleshoot MEUI (mechanical electrical unit injector) fuel pump and system

Competency Units	Performance Criteria
A1. Troubleshoot MEUI (mechanical electrical unit injector) fuel pump and system	P1. Troubleshoot fuel tank. P2. Troubleshoot/replace Float valve from float tank. P3. Replace fuel filter. P4. Trouble shoot/replace fuel Lines. P5. Troubleshoot/replace Fuel cut off solenoid. P6. Disassemble MEUI Pump. P7. Troubleshoot/replace the MEUI pump as per requirement. P8. Assemble MEUI Pump. P9. Install MEUI pump on engine. P10. Remove injector from engine. P11. Troubleshoot the solenoid of Injector. P12. Disassemble fuel injector. P13. Troubleshoot the electrical circuit of Injector. P14. Troubleshoot/replace Fuel Return Line.
A2. Adjust MEUI (mechanical electrical unit injector) fuel pump and system	P1. Place dial Indicator on injector. P2. Check the tension of injector spring. P3. Adjust the height test of injector. P4. Adjust the components of MEUI pump.

Knowledge & Understanding

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

- Describe troubleshoot of Fuel system.
- Describe disassembling/troubleshoot of MEUI Pump
- Describe disassembling/troubleshoot of Fuel Injectors.
- Describe height test of fuel injector.

Critical Evidence(s) Required

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

- Capable to service MEUI fuel system fuel lines.
- Capable to service MEUI Fuel Components.
- Capable to service priming pump.
- Capable to service MEUI pump.
- Capable to adjust the MEUI Injectors.

List of Tools and Equipments

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)

2	Special Service tools
3	MEUI injector tester

0716-MVS&A-75- Maintain HEUI (hydraulic electrical unit injector) fuel system

Overview: This Competency Standard identifies the competencies required to troubleshoot HEUI (hydraulic electrical unit injector) fuel system.

Competency Units	Performance Criteria
A1. Troubleshoot HEUI (hydraulic electrical unit injector) fuel system	<p>P1. Troubleshoot fuel tank.</p> <p>P2. Troubleshoot/replace fuel tank cap.</p> <p>P3. Troubleshoot/replace primary fuel pump.</p> <p>P4. Troubleshoot/replace fuel filters and fuel lines.</p> <p>P5. Troubleshoot/replace IAP (Injection Actuating Pressure) Sensor and Valve.</p> <p>P6. Troubleshoot/replace the ECM (Electronic control Module).</p> <p>P7. Troubleshoot the Oil cooler.</p> <p>P8. Replace the Oil filter.</p> <p>P9. Disassemble HEUI Pump.</p> <p>P10. Troubleshoot/replace the HEUI pump as per requirement.</p> <p>P11. Assemble HEUI Pump.</p> <p>P12. Replace the solenoid of Injector.</p> <p>P13. Troubleshoot the electrical circuit of Injector.</p>
A2. Adjust HEUI (hydraulic electrical unit injector) fuel system	<p>P1. Check QR code of Injector by using Specific Tool.</p> <p>P2. Adjust/check the fuel pressure.</p> <p>P3. Check the fuel temperature.</p> <p>P4. Adjust oil pump pressure.</p>

Knowledge & Understanding

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

- Describe troubleshoot of Fuel system.
- Describe disassembling/troubleshoot of HEUI Pump.
- Describe troubleshoot of Lubrication system.
- Describe disassembling/troubleshoot of Fuel Injectors.

Critical Evidence(s) Required

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

- Capable to service HEUI fuel system fuel lines.
- Capable to service HEUI Fuel Components.
- Capable to service HEUI pump.
- Capable to adjust the HEUI Injectors.
- Capable to service the electrical harness of injector and solenoid.

List of Tools and Equipments

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools
3	Multi meter
4	ET Tester
5	HEUI Injector Tester

0716-MVS&A-76: Analyse Thermodynamic Performance

Overview: This Competency Standard covers the analysis of heating, ventilating, air conditioning and refrigeration (HVAC/R) systems to provide solution to thermodynamic performance issues. It encompasses working safely, apply extensive knowledge of thermodynamic parameters, gathering and analyzing data, applying problem solving techniques, developing and documenting results and solutions for use in design work to provide you the basis for your work.

Competency Units	Performance Criteria
<p>CU-1: Prepare to analyze the thermodynamic performance</p>	<p>P-1. Observe safe work practices and personal protective OHS processes and procedures for a given work area are identified, obtained and understood.</p> <p>P-2. Establish OHS risk control measures and procedures are followed in preparation for the work.</p> <p>P-3. Determine extent of the thermodynamic issues from performance specifications, situation reports and in consultations with relevant persons</p> <p>P-4. Plan activities to meet scheduled timelines in consultation with others involved in the work</p> <p>P-5. Form effective strategies to ensure solution development and implementation to carry out efficiently.</p>
<p>CU-2: Analyze the thermodynamic performance of Heavy Construction Machinery</p>	<p>P-1. Apply thermodynamic principles to analytical solutions on refrigeration and air conditioning systems.</p> <p>P-2. Obtain Parameters, specifications and performance requirements in relation to refrigeration and air conditioning systems in accordance with established procedures.</p> <p>P-3. Carry out approaches to analyzing thermodynamic parameters to provide the most effective solution.</p> <p>P-4. Deal unplanned events with safely and effectively, consistent with regulatory requirements and enterprise policy.</p> <p>P-5. Monitor quality of work against personal performance agreement and/or establish organizational & professional standards</p>
<p>CU-3: Report and action on the results of thermodynamic performance analysis</p>	<p>P-1. Evaluate to determine their effectiveness of solutions for thermodynamic issues and modify where necessary.</p> <p>P-2. Report the analysis including details of all findings, calculations and assumptions.</p>

- P-3.** Report analysis to appropriately personnel to establish appropriate action to be taken based on findings.
- P-4.** Take actions regarding equipment, documented for inclusion in work/project or development records in accordance with professional standards and manufacturers specifications.

Knowledge and Understanding

This describes the essential skills and knowledge and their level, required for this unit. Evidence shall show that knowledge has been acquired of safe working practices and analyzing the thermodynamic performance of HVAC/R systems.

- K-1. Understanding the thermodynamic performance issues
- K-2. Forming effective strategies for analyzing refrigeration and air conditioning systems performance
- K-3. Obtaining thermodynamic performance parameters, specifications and performance requirements appropriate to each situation.
- K-4. Evaluating the results of the analysis
- K-5. Documenting analysis details of all findings, calculations and assumptions.

Prepare Boiler for Smooth Operation (Delete)

Overview: This Competency Standard covers the competencies required to enable the student to prepare boiler for smooth operation. This unit covers the knowledge low pressure boiler, application of boiler in HVAC technology, its controls, chemical treatment of boiler/ water and feed water tanks to provide you the basis for your work.

Competency Units	Performance Criteria
CU-1: Prepare the Boiler for Operation	<p>P-1. Review operational order and where required check with appropriate personal</p> <p>P-2. Identify and report health and safety hazards / maintenance requirements to appropriate personnel according to workplace reporting procedures</p> <p>P-3. Identify and set quantity of steam to be generated for allocated Process</p> <p>P-4. Purge the boiler according to workplace procedure</p> <p>P-5. Perform pre-operational checks to confirm operational status of boiler and related equipment</p>
CU-2: Operate and monitor boiler	<p>P-1. Use equipment in line with organizational safety procedures, manufacturer's instructions and environmental protection practices.</p> <p>P-2. Apply complete pre-operational safety and pre start-up checks to ensure operational effectiveness.</p> <p>P-3. Start boiler and bring safely on line; communicate recent performance to appropriate personnel.</p> <p>P-4. Monitor boiler operation, diagnose status and adjust to maintain safe and efficient operation.</p>
CU-3: Shut down and store boiler	<p>P-1. Shut down boiler according to workplace procedures and manufacturer's recommendations</p> <p>P-2. Clean boiler internally and externally according to workplace procedures and manufacturer's recommendations</p> <p>P-3. Remove valves and fittings in preparation for maintenance</p> <p>P-4. Store the boiler in the appropriate storage mode according to workplace procedures and manufacturer's recommendations</p> <p>P-5. Store and record boiler house chemicals, in line with safety procedures and environmental protection practices.</p> <p>P-6. Follow emergency shutdown procedures in cases of fire.</p> <p>P-7. Complete operating log, record fuel efficiency and report to appropriate personnel.</p>

CU-4: Analyze and respond to abnormal performance (Trouble Shooting of Boiler)

- P-1.** Analyze operating data and plant operating conditions to identify causes of abnormal performance
- P-2.** Take action correctively in accordance with workplace procedures in response to Hazards, out-of-specification test results and/or plant performance
- P-3.** Implement emergency procedures as required according to workplace procedures and manufacturer's recommendations

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:

- K-1.** Safe work procedures including awareness of health and safety hazards related to boiler operation and associated control measures. Hazards typically include working around hot surfaces, manual handling, fuel and steam leaks
- K-2.** Purpose and limitations of protective clothing and equipment
- K-3.** Hierarchy of hazard control measures
- K-4.** Duty of care of the boiler operator
- K-5.** Purpose and basic principles of combustion and boiler operation. This includes principles of heat transfer and properties of steam
- K-6.** Boiler system layout and steam cycle
- K-7.** The purpose of purging a boiler
- K-8.** The effect of fuel quality on boiler operation
- K-9.** Impact of ash removal on efficient boiler operation and impact of sluice water flow
- K-10.** Relationship to other processes. This includes an understanding of the impact of sudden load changes on boiler pressure and plant operation
- K-11.** Purpose and limitations of protective clothing and equipment
- K-12.** Methods used to render equipment safe to inspect, maintain and/or clean including lock-out, tag-out and isolation procedures

0716-MVS&A-77: Solve problems related to fundamentals of thermodynamics

Overview: The user/ individual on the job needs to know and understand how to Solve problems of fundamentals of thermodynamics, heat, mass & weight, force, work done and power. Develop skill, mathematical attitudes and logical perception in the use of mathematical instruments as required in the automobile fields.

Competency Units	Knowledge Criteria
CU-1 Preform the conversation of Temperature scales	P1. Measuring the temperature and convert to K to C. P2. Solve the problem with the help formula. P3. Measuring the temperature with appropriate tool.
CU-2 Measuring the vacuum and pressure gauge	P1. Measure the vacuum use with vacuum gauge on engine. P2. Measure the pressure use with the pressure gauge in different scales. P3. Perform the conversation of vacuum and pressure in different scales. P4. Solve the problems of mathematical attitudes and logical perception in the use of mathematical instruments
CU-3 Understand and Solve the problems of Different Energies	P1. Solve the problems of following energies: a) Potential Energy b) Kinetic Energy c) Thermal Energy d) Chemical Energy P2. Drive the law of <ul style="list-style-type: none">• Laws of thermodynamics• Law of conservation of energy
CU-4 Derive the mathematical relations	P1. Drive the following laws: a) Boyles Law b) Charles Law c) Joules Law P2. Solve the mathematical problems applying the laws

0716-MVS&A-78: Solve problems of Laws and properties of perfect gases

Overview: The user/ individual on the job needs to know and understand how to the knowledge of fundamentals of thermodynamics, laws and properties of gases, thermodynamic processes and cycles, steam and Gas turbines, I.C. Engines.

Competency Units

Performance Criteria

0716-MVS&A-1 Applying Gas Laws in problems	P1. Derive the following mathematical relations: a) General gas equation b) Characteristic Gas equation c) Universal Gas equation P2. Understand the specific heats of a gas and derive its mathematical relations.
0716-MVS&A-2 Derive the mathematical equation	P1. Derive the mathematical equation of Enthalpy of a Gas.

Understanding and Knowledge:

K-1. Perfect gas and its property

K-2. Derive the mathematical relations.

- Boyle's law.
- Charles's law
- Joule's law

K-1. Derive the mathematical relations.

- General gas equation
- Characteristic Gas equation
- Universal Gas equation

K-2. Describe the following.

The two specific heats of a gas and derive its mathematical relations.

- K.5 State the following.
- Enthalpy of a Gas

0716-MVS&A-79: Derive Thermodynamics Processes and Cycles

Overview: The user/ individual on the job needs to know and understand how to prepare the properties of steam, steam boilers and their performance , steam and Gas turbines , I.C. Engines, Air compressors and their problems.

Competency Units	Performance Criteria
CU-1 Draw the different Cycles	<p>P1 Explain CARNOT CYCLE with the help of P-V diagram; also derive its mathematical relations for Air Standard Efficiency during the cycle of operation.</p> <p>P2 OTTO CYCLE with the help of P-V diagram; also derive its mathematical relations for Air Standard Efficiency during the cycle of operation</p> <p>P3. DIESEL CYCLE with the help of P-V diagram; also derive its mathematical relations for Air Standard Efficiency during the cycle of operation.</p> <p>P4. DUAL COMBUSTION CYCLE with the help of P-V diagram; also derive its mathematical relations for Air Standard Efficiency during the cycle of operation.</p>
CU-2 Evaluate the performance of steam boilers	<p>P1. Working and general construction of a boiler, Classification of boilers, Selection factors of a good steam boiler, Important terms used for steam boilers.</p> <p>P2. The construction and working of Simple Vertical Boiler with the help of neat sketch.</p> <p>P-3. The construction and working of COCHRAN Boiler (Multi tubular boiler) with the help of neat sketch.</p> <p>P-4 The construction and working of Babcock and Wilcox Boiler with the help of neat sketch.</p>
CU-3 Derived and solved the mathematically problems of I.C engines	<p>P1. Solve and Derived following</p> <ol style="list-style-type: none">1) Torque and its unit in SI system.2) Mean effective pressure.3) Indicated power and its formula.4) Brake Horse power and its formula.5) Measurement of Brake Horse power <p>P2. Solve and Derived following</p> <ol style="list-style-type: none">1) Friction Horse power.2) Mechanical efficiency.3) Thermal efficiency.

Understanding and Knowledge:

K.1 Explain CARNOT CYCLE with the help of P-V diagram; also derive its mathematical relations for Air Standard Efficiency during the cycle of operation.

K.2 Explain OTTO CYCLE with the help of P-V diagram; also derive its mathematical relations for Air Standard Efficiency during the cycle of operation.

K.3 Explain DIESEL CYCLE with the help of P-V diagram; also derive its mathematical relations for Air Standard Efficiency during the cycle of operation.

K.4 Explain DUAL COMBUSTION CYCLE with the help of P-V diagram; also derive its mathematical relations for Air Standard Efficiency during the cycle of operation.

K.5 Solve the mathematical expressions of following:

- a. Performance of boiler
- b. Equivalent evaporation of boiler
- c. Efficiency of boiler

K.6 Derived formula of Comparison between Water tube and Fire tube boilers.

Operation of Construction Machinery

0716-MVS&A-80 Identify Machines & Its Attachments

Overview: This competency standard covers the skills and knowledge required to identify machines its types and various attachments associated with the machines.

Competency Units	Performance Criteria
CU1. Identify Machine and its sizes.	P1. Enlist name of different heavy machines P2. Enlist crawler machines P3. Enlist wheeled/tire machines P4. Check specifications of crawler machines P5. Check specifications of wheeled/tire machines
CU2. Identify components & Attachments	P1. Enlist different components P2. Enlist different attachments
CU3. Identify capacities & capabilities of Machine	P1. Check capacity as per manufacturers specifications P2. Check capability as per manufacturers specifications P3. Ensure proper capacity of machine P4. Ensure proper capability of machine
CU4. Identify basic tools and supplies associated with Machines	P1. Check standard tools supplied with machines P2. Check spares/consumable materials P3. Adopt manufacturers specifications for tools and supplies
CU5. Manage Inventory of tools and equipment.	P1. Check number of tools and equipment as per record P2. Report for faulty tools and equipment P3. Generate demand for defective tools and equipment P4. Maintain record of all tools and equipment.

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:

- Define common Heavy Machines & Industry terminologies.
- Describe Common Heavy Machine Capabilities, Advantages & Limitations.
- Describe Heavy Machines Attachments, their Purpose and Capabilities.
- Describe basic Tools, Supplies & Lubricants associated with Heavy Machines.
- Describe Inventory management procedure of Tools & Equipment.

Critical Evidence(s) Required

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

- Identify Machines and its related Attachments
- Identify Capacity of machine before use
- Ensure Capability of attachments as per standards

Machines and Its Attachments

A. Bulldozer Attachments: -

1. Blades.
2. Ripper

B. Excavator (Wheel & Crawler) Attachments: -

1. Buckets.
2. Grapppler.
3. Coupler.
4. Thumbs.
5. Pulverize.
6. Lifting.
7. Rakes.
8. Chuck
9. Blades.
10. Ripper.
11. Forks.
12. Adapter.
13. Hammer.
14. Auger.
15. Compactor.
16. Stump Harvester.

C. Motor Grader Attachments: -

1. Angle Blade.
2. Lift Group.
3. One way Plow.
4. Snow Gate.
5. Snow Wing.
6. Straight Blade
7. UV Angle Blade.
8. V-Plow

D. Wheel Loader Attachments: -

1. Coupler.
2. Dozer Blade.
3. Boom Poles.
4. Bucket.
5. Fork.
6. Grapppler.
7. Snow Blade
8. Trailer Hitches.
9. Rotary Sweeper.
10. Broadcast Spreader

0716-MVS&A-81: Maintain Machines (with Engine Off)

Overview: This competency standard covers the skills and knowledge required to Inspect and service Lubrication, Electrical, Hydraulic, Cooling, Fuel, and braking system of the Heavy Machines.

Competency Units	Performance Criteria
CU1. Inspect and service lubrication system	<p>P1. Locate components to be inspected</p> <p>P2. Identify low oil levels, dirty filler cap</p> <p>P3. Select appropriate tools</p> <p>P4. Adjust oil levels</p> <p>P5. Identify and report leakages</p>
CU2. Inspect and service electrical system	<p>P1. Locate components to be inspected</p> <p>P2. Identify service needs, defects and hazardous conditions through visual/physical inspection</p> <p>P3. Select appropriate tools for rectification of minor defects</p> <p>P4. Check water level of batteries</p> <p>P5. Replace batteries.</p>
CU3. Inspect and service hydraulic system	<p>P1. Locate components to be inspected</p> <p>P2. Identify service needs, defects and hazardous conditions through visual/physical inspection</p> <p>P3. Identify and report leakages and noise of the hydraulic system</p> <p>P4. Check hydraulic oil levels</p> <p>P5. Replace hoses/pipes</p>
CU4. Inspect and service cooling system	<p>P1. Adopt appropriate safety measures.</p> <p>P2. Ensure unobstructed airflow through radiator</p> <p>P3. Locate components to be inspected</p> <p>P4. Adjust coolant level</p> <p>P5. Replace belts and hoses</p>
CU5. Inspect and service air intake system	<p>P1. Locate components to be inspected</p> <p>P2. Check air service indicators</p> <p>P3. Select appropriate tools</p> <p>P4. Clean primary air filter.</p> <p>P5. Replace intake hoses and clamps</p>
CU6. Inspect and service fuel system	<p>P1. Locate components to be inspected</p> <p>P2. Identify and read fuel gauges and level indicator</p> <p>P3. Select appropriate tools</p> <p>P4. Identify service needs, defects and hazardous conditions through visual/physical inspection</p> <p>P5. Perform basic maintenance such as cleaning of fuel strainer</p> <p>P6. Report fuel leakage</p>

CU7. Inspect and service suspension system	<p>P1. Locate components to be inspected</p> <p>P2. Select appropriate tools</p> <p>P3. Check gashes or bulges and tires</p> <p>P4. Grease , bearings, bush and pins</p> <p>P5. Change damaged grease fittings</p>
CU8. Inspect and service drive train	<p>P1. Locate components to be inspected</p> <p>P2. Select appropriate tools</p> <p>P3. Identify service needs, defects and hazardous conditions through visual/physical inspection</p> <p>P4. Check wear, leaks and damage to components</p> <p>P5. Identify defective undercarriage components</p>
CU9. Inspect and service braking system	<p>P1. Locate components to be inspected</p> <p>P2. Select appropriate tools</p> <p>P3. Identify service needs, defects and hazardous conditions through visual/physical inspection</p> <p>P4. Top-up fluid reservoir</p> <p>P5. Identify defective components of braking system</p>
CU10. Inspect and service operator station/Cab	<p>P1. Locate and identify controls inside operator station/Cab</p> <p>P2. Identify missing or defective components or controls</p> <p>P3. Clean front/rear wind screen, windows and mirrors</p> <p>P4. Adjust mirrors</p> <p>P5. Replace broken mirror/frame</p> <p>P6. Adjust seat and seat belt</p> <p>P7. Check nobs of all lights and indicators</p>
CU11. Inspect safety equipment	<p>P1. Ensure safety equipment is securely mounted</p> <p>P2. Replace expired fire extinguisher</p> <p>P3. Ensure wearing of PPE</p>
CU12. Inspect and service Attachments	<p>P1. Identify service needs, defects and hazardous conditions through visual/physical inspection</p> <p>P2. Select appropriate tools</p> <p>P3. Perform basic maintenance such as greasing, bushing and pins</p> <p>P4. Report worn teeth</p>
CU13. Inspect and service supporting pneumatic (Air-filled) system	<p>P1. Locate components to be inspected</p> <p>P2. Select appropriate tools</p> <p>P3. Identify service needs, defects and hazardous conditions through visual/physical inspection</p> <p>P4. Perform basic maintenance, such as choked drain valves</p> <p>P5. Replace air lines</p>

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:

- Describe Functions of Mechanical Systems in Heavy Machines.
- Explain Inspection & Maintenance of Heavy Machines, and their associated Attachments.
- Describe Inspection & Maintenance procedure of Mechanical Systems in Heavy Machines.

Critical Evidence(s) Required

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

- Inspect and service braking system.
- Inspect and service hydraulic system.
- Inspect and service lubrication system.
- Inspect and service cooling system.

Tools and Equipment

1. Basic tools, such as grease gun,
2. Hammer,
3. Screwdrivers,
4. Pliers,
5. Self-locking pliers,
6. Adjustable wrench,
7. Assorted other wrenches,
8. Basic supplies, such as grease, oil, window cleaner, rags, ice scraper, whisk broom.

0716-MVS&A-82: Maintain Machines (with Engine Running)

Overview: This competency standard covers the skills and knowledge required to monitor warning systems, engine warm up, cycle equipment functions, requirement of scheduled maintenance and operate Logbook.

Competency Units	Performance Criteria
CU1. Start engine monitor warning systems	P1. Identify leaks and burnt lights P2. Select appropriate tools P3. Replace fuses and tighten loose fittings
CU2. Warm up engine	P1. Monitor instrument panel P2. Warm up engine according to manufacturer's instructions
CU3. Troubleshoot basic equipment functions	P1. Activate all functions, such as brakes, steering, lights, wipers and hydraulic functions P2. Identify problems with functions P3. Perform required service
CU4. Comply with Scheduled Maintenance Requirements	P1. Comply with safety requirements P2. Read indicators/warning signals and remove the problem P3. Maintain record and documentation. P4. Perform scheduled maintenance
CU5. Maintain Logbook	P1. Record fuel consumption P2. Record oil change P3. Record time period/mileage of vehicle for schedule maintenance.

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:

- Describe warning systems of Machines.
- Describe different types of machine warning
- Describe procedure of engine warming up
- Describe cycle equipment functions
- Enlist Techniques of Scheduled Maintenance.
- Describe procedure to maintain Logbook

Critical Evidence(s) Required

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

- Start engine monitor warning systems
- Warm up engine
- Maintain Logbook.

Tools and Equipment

1. Utility documentation.
2. Logbooks.
3. Service Manuals.
4. Operational Manuals.

0716-MVS&A-83: Perform Parking of Machines

Overview: This competency standard covers the skills and knowledge required to Clean under carriage and attachments before parking, Park equipment in appropriate location, Shut down and secures equipment, Perform housekeeping tasks, and Perform visual inspection.

Competency Units	Performance Criteria
CU1. Clean under carriage and attachments before parking	P1. Clean machine body, wheels, & undercarriage P2. Clean attachments according to manufacturer's specifications and company policy and procedure
CU2. Park equipment in appropriate location	P1. Identify appropriate parking location P2. Park equipment according to company policy and procedure P3. Lower the attachments to the ground level P4. Put paddings under the attachment if the machine is to be parked for longer duration
CU3. Shut down and secure equipment	P1. Shut down equipment according to the manufacturers specifications P2. Secure equipment against movement and damage
CU4. Perform housekeeping tasks	P1. Clean wind shields, side rails, steps and instrument panel P2. Sweep floor P3. Remove garbage P4. Apply glass/mirror covers
CU5. Perform visual inspection	P1. Check parked equipment visually P2. Identify existing or potential problems P3. Communicate to appropriate personnel such as supervisor/mechanic

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:

- Read Manufacturers' specifications
- Read Company policies and procedures
- Define importance of cleaning tracks, wheels, rollers, and attachments.
- Describe suitable and safe parking locations, such as dry and clean surface, level, away from fuel storage or water courses, secure area.

Critical Evidence(s)

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

- Park machine at appropriate location.
- Switch off and secure machine.
- Perform housekeeping tasks.
- Perform visual inspection.

0716-MVS&A-84: Perform Transportation of Machines

Overview: This competency standard covers the skills and knowledge required to Prepare to load machine and attachments, Load or assist with loading machine and attachments, Assist with securing machine and attachments. Unload or assist with unloading machine and attachments, Prepare rubber-tired machine for road travel, and Drive rubber tired machine on Public roads

Competency Units	Performance Criteria
CU1. Prepare to load machine and attachments	<p>P1. Assess hazards, such as ground and utility lines</p> <p>P2. Prepare machines and attachments for transport, such as clean tracks or wheels or disassemble for transport</p>
CU2. Load or assist with loading machine and attachments	<p>P1. Avoid hazards, such as uneven ground and utility lines</p> <p>P2. Load or assist with loading of machines and attachments</p> <p>P3. Respond to hand signals</p>
CU3. Assist with securing machine and attachments	<p>P1. Protect equipment from damage, such as cover windshield and exhaust pipe</p> <p>P2. Secure attachments, such as bucket</p> <p>P3. Assist transport vehicle driver as required, such as secure machines, attach warning flags and reflectors.</p>
CU4. Unload or assist with unloading machine and attachments	<p>P1. Assess and adjust to hazards, such as overhead obstructions, narrow landing areas</p> <p>P2. Unload or assist with unloading machines and attachments.</p> <p>P3. Assist transport vehicle driver as required, such as remove tie-down, warning flags and reflectors</p> <p>P4. Clean equipment.</p>
CU5. Prepare rubber-tired machine for road travel	<p>P1. Secure attachments in proper position for road travel.</p> <p>P2. Complete inspection, such as check brakes, steering, lights, tires and back-up warnings.</p> <p>P3. Clean equipment.</p>
CU6. Drive rubber tired machine on public roads	<p>P1. Comply with legislation, such as traffic laws.</p> <p>P2. Possess appropriate and valid driver license.</p> <p>P3. Read maps</p> <p>P4. Follow route to destination</p> <p>P5. Adjust to road and weather conditions, such as adjust speed.</p> <p>P6. Recognize and avoid potential hazards.</p>

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:

- Define Loading/unloading techniques
- Estimate carrying capacities of transport vehicles
- Describe Road, weather and deck conditions
- Define Hazards and blocking
- Describe Hand signals.
- Describe Tie-down points.
- Explain limitations on public roads, such as speed and blind spots
- Define applicable legislation, such as traffic laws
- Explain Route and destination
- Define Proper positioning of attachments for road travel

Critical Evidence(s)

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

- Prepare to load machine and attachments.
- Load or assist with loading machine and attachments.
- Assist with securing machine and attachments.
- Unload or assist with unloading machine and attachments.
- Prepare rubber-tired machine for road travel.
- Drive rubber tired machine on public roads.

0716-MVS&A-85: Operate Excavator

Overview: This competency standard covers the skills and knowledge required to Comply with safety requirements, Sets up equipment, Install attachments, Operate controls of Wheel Excavator, Operate controls of Crawler Excavator, Create Slopes, Build, excavate, and maintain haul roads and ramps, Create mass Excavation, Excavate trenches, Excavate ditches Load Trucks, Cut and fills materials, Stock piles materials, Excavate Back fills trenches, Hoist objects, Clear land, Demolish buildings and other structures, and Ensure performance of equipment

Competency Units	Performance Criteria
CU1. Comply with safety requirements	P1. Operate safety controls and equipment. P2. Respond to caution, warning and hazard signs, lights and symbols.
CU2. Sets up equipment	P1. Adjust to factors affecting safe operation of equipment. P2. Maintain stability of equipment. P3. Position equipment correctly. P4. Communicate with traffic control person.
CU3. Install attachments	P1. Select appropriate tools. P2. Position equipment and attachment for installation. P3. Respond to hand signals. P4. Install attachments safely.
CU4. Operate control Levers/joystick of Wheel Excavator	P1. Operate control levers/joystick smoothly and safely P2. Operate different operating control levers/joystick simultaneously as required. P3. React to changing conditions/situations.
CU5. Operate control Levers/joystick of Crawler Excavator	P1. Operate control levers/joystick smoothly and safely P2. Operate different operating control levers/joystick simultaneously as required. P3. React to changing conditions/situations.
CU6. Create Slopes	P1. Interpret specifications of slope. P2. Practice grade checking instruments P3. Fill cuts in the slope with a partial bucket technique.
CU7. Build, excavate, and maintain haul roads and ramps	P1. Work around obstructions and hazards. P2. Practice grade checking devices. P3. Protect existing structures and utilities. P4. Build, excavate or maintain haul roads and ramps in accordance with job specifications.
CU8. Create mass Excavation.	P1. Adopt laser location for line of sight as excavation progresses. P2. Perform straight edges and stable sides. P3. Dig offset from footing location.

		<p>P4. Keep the machine level.</p> <p>P5. Level to very fine tolerance.</p> <p>P6. Adopt partial bucket technique.</p>
CU9.	Excavate trenches	<p>P1. Work around site obstructions and hazards.</p> <p>P2. Maintain equipment in stable position and correct location for job.</p> <p>P3. Practice grade checking devices.</p> <p>P4. Excavate trench in accordance with job specifications.</p> <p>P5. Respond to hand signals.</p>
CU10.	Excavate ditches	<p>P1. Work around site obstructions and hazards.</p> <p>P2. Maintain equipment in stable position and correct location for job.</p> <p>P3. Practice grade checking devices.</p> <p>P4. Excavate ditches in accordance with job specifications.</p> <p>P5. Respond to hand signals.</p>
CU11.	Load Trucks	<p>P1. Work around obstructions and hazards.</p> <p>P2. Direct loading vehicle operators.</p> <p>P3. Align according to the position of truck.</p> <p>P4. Load transport vehicles in accordance with job specifications.</p> <p>P5. Respond to hand signals.</p>
CU12.	Cut and fills materials	<p>P1. Work around site obstructions and hazards.</p> <p>P2. Position equipment correctly.</p> <p>P3. Practice grade checking devices.</p> <p>P4. Cut and fill material in accordance with job specifications</p> <p>P5. Tamp the filled material</p> <p>P6. Respond to hand signals.</p>
CU13.	Stock materials piles	<p>P1. Work around site obstructions and hazards.</p> <p>P2. Stockpile material in accordance with jobs specifications.</p>
CU14.	Excavate Back trenches and fills	<p>P1. Work around site obstructions and hazards.</p> <p>P2. Ensure that structures or utility lines are not damaged during backfilling.</p> <p>P3. Maintain stability of equipment</p> <p>P4. Level or layer the material</p> <p>P5. Practice grade checking devices.</p> <p>P6. Backfill trenches/excavations in accordance with job specifications.</p> <p>P7. Respond to hand signals.</p>
CU15.	Hoist objects	<p>P1. Inspect rigging (ropes) components visually.</p> <p>P2. Identify and discard worn or damaged rigging components.</p> <p>P3. Communicate with appropriate personnel to replace worn or damaged components.</p> <p>P4. Work around obstructions and hazards.</p>

	<p>P5. Set up equipment in stable position and correct location for jobs.</p> <p>P6. Hoist materials in accordance with manufacturer’s specifications, job specifications and legislation.</p> <p>P7. Respond to hand signals.</p>
CU16. Clear land	<p>P1. Work around obstructions and hazards.</p> <p>P2. Install attachments.</p> <p>P3. Maintain haul roads as required.</p> <p>P4. Clear land in accordance with job specifications.</p>
CU17. Demolish buildings and other structures	<p>P1. Work around obstructions and hazards.</p> <p>P2. Position equipment safely while demolition and always have means of exist.</p> <p>P3. Demolish structures and remove demolished materials in accordance with job specifications.</p> <p>P4. Respond to hand signals.</p>
CU18. Monitor performance of machines	<p>P1. Interpret information from gauges and symbols.</p> <p>P2. Monitor performance using own senses.</p> <p>P3. Identify equipment problems.</p>

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:

- Describe types and sizes of Machines.
- Describe components and functions.
- Explain capacities & capabilities.
- Describes attachments and purposes.
- Define basic tools and supplies.
- Explain safety equipment.
- Describe daily maintenance work
- Define Machine emergency shut-down procedure.
- Describe basic operating functions.
- Explain Pre-start checks, startup and shutdown procedures.

Critical Evidence(s) Required

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

- Install attachments

- Operate controls of Wheel Excavator
- Operate controls of Crawler Excavator
- Create Slopes
- Create mass Excavation.
- Excavate trenches
- Excavate ditches
- Load Trucks
- Cut and fills materials
- Stock piles materials
- Excavate and back fill trenches
- Hoist objects
- Clear land
- Demolish buildings and other structures.

0716-MVS&A-86: Conduct dump truck operations

Overview: This competency standard covers the skills and knowledge required to plan and prepare, Conduct machine pre-operational checks, Operate truck, Load, transport and tip materials, Carry out driver maintenance and Clean up.

Competency Units	Performance Criteria
CU1. Plan and prepare	<p>P1. Obtain, confirm and apply work instructions, including plans, specifications, quality requirements and operational details to the allotted task</p> <p>P2. Obtain, confirm and apply work safety requirements from the site safety plan and organisational policies and procedures to the allotted task</p> <p>P3. Identify, obtain and implement signage requirements from the project traffic management plan</p> <p>P4. Select vehicle, tools and equipment to carry out tasks consistent with the requirements of the job, check for serviceability and rectify or report any faults</p> <p>P5. Identify, confirm and apply environmental protection requirements from the project environmental management plan to the allotted task</p>
CU2. Conduct machine pre-operational checks	<p>P1. Carry out Pre-start, start up, park and shut down procedures in accordance with manufacturers' and/or site specific requirements</p> <p>P2. Check dump truck controls and functions, including tray, articulation, brakes and manoeuvrability for serviceability and rectify or report any faults</p>
CU3. Operate truck	<p>P1. Identify site hazards associated with dump truck operations and use safe operating techniques to minimise risk</p> <p>P2. Manage engine power to ensure efficiency of truck movements and to minimise damage to the engine and gears</p> <p>P3. Coordinate engine power with gear selection ensuring smooth transition and operation within torque range</p> <p>P4. Operate dump truck to work instructions under varied site and weather conditions in accordance with safe work practices and operating procedures</p> <p>P5. Monitor road/traffic conditions constantly taking into account of road standards, traffic flow, distance and load, ensuring no injury to people or damage to property, equipment, loads and facilities</p>

	<p>P6.Bring vehicle to a halt without injury to personnel or damage to property, equipment and loads, through the use of engine retarder, gears and brakes using straight line braking techniques</p> <p>P7.Assume responsibility for self-direction to achieve finished product to job/design specification</p>
<p>CU4. Load, transport and tip materials</p>	<p>P1.Position vehicle at load and discharge points with a minimum of manoeuvre</p> <p>P2.Control dump truck movements including the raising and lowering of the tray smoothly</p> <p>P3.Assess weight and distribution of load for type of material and size of vehicle to ensure it is within vehicle capacity</p> <p>P4.Maintain safety and security of load, including load cover requirements, from loading site to discharge site</p> <p>P5.Discharge load on slope and/or over face at fill site in accordance with standard procedures</p> <p>P6.Dump/spread material evenly in accordance with standard procedures</p> <p>P7.Clear, lower and secure tray before resuming travel in accordance with manufacturers' instructions</p>
<p>CU5. Carry out driver maintenance</p>	<p>P1.Park dump truck safely, prepare for maintenance and shut down in accordance with manufacturers' manual and organisational requirements</p> <p>P2.Conduct inspection and fault finding in accordance with manufacturers' specifications and/or organisational requirements</p> <p>P3.Remove and replace defective parts safely and effectively according to manufacturers' manual and organisational requirements</p> <p>P4.Carry out regular programmed maintenance tasks in accordance with manufacturers' and/or organisational requirements</p>
<p>CU6.Clean up</p>	<p>P1.Clear work area and dispose of or recycle materials in accordance with project environmental management plan</p> <p>P2.Clean, check maintain and store vehicle, tools and equipment in accordance with manufacturers' recommendations and standard work practices</p>

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:

- Dump truck types, characteristics, technical capabilities and limitations
- Basic principles of soil technology for civil works
- Site and equipment safety requirements
- Dump truck operational techniques related to essential tasks
- Processes for interpreting engineering drawings and sketches
- Operational, maintenance and basic diagnostic procedures
- Site isolation and traffic control responsibilities and authorities
- Materials Safety Data Sheets and materials handling methods
- Project quality requirements
- Civil construction terminology
- Methods of changing machine attachments
- Safe operating techniques in all terrain
- Basic earthworks calculations
- Civil construction activity sequences of road construction, earthworks and drainage

Critical Evidence(s) Required

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

0716-MVS&A-87: Operate Bulldozer

Overview: This competency standard covers the skills and knowledge required to Operate Control levers/joystick, Strip and stockpiles surface materials, Cut and fill material, Create slopes, Create ditches, Spread ballast, Rip dense materials, Clear land, and Push scraper

Competency Units	Performance Criteria
CU1. Operate Controls Levers/joystick	<p>P1. Operate control levers/joystick smoothly and safely</p> <p>P2. Operate different operating control levers/joystick simultaneously as required</p> <p>P3. React to changing conditions/situations</p>
CU2. Strip and stockpile surface materials	<p>P1. Distinguish waste layer from structural layer</p> <p>P2. Remove waste layer</p> <p>P3. Move full blade load with optimum capacity</p> <p>P4. Clean up windrows and any remaining waste material</p> <p>P5. Stockpile waste materials.</p>
CU3. Cut and fill material	<p>P1. Estimate the height of cuts and fills</p> <p>P2. Observe grade by coordination with surveyors</p> <p>P3. Cut “humps” and create enough loose material to fill blade before pushing to haulage distance</p> <p>P4. Push material to fill depressions</p> <p>P5. Match blade load with available power and traction</p> <p>P6. Perform rough leveling of ground</p> <p>P7. Eliminate windrows and clean up.</p>
CU4. Create slopes	<p>P1. Interpret stakes/specifications</p> <p>P2. Apply grade checking instruments</p> <p>P3. Cut the slope next to each row of stakes</p> <p>P4. Perform heavy cuts down hill</p> <p>P5. Match blade load with available power and traction</p> <p>P6. Apply safe practices regarding stability issues</p> <p>P7. Grade area to a given slope and eliminate windrows and clean up.</p>
CU5. Create ditches	<p>P1. Identify the required profile using grade checking instruments</p> <p>P2. Create ditch of specified dimensions</p> <p>P3. Stockpile or blend in material</p> <p>P4. Level the ground roughly, eliminate windrows and clean up.</p>
CU6. Spread ballast	<p>P1. Identify dumping location and pattern</p> <p>P2. Match blade load with available power and traction</p> <p>P3. Spread material</p> <p>P4. Grade to requisite level</p>

CU7. Rip dense materials	P1. Rip hard strata P2. Balance ripper load depth & load to available power and traction
CU8. Clear land	P1. Work around obstructions and hazards P2. Clear land in accordance with job specifications.
CU9. Push scraper	P1. Balance engine power to load and traction P2. Minimize wear & tear impact, track spinning P3. Assess grade and level. P4. Remove obstacles and rocks.

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:

- Describe types and sizes of Machines.
- Describe components and functions of Machines.
- Define capacities & capabilities of Machines.
- Describe attachments and its purposes.
- Describe basic tools and supplies.
- Describe Safety equipment.
- Describe daily maintenance work
- Describe Machine emergency shut-down procedure.
- Define basic operating functions.
- Explain Pre-start checks, Startup/Shutdown Procedures.

Critical Evidence(s)

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

- Operate Controls.
- Strip and stockpile surface materials.
- Cut and fill material.
- Create slopes.
- Create ditches.
- Spread ballast.
- Rip dense materials.
- Clear land.

- Push scraper.

Tools and Equipment

1. Color-code cards,
2. Utility documentation.
3. Logbooks.
4. Service Manuals,

O. H. S Regulation,

0716-MVS&A-88: Operate Wheel Loader

Overview: This competency standard covers the skills and knowledge required to Operate Controls, Dig, Carry (tram) & Stockpile Materials. Place and Spread materials, Backfill trenches & Excavate, and Load Trucks.

Competency Units	Performance Criteria
CU1. Operate Control Levers/joystick	P1. Operate control levers/joystick smoothly and safely P2. Operate different operating control levers/joystick simultaneously as required P3. React changing conditions/situations
CU2. Dig, Carry (tram) & Stockpile Materials	P1. Fill bucket in loose material P2. Carry loose material to a short distance P3. Place material in a stockpile P4. Maintain smooth pit floor/running surface
CU3. Place and Spread materials	P1. Load bucket quickly and fully in loose material P2. Carry loose material to a short distance P3. Spread material P4. Maintain smooth pit floor/running surface
CU4. Backfill trenches & Excavate	P1. Place backfill material P2. Manage piles of imported aggregates to minimize waste P3. Spread materials at work area P4. Excavate soft soil strata
CU5. Load Trucks	P1. Arrange the loading site P2. Maintain the pit floor, level, smooth and clear of obstructions P3. Load smoothly and gently P4. Communicate with signaler P5. Load truck as per capacity

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:

- Describe types and sizes of Machines.
- Describe components and their functions.
- Describe capacities & capabilities.
- Describe attachments and purposes.

- Describes basic tools and supplies.
- Describe Safety equipment.
- Explain daily maintenance work
- Describe Machine emergency shut-down procedure.
- Describe basic operating functions.
- Define Pre-start checks, startup/shutdown procedures.

Critical Evidence(s)

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

- Install attachments.
- Operate controls.
- Dig, carry (tram) & stockpile materials.
- Lift and place, spread, & grade materials.
- Backfill trenches & excavate.
- Load trucks.

0716-MVS&A-89: Operate Road Roller

Overview: This competency standard covers the skills and knowledge required to plan and prepare roller/compactor operations, operate roller/compactor, select, relocate the roller, carryout operator maintenance and conduct housekeeping activities.

Competency Units	Performance Criteria
CU1. Plan roller/compactor operations for	<p>P1. Access, interpret and apply mobile plant and equipment documentation and ensure the work activity is compliant</p> <p>P2. Obtain, read, interpret, clarify and confirm work requirements</p>
CU2. Prepare roller/compactor operations for	<p>P1. Select and wear personal protective equipment appropriate for work activities</p> <p>P2. Identify and address potential risks, hazards and environmental issues and implement control measures</p> <p>P3. Identify, obtain and implement traffic management signage requirements</p> <p>P4. Select, and check for faults, equipment and/or attachments and ensure ready for work activities</p> <p>P5. Obtain and interpret emergency procedures, and be prepared for fire/accident/emergency</p>
CU3. Operate roller/compactor	<p>P1. Carry out start-up, park, shutdown and secure equipment procedures</p> <p>P2. Coordinate activities with others at the site prior to commencement of, during and on completion of the work activity</p> <p>P3. Drive and operate equipment within recommended speed, engine capability and limitations</p> <p>P4. Engage and disengage the compacting device</p> <p>P5. Assess materials and site conditions, and apply appropriate operating techniques</p> <p>P6. Identify, remove or manage contaminants</p> <p>P7. Compact to required degree of compaction</p> <p>P8. Monitor and manage equipment performance using appropriate indicators, and ensure efficiency of operations</p> <p>P9. Continually monitor hazards and risks, and ensure safety of self, other personnel, plant and equipment</p>
CU4. Relocate the roller	<p>P1. Prepare the roller for relocation</p> <p>P2. Move the machine between worksites, observing relevant codes and traffic management requirements</p> <p>P3. Load and unload machine from float/trailer</p>

CU5. Carry out operator maintenance	P1. Prepare machine for maintenance P2. Conduct inspection and fault finding P3. Carry out scheduled maintenance tasks P4. Return machine to service P5. Process written maintenance records
CU6. Conduct housekeeping activities	P1. Clear work area and dispose of or recycle materials P2. Manage/report hazards, and maintain a safe working environment P3. Process records

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:

- Describe types and sizes of Machines.
- Explain types of soils w.r.t. cohesion
- Explain selection of type of rollers for specific soil conditions
- Describe components and functions.
- Define capacities & capabilities.
- Describe attachments and its purposes.
- Describe basic tools and supplies.
- Describe safety equipment.
- Explain daily maintenance work
- Describe Machine emergency shut-down procedure.
- Define basic operating functions.
- Explain Pre-start checks, start-up and shutdown procedures

Critical Evidence(s) Required

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

- Conducting prestart checks prior to commencing operations and shutdown procedures on completion of operations
- Carrying out vehicle refuelling requirements and procedures
- Applying appropriate lifting techniques to remove items from path of plant
- Driving and operating equipment under variable ground conditions and grades
- Engaging and disengaging the compacting device
- Identifying, removing and managing contaminants
- Applying safe work practices and identifying and reporting all potential hazards, risks and environmental issues
- Applying problem solving and troubleshooting techniques

- Manoeuvring the roller compactor safely and smoothly
- Adjusting driving and operations techniques to suit material type and ground conditions
- Completing a minimum of 500 metres roller/compactor operations of tailings and haul road
- Achieving the required degree of compaction of the surface

0716-MVS&A-90: Operate a Wheel-mounted loading crane

Overview: This competency standard covers the skills and knowledge required to Position and stabilise crane, Operate vehicle-mounted crane, Monitor lift conditions, Pack up crane and Conduct housekeeping activities.

Competency Units	Performance Criteria
CU1. Position and stabilise crane	<p>P1. Drive crane to position as per job plan to ensure safe operation in accordance with applicable standards, codes of practice, manufacturers specifications and, where applicable, regulatory and local government requirements</p> <p>P2. Use appropriate, barriers, fencing, temporary boundaries, signage and the like to isolate working area in accordance with safe working practice and lift requirements</p> <p>P3. Check ground to ensure it is firm enough to bear the load</p> <p>P4. Use appropriate plates or packing correctly to adequately distribute the load</p> <p>P5. Deploy and position any outriggers and stabilizers correctly in accordance with manufacturer's instructions and the appropriate standard and other relevant statutory regulations or local authority requirements</p> <p>P6. Check outrigger packing for adequacy prior to and after load is taken</p>
CU2. Operate vehicle-mounted crane	<p>P1. Implement planned hazard control strategies</p> <p>P2. Give, interpret and follow required signals are correctly in accordance with appropriate standards</p> <p>P3. Assess load mass and correlate with lifting capacity of crane throughout proposed radii of operation</p> <p>P4. Select appropriate lifting gear and load securely</p> <p>P5. Hoist and lower load into position using crane movements in accordance with the appropriate standard</p> <p>P6. Operate crane controls smoothly</p> <p>P7. Shut down and secure crane during periods of non-operation according to manufacturers specifications and workplace procedures</p>
CU3. Monitor lift conditions	<p>P1. Monitor load constantly to ensure load and structural stability</p> <p>P2. Identify and monitor conditions which may affect the continuing stability of the crane</p> <p>P3. Respond to unplanned situations in line with workplace procedures in a manner that minimises risk to personnel</p>

	<p>and equipment</p> <p>P4. Seek advice from supervisor where there is doubt about correct response to unanticipated conditions, or conflict with customer request</p> <p>P5. Advise supervisor/allocator of any concern about completing the job within timeframe</p> <p>P6. Implement shut-down procedures in accordance with manufacturer's instructions in the event of an emergency</p> <p>P7. Apply relevant motion locks and brakes</p> <p>P8. Shut down crane using the correct sequence of procedures in accordance with manufacturers specifications and workplace procedures</p> <p>P9. Carryout routine post-operational equipment checks in accordance with manufacturers specifications</p>
CU4. Pack up crane	<p>P1. Check all lifting equipment and crane components for any signs of deterioration or damage in accordance with the appropriate standard</p> <p>P2. Segregate damaged or worn equipment is and report to an authorised person for testing/repair/destruction</p> <p>P3. Stow and secure crane equipment correctly in accordance with manufacturer's instructions and the appropriate standard</p> <p>P4. Immobilise and secure crane for travel in accordance with manufacturer's instructions, workplace guidelines and regulatory requirements</p>
CU5. Conduct housekeeping activities	<p>P4. Clear work area and dispose of or recycle materials</p> <p>P5. Manage/report hazards, and maintain a safe working environment</p> <p>P6. Process records</p>

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:

- Relevant road rules, regulations, permit and licence requirements pertaining to mobile crane operation
- Relevant OH&S and environmental procedures and regulations
- Mobile crane applications, capacities, configurations, safety hazards and control mechanisms
- Operational procedures for crane crews

- Prioritising and multi-tasking work
- Company work procedures concerning the setting up and rigging of a mobile crane at a work site
- Problems that may arise when operating a vehicle-mounted loading crane and actions that should be taken to prevent or solve them
- Focus of operation of work systems and equipment
- Application of relevant agreements, codes of practice or other legislative requirements

Critical Evidence(s) Required

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

0716-MVS&A-91: Operate Motor Grader

Overview: This competency standard covers the skills and knowledge required to Operate Controls, Apply Grading Fundamentals, Form and handle windrows, Strip surface materials, Cut and fill material, Maintain access roads, Create slopes, Create ditches, Create shouldering, Form sub-grade, Place aggregates to specified elevations (finish grading), and Clear snow .

Competency Units	Performance Criteria
CU1. Operate Control levers/joystick	<p>P1. Operate control levers/joystick smoothly and safely.</p> <p>P2. Operate different operating control levers/joystick simultaneously as required</p> <p>P3. React to changing conditions/situations.</p>
CU2. Apply Grading Fundamentals	<p>P1. Apply wheel lean control</p> <p>P2. Apply frame articulation fundamentals</p> <p>P3. Select gear and engine speed</p> <p>P4. Apply grading tips</p>
CU3. Form and handle windrows	<p>P1. Choose gear and engine speed</p> <p>P2. Choose blade position</p> <p>P3. Cut material to form a windrow</p> <p>P4. Move material back over area</p>
CU4. Strip surface materials	<p>P1. Distinguish waste layer from structural layer</p> <p>P2. Strip waste materials (usually organic)</p> <p>P3. Finish windrows of stripped material</p> <p>P4. Enter and exit machine</p>
CU5. Cut and fill material	<p>P1. Estimate the height of cut and fill</p> <p>P2. Choose blade tilt, angle and position</p> <p>P3. Cut heights</p> <p>P4. Match blade load to available power and traction</p> <p>P5. Move material to low areas</p> <p>P6. Grade area to desired profile</p>
CU6. Maintain access roads	<p>P1. Identify drainage structures, culverts and obstacles</p> <p>P2. Adjust windrow to allow traffic to continue</p> <p>P3. Choose blade position, wheel lean, articulation, gear and speed</p> <p>P4. Reshape and recover materials for the road surface</p> <p>P5. Cut shoulders and move material to center or from one side to another</p>
CU7. Create slopes	<p>P1. Identify required slope</p> <p>P2. Apply grade checking instruments</p> <p>P3. Choose blade position, wheel lean, articulation, gear and speed</p>

	<p>P4. Smooth the area at the base of the slope for smooth working platform</p> <p>P5. Start at the top of slope</p> <p>P6. Shape the shoulder accurately</p>
CU8. Create ditches	<p>P1. Identify the required profile using grade checking instruments</p> <p>P2. Choose blade position, wheel lean, articulation, gear and speed</p> <p>P3. Shape ditch by repeated passes.</p>
CU9. Create shouldering	<p>P1. Choose blade position, wheel lean, articulation, gear and speed</p> <p>P2. Position grader with outer tires on pavement, and inner tires just off pavement on shoulder for left side shoulder</p> <p>P3. Position grader with inner tires on pavement, and outer tires just off pavement on shoulder for right side shoulder</p> <p>P4. Move only enough material to pavement edge to dress the shoulder</p> <p>P5. Roll the windrow back away from the pavement edge</p> <p>P6. Shape the shoulder accurately</p>
CU10. Form sub-Grade	<p>P1. Choose blade tilt, angel and position</p> <p>P2. Match blade load to available power and traction</p> <p>P3. Remove unsuitable material</p> <p>P4. Cut and fill load bearing soils to create desired profile</p> <p>P5. Shape for drainage and ditch as required</p>
CU11. Place aggregates to specified elevations (finish grading)	<p>P1. Identify the required profile using grade checking instruments</p> <p>P2. Get the correct volume in the efficient placement</p> <p>P3. Position for efficient spreading</p> <p>P4. Get correct volume of aggregates</p> <p>P5. Shift the circle and blade towards the piles</p> <p>P6. Cut out windrows only as large as the machine can handle without tire spinning</p> <p>P7. Angle the blade as appropriate</p> <p>P8. Precise control to achieve elevations and shape to very accurate tolerances</p>
CU12. Clear snow and ice	<p>P1. Choose proper attachment, as chains, V-plow, wing plow, skid shoes and wing gates</p> <p>P2. Identify snow type, moisture content, density, weight, depth of snow, underlying surface, weather, visibility, traffic, obstacles and hidden structures</p>

P3. Mount chain on tires carefully

P4. Drive the machine in higher speed to move snow across and off the blade

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:

- Describe types and sizes of Machines.
- Describe components and functions.
- Define capacities & capabilities.
- Describe attachments and its purposes.
- Describe basic tools and supplies.
- Describe safety equipment.
- Explain daily maintenance work
- Describe Machine emergency shut-down procedure.
- Define basic operating functions.
- Explain Pre-start checks, startup and shutdown procedures

Critical Evidence(s) Required

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

- Operate Controls.
- Strip surface materials.
- Cut and fill material.
- Maintain access roads.
- Create slopes.
- Create ditches.
- Create shouldering.
- Form road base (sub-grade).
- Place aggregates to specified elevations (finish grading).

0716-MVS&A-92: Conduct asphalt paver operations

Overview: This competency standard covers the skills and knowledge required to plan and prepare, Set up asphalt paver, Operate asphalt paver, Carry out operator maintenance, Relocate paver and clean up.

Competency Units	Performance Criteria
CU1. Plan and prepare the machine	<p>P1. Access, interpret and apply compliance documentation relevant to the work activity</p> <p>P2. Obtain and confirm safety requirements from the site safety plan and organisational policies and procedures, and apply to the allotted task</p> <p>P3. Identify, obtain and implement signage requirements from the project traffic management plan</p> <p>P4. Determine material to be laid and handling procedures to be employed according to specifications</p> <p>P5. Select plant, tools and equipment to carry out asphalt paver tasks consistent with the requirements of the job, check for serviceability and rectify or report any faults</p> <p>P6. Identify environmental protection requirements from the project environmental management plan, and confirm and apply to the allotted task</p>
CU2. Set up asphalt paver	<p>P1. Carry out start-up, park, and shutdown procedures in accordance with manufacturer's and/or site specific requirements</p> <p>P2. Adjust, change or inflate tyres using safe handling procedures</p> <p>P3. Set equipment to correct levels to enable the laying of materials to specifications</p> <p>P4. Set heating controls for the screed board to specifications</p> <p>P5. Install feeder bin where required</p> <p>P6. Check materials spreading controls for correct operation</p>
CU3. Operate asphalt paver	<p>P1. Engage delivery vehicles smoothly without bumping</p> <p>P2. Maintain appropriate uniform speed during spreading operations</p> <p>P3. Monitor and maintain asphalt mix according to job specifications</p> <p>P4. Maintain communication with screed hand to ensure job is progressing satisfactorily and that materials are being spread to specifications</p> <p>P5. Monitor movement of the plant to ensure safety of asphalt crew</p>

CU4. Carry out machine maintenance	<p>P1. Park paver safely, prepare for maintenance and shutdown as per manufacturer's manual and organisational requirements</p> <p>P2. Conduct inspection and fault finding</p> <p>P3. Carry out routine operational servicing and lubrication tasks</p> <p>P4. Carry out minor maintenance</p> <p>P5. Record performance of machine constantly to enable timely repair of equipment</p>
CU5. Relocate paver	<p>P1. Prepare paver for relocation</p> <p>P2. Drive paver safely on highways and construction sites, observing highway code and local safety requirements</p>
CU6. Clean up the machine and work area	<p>P1. Clear work area and dispose of or recycle materials in accordance with project environmental management plan</p> <p>P2. Clean, check, maintain and store plant, tools and equipment</p>

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:

- Site and equipment safety requirements
- Asphalt paving techniques
- Asphalt paving operations
- Asphalt strength and performance characteristics
- Edge and joint treatments
- Equipment types, characteristics, technical capabilities and limitations
- Operational, maintenance and basic diagnostic procedures
- Site isolation and traffic control responsibilities and authorities
- Processes for the calculation of material requirements, mix, application rates, uniformity and travel speed
- Materials safety data sheets and materials handling methods
- Project quality requirements
- Civil construction terminology

Critical Evidence(s) Required

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

0716-MVS&A-93: Develop Communication Skill

Overview:

The user/ individual on the job needs to know and understand how to writing skills, reading skills and oral communications skills (Listening and speaking)

<i>Unit of Competency</i>	<i>Performance Criteria</i>
CU-1: Writing Skills	<p>The user/ individual on job needs to know and understand how to:</p> <ul style="list-style-type: none"> P-1. Document instructions, itinerary and task lists P-2. Maintain documents and reports pertaining to security operations, emergency response, personnel and equipment P-3. Document activities and incidents in a chronological order P-4. Write letters/ memos, feedback and reports P-5. Use computers to generate Management Information System (MIS), emails and other reports P-6. Write in English and at least in one vernacular language proficiently
CU-2: Speaking and Listening Skills	<p>The user/ individual on job needs to know and understand how to:</p> <ul style="list-style-type: none"> P-1. Read and assimilate organizational procedures, site and security instructions, and correspondence, as applicable P-2. Read security registers, documents, feedback, reports and applications Oral Communication (Listening and Speaking skills)The user/individual on the job needs to know and understand how to: P-3. Speak clearly and emphatically P-4. Receive briefings and instructions from superiors and ask queries P-5. Brief and instruct subordinates and receive debriefings P-6. Reply to the queries from stakeholders P-7. Ask questions from visitors P-8. Raise alarm/ make announcements/ speak over phone/ radio
CU-3: Professional Skills	<p>Decision Making The user/individual on job needs to know and understand how to: SB1 take decisions pertaining to security operations, training,</p>

administration and emergency situations **Plan and Organize.** The user/individual on the job needs to know and understand how to:

P-1. Plan security operations as per site instructions and resources available assess and assign tasks to teams and individuals

P-2. Conduct training, rehearsals and mock drills **Customer Centricity** The user/individual on the job needs to know and understand how to:

P-3. Manage relationships with stakeholders and visitors **Problem Solving** The user/individual on the job needs to know and understand how to:

P-4. Think through the problem, evaluate the possible solution(s) and adopt a best possible solution(s)

P-5. Handle disruption in security operations **Analytical Thinking** The user/individual on the job needs to know and understand how to:

P-6. Anticipate and identify potential risk and threats and take suitable actions

P-7. Observe people, activities and movements keenly **Critical Thinking** The user/individual on the job needs to know and understand how to:

P-8. Analyze and evaluate a situation and available information to take appropriate action

Knowledge & Understanding

- K-1 Analytical techniques:** Brainstorming, Intuitions/Logic, Cause and effect diagrams, Pareto analysis, SWOT analysis, Gant chart, Pert CPM and graphs, Scatter grams.
- K-2 Problem:** Non – routine process and quality problems, Equipment selection, availability and failure, Teamwork and work allocation problem, Safety and emergency situations and incidents.
- K-3 Action plans:** Priority requirements, Measurable objectives, Resource requirements, Timelines, Co-ordination and feedback requirements, Safety requirements, Risk assessment, Environmental requirements

Knowledge & Understanding

- K-29.** Describe the different hydraulic symbol
- K-30.** Describe the different hydro pneumatic symbol.
- K-31.** Describe the pneumatic symbol.
- K-32.** Describe the different electro pneumatic symbols.

Critical Evidence(s) Required

- Capable to identify the hydraulic symbol.
- Capable to identify the pneumatic symbol.

- Capable to

0716-MVS&A-94: Develop Administrative Skills

Overview:

The user/ individual on the job need to know and understand how to develop administrative skills.

<i>Unit of Competency</i>	<i>Performance Criteria</i>
CU-1: Decision making	P-1. Perform decisions pertaining to security operations, training and administration P-2. Perform emergency situations
CU-2: Make Plan and Organize the workshop	The user/individual on job needs to know and understand how to: P-1. Plan security operations as per site instructions and resources available assess and assign tasks to teams and individuals P-2. Conduct training, rehearsals and mock drills P-3. Manage relationships with stakeholders and visitors
CU-3: Evaluate the possible solution	P-1. Think through the problem, evaluate the possible solution(s) and adopt a best possible solution(s) P-2. Handle disruption in security operations P-3. Anticipate and identify potential risk and threats and take suitable actions P-4. Observe people, activities and movements keenly P-5. Analyze and evaluate a situation and available information to take appropriate action

Knowledge & Understanding

- K-4 Analytical techniques:** Brainstorming, Intuitions/Logic, Cause and effect diagrams, Pareto analysis, SWOT analysis, Gant chart, Pert CPM and graphs, Scatter grams.
- K-5 Problem:** Non – routine process and quality problems, Equipment selection, availability and failure, Teamwork and work allocation problem, Safety and emergency situations and incidents.
- K-6 Action plans:** Priority requirements, Measurable objectives, Resource requirements, Timelines, Co-ordination and feedback requirements, Safety requirements, Risk assessment, Environmental requirements

Knowledge & Understanding

- K-33.** Describe the different hydraulic symbol
- K-34.** Describe the different hydro pneumatic symbol.
- K-35.** Describe the pneumatic symbol.
- K-36.** Describe the different electro pneumatic symbols.

Critical Evidence(s) Required

- Capable to identify the hydraulic symbol.
- Capable to identify the pneumatic symbol.

0716-MVS&A-95: Analyze Parts of Generators

Overview: This Competency Standard identifies the competencies required Identify parts of generator, Inspection of generator and Troubleshooting of generator

Competency Units	Performance Criteria
CU1 Identify parts of generator	P1. Identify engine P2. Identify main alternator P3. Identify AVR(automatic voltage regulator) P4. Identify ATS(auto transfer switch) P5. Identify control panel P6. Identify circuit barker P7. Identify cables P8. Identify anti vibration mountings
CU2 Inspect of generator	P1. Inspect of the engine P2. Inspect of main alternator P3. Inspect of AVR(automatic voltage regulator) P4. Inspect of ATS(auto transfer switch) P5. Inspect the control panel P6. Inspect the circuit barker P7. Inspect the cables P8. Inspect of anti-vibration mountings
CU3 Troubleshoot of generator	P1. Troubleshoot engine P2. Troubleshoot main alternator P3. Troubleshoot control panel P4. Troubleshoot AVR(automatic voltage regulator) P5. Troubleshoot ATS(auto transfer switch) P6. Troubleshoot circuit barker P7. Troubleshoot cables

Knowledge & Understanding

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

- K-1.** Describe Engine
- K-2.** Describe main alternator
- K-3.** Describe control panel
- K-4.** Describe circuit barker
- K-5.** Describe AVR(automatic voltage regulator)
- K-6.** Describe ATS(auto transfer switch)
- K-7.** Describe cables
- K-8.** Describe anti vibration mountings

Critical Evidence(s) Required

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

- E1 Capable to identify the main parts of the generator
- E2 Capable to inspect the generator
- E3 Capable to troubleshoot the generator

List of Tools and Equipment

S No.	Description
	1. Hand tools trolley
	2. Generator
	3. Main Alternator

0716-MVS&A-96: Analyze Main Alternator

Overview: This competency standard identifies the competencies you need to Identification of main alternator, inspection of main alternator and Troubleshooting of main alternator

Competency Units		Performance Criteria
CU1 Identify alternator	main	P1. Identify stator P2. Identify rotor P3. Identify exciter P4. Identify rectifiers P5. Identify fan P6. Identify coupling disc
CU2 Inspect alternator	main	P1. inspect stator P2. inspect rotor P3. inspect exciter P4. inspect rectifiers P5. inspect fan P6. inspect coupling disc
CU3 Troubleshoot main alternator	of	P1. Troubleshoot stator P2. Troubleshoot rotor P3. Troubleshoot exciter P4. Troubleshoot rectifiers P5. Troubleshoot fan

Knowledge & Understanding

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

- K-1. Describe rotor
- K-2. Describe exciter
- K-3. Describe rectifiers
- K-4. Describe fan
- K-5. Describe coupling disc
- K-6. Describe stator

Critical Evidence(s) Required

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

- Capable to identify the Alternator
- Capable to Inspect the Alternator
- Capable to troubleshoot the Alternator

List of Tools and Equipment

S No.	Description
	1. Hand tools trolley
	2. Generator
	3. Main Alternator

0716-MVS&A-97: Analyse Operation of Control Panel

Overview: This competency standard identifies the competencies you need to Operation of module, Inspection of module and Troubleshooting of module.

Competency Units	Performance Criteria
CU1 Perform Operation of module	P1. Perform starting/auto starting/stopping of module P2. Check voltage, frequency, amperes, rpm, temperature, oil pressure, hour meters, load, error codes of module P3. Check fuse, relay, timer, sensors of module
CU2 Inspect module	P1. inspect starting/auto starting/stopping of module P2. inspect voltage, frequency, amperes, rpm, temperature, oil pressure, hour meters, load, error codes of module P3. inspect fuse, relay, timer, sensors of module
CU3 Troubleshoot of module	P1. Check Start/Stop of Module. P2. Check Power Supply to module. P3. Check the module for Fault Indication. P4. Enter password to access setting of module or connect laptop to module for parameter setting/Programming.

Knowledge & Understanding

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

- K-1.** Knowledge of start/auto start/stop.
- K-2.** Knowledge of Fault Indication.
- K-3.** How to read the Fault Code.
- K-4.** How to perform task on Module
- K-5.** How to check the faulty Module
- K-6.** How to establish connection of module with Laptop.
- K-7.** Knowledge to perform parameter setting from Module.
- K-8.** Knowledge of safety protection

Critical Evidence(s) Required

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

- Capable to operate the Module
- Capable to inspect the Module
- Capable to trouble shoot the module
- Capable to perform the parameter setting/Calibration.

0716-MVS&A-98: Perform Preventive Maintenance

Overview: This competency standard identifies the competencies you need to perform Daily maintenance of Engine, operating hour maintenance of Engine,500 HR maintenance of engine,1000 HR maintenance of engine,2000 HR maintenance of engine, Alternator preventive maintenance, Decommissioning, Dismantling and disposal,

Competency Units		Performance Criteria
CU1	Perform maintenance of Engine Daily	<ul style="list-style-type: none"> P1. Drain water from fuel filter. P2. Check fuel level. P3. Empty air filter evacuator valve. P4. Check engine oil level. P5. Check Coolant Level. P6. Check electrolyte level of Battery. P7. Check for fault indication (If any). P8. Check on abnormal noise. P9. Check obstruction on crankcase breather.
CU2	:Perform 250 operating hour maintenance of Engine	<ul style="list-style-type: none"> P1. Change Engine Oil. P2. Change Oil Filter. P3. Check hoses & Pipes for any leakage/damage. P4. Inspect/Adjust fan/alternator belt. P5. Check Indicator Air Filter (Clean Filter if necessary).
CU3	Perform 500 Hour maintenance of engine.	<ul style="list-style-type: none"> P1. Change fuel filter (primary/secondary) P2. Change air filter primary. P3. Test earth leak relay. P4. Check emergency stop P5. Clean radiator P6. Check hoses, pipes & clamps (replace if necessary) P7. Check electrolyte level & battery terminal P8. Analyze coolant P9. Drain/clean fuel tank water & sediment.
CU4	Perform 1000 Hour maintenance of engine	<ul style="list-style-type: none"> P1. Replace air filter safety. P2. Replace fan/alternator belt P3. Check electrical system cables for wear P4. Check/Test glow plugs P5. Check torque on critical bolt connection P6. Check rubber flexible P7. Adjust engine inlet/outlet valve P8. Check engine protective devices

CU5 Perform 2000 Hour maintenance of engine	P1. Check fuel injectors P2. Check starting motor P3. Check turbocharger P4. Check water pump P5. Inspect charging alternator
CU6 Carry out Alternator preventive maintenance	P1. Inspect the alternator winding conditions and carry out general cleaning P2. Inspect cable connections between the alternator and circuit breaker P3. Measure alternator insulation resistance (After 1000 operating hour)
CU7 Decommission, Dismantle and disposal of material	P1. Consult your local Dealer and local regulations regarding the disposal of materials on your generator set P2. Contact with companies specializing in recycling of iron, steel and copper from gen set P3. Perform special treatment for some components such as electrical cable, electronic accessories and plastics as per standard P4. Consult a specialist company regarding the removal of other components like gaskets and seals of gen set etc.

Knowledge & Understanding

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

- K-1. Knowledge of electrically simulating faults
- K-2. Knowledge of cleaning all battery cap vents
- K-3. Knowledge of tightening all exhaust connections
- K-4. Knowledge of tightening all electric connections
- K-5. Types of alternator windings
- K-6. Knowledge of instrument panel gauges and meters
- K-7. Knowledge of circuit breakers
- K-8. Knowledge of daily start up checks
- K-9. Knowledge of weekly checks
- K-10. Knowledge of how to measure the insulation resistance of alternator.

Critical Evidence(s) Required

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

- Capable to perform daily checkups
- Capable to perform 250 hour maintenance
- Capable to perform 500 hour maintenance
- Capable to perform 1000 hour maintenance.
- Capable to perform the 2000 hour maintenance.
- Capable to dispose of the material.

0716-MVS&A-99: Carry out Trouble Shooting Guide

Overview: This competency standard identifies the competencies you need to Analyse why Engine Fails to Start, Check Engine stoppage due to high coolant temperature, Troubleshoot fan malfunction, Analyse automode (on, off) of generator, Check Alarm For Not In Auto Mode (Standby Sets Only), Check Output Voltage, Analyse why Output Voltage low, Analyse Voltage drop when load is imposed and Check why Voltage Higher than rated Voltage

Competency Units	Performance Criteria
CU-1: Analyze why Engine Fails To Start	<p>P1. Check all emergency stop push buttons are released</p> <p>P2. Check the stop button light is not on</p> <p>P3. Check there are no shutdown events active</p> <p>P4. Reset, if required, after remedying the indicated fault</p> <p>P5. Refer to your instructor if necessary</p>
CU-2: Check Engine stoppage due to high coolant temperature.	<p>P1. Check coolant level in the radiator.</p> <p>P2. Refer to safety section before removing the radiator cap</p> <p>P3. Remove radiator cap safely using cloth</p> <p>P4. Fill water if necessary</p> <p>P5. Check the radiator</p> <p>P6. Check Thermostat</p> <p>P7. Check Water Pump</p> <p>P8. Refer to your instructor if necessary</p>
CU-3: Troubleshoot fan malfunction	<p>P1. Check radiator fan working or not</p> <p>P2. Check fuse of radiator fan</p> <p>P3. Check electrical supply of radiator fan</p> <p>P4. Ensure that electric connectors are attached properly</p> <p>P5. Refer to your instructor if necessary</p>
CU-4: Analyze auto mode(on, off) of generator	<p>P1. Check that the generator set stops</p> <p>P2. Depress emergency stop push button</p> <p>P3. Held down the stop key for 5 seconds</p> <p>P4. Skip cool down time</p> <p>P5. Refer to your instructor if necessary</p>
CU-5: Check Alarm For Not In Auto Mode (Standby Sets Only)	<p>P1. Check the module is in "auto" mode</p> <p>P2. Check emergency stop push buttons are not pressed</p> <p>P3. Refer to your instructor if necessary</p>
CU-6: Check Output Voltage	<p>P1. Fuse on AVR broken.</p> <p>P2. AVR broken.</p> <p>P3. Rotating rectifier (diode bridge) defect.</p> <p>P4. Alternator winding burned or broken.</p> <p>P5. Bad wire connection</p>

CU-7: Analyze why Output Voltage low	P1. Adjust voltage on AVR. P2. Check alternator speed. P3. AVR defect. P4. Alternator windings damaged
CU-8: Analyze Voltage drop when load is imposed	P1. Check LED's on AVR. P2. Check nominal power with load requirements. Yellow LED: overload or $\cos\phi$ = bad. P3. Power problem on engine. Red LED: under speed. P4. AVR defect. P5. Alternator windings
CU-9: Check why Voltage Higher than rated Voltage	P1. Unbalanced load. P2. Nonlinear load, harmonics. P3. AVR defect.

Knowledge & Understanding

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

- K-1.** Knowledge of display in Gen Set
- K-2.** Knowledge of emergency signals
- K-3.** Knowledge of signal LED's
- K-4.** Knowledge of water pump
- K-5.** Knowledge of Thermostat
- K-6.** Knowledge of ATS(auto transfer switch)
- K-7.** Knowledge of cool down time
- K-8.** Knowledge of engine gauges

Critical Evidence(s) Required

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

- Capable to diagnose/troubleshoot the Genset.

0716-MVS&A-100: Perform Safety Practices and Procedures of Gen Set

Overview: This competency standard identifies the competencies you need to Adopt Health & Safety regulations, Encourage primary safety program,

Competency Units	Performance Criteria
CU-1: Adopt Health & Safety regulations.	<p>P1. Do not charge a frozen battery, this may cause an explosion</p> <p>P2. Ensure the generator set room is properly ventilated</p> <p>P3. Keep the room, the floor and the generator set clean.</p> <p>P4. When spills of fuel, oil, battery electrolyte or coolant occur, they should be cleaned up immediately</p> <p>P5. Never store flammable liquids near the engine</p> <p>P6. Identify rights & responsibilities regarding safety</p> <p>P7. Interpret regulations & guidelines specific to Heavy Machines.</p> <p>P8. Interpret common safety rules and tips.</p> <p>P9. Identify employer safety rules and policies.</p>
CU-2: Encourage primary safety program	<p>P1. Motivate by regulation.</p> <p>P2. Motivate by ethics, legitimate concern</p> <p>P3. Motivate by cost of lost time and injury Claims.</p> <p>P4. Motivate by liability</p>

Knowledge & Understanding

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

- 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

Critical Evidence(s) Required

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

- Capable to adopt safety precautions according to requirements.

0716-MVS&A-101: Recognize steering & brake system of bulldozer.

Overview:

This learning unit is designed to provide skills and knowledge to identify steering & brake system of bulldozer.

Unit of Competency	Performance criteria
CU1. Identify the layout of steering & brake system of bulldozer	P1. Identify steering and brake control lever and pedals. P2. Identify steering pump & filter P3. Identify steering control valve P4. Identify steering case P5. Identify steering clutch & brake unit P6. Identify the modulating steering valve.
CU2. Demonstrate power Train of Bulldozer	P1. Locate Engine P2. Locate main clutch / Torque converter P3. Locate Transmission and Transmission Pinion P4. Locate Bevel gear and Axle shaft P5. Locate steering clutches P6. Locate Final Drives P7. Locate sprockets and Track chains.
CU3. Demonstrate on cutaway model of steering clutch of CL-I type.	P1. Identify clutch drum & Brake drum P2. Identify disc & plates of clutch P3. Identify bearing, cage, piston & spring of clutch assembly.
CU4. Demonstrate on cutaway model of steering clutch of CL-III type.	P1. Identify clutch drum & Brake drum P2. Identify disc & plates of steering clutch P3. Identify bearing, cage, piston, pressure Plate & spring of steering clutch assembly. P4. Demonstrate difference between CL-I and CL-III steering clutches.
CU5. Demonstrate hydraulic circuit of steering & brake system of bulldozer	P1. Demonstrate steering hydraulic circuits in straight crawling, right and left turning P2. Demonstrate brake hydraulic circuits in straight crawling, right and left turning P3. Identify Different Take off ports for pressure gauges

Knowledge & Understanding

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

- K1.** Describe Steering clutches structure.
- K2.** Describe Steering clutches operation.
- K3.** Describe hydraulic circuits of steering clutches.
- K4.** Describe hydraulic circuits of brake circuit.

Critical Evidence(s) Required

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

- Capable to identify the location of different components of steering and brake system of Bulldozer.
- Capable to identify different types of steering clutches
- Capable to demonstrate CL-I type steering clutch.
- Capable to demonstrate CL-III type steering clutch.
- Understand the hydraulic circuit of steering and brake system.

List of Tools and Equipment's

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools

0716-MVS&A-102: Disassemble and assemble steering clutch of bulldozer.

Overview:

This learning unit is designed to provide skills and knowledge to disassemble and assemble steering clutch of bulldozer.

CU1. Disassemble steering clutch of bulldozer	P1. Arrange proper tools to Disassemble the steering clutch P2. Disassemble the brake band P3. Disassemble the brake drum P4. Remove the bolts P5. Remove the pressure plate P6. Remove disc & plates P7. Disassemble clutch drum. P8. Remove springs & sleeves. P9. Remove clutch piston
CU2. Assemble steering clutch of bulldozer	P1. Install clutch piston P2. Install springs & sleeves. P3. Install clutch drum P4. Install disc & plates. P5. Install pressure plate. P6. Install bolts. P7. Install the brake drum P8. Install brake band.

Knowledge & Understanding

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

- K1 Describe Disassembling chart of steering clutch
- K2. Describe assembling chart of steering clutch

Critical Evidence(s) Required

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

- Capable to disassemble the steering clutch of Bulldozer
- Capable to assemble steering clutch of Bulldozer
- Capable to inspect the steering clutch different components
- Able to refill the steering oil in steering case.

List of Tools and Equipments

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools

0716-MVS&A-103: Disassemble and assemble the steering control valve of bulldozer

Overview:

This learning unit is designed to provide skills and knowledge to Disassemble and assemble the steering control valve of bulldozer

CU1. Disassemble the steering control valve of bulldozer	P1. Arrange Proper tools to Disassemble the steering control valve of bulldozer P2. Disassemble steering relief valve P3. Remove brake valve assembly from steering valve assembly. P4. Disassemble steering valve assembly. P5. Disassemble brake valve assembly.
CU2. Assemble the steering control valve of bulldozer	P1. Arrange Proper tools to Assemble the steering control valve of bulldozer P2. Inspect, clean and replace faulty parts of steering control valve of bulldozer. P3. Assemble brake valve parts. P4. Assemble steering valve parts. P5. Install clutch & brake valve assembly together. P6. Assemble relief valve.

Knowledge & Understanding

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

- K-1.** Explain Disassembling Procedure of steering control valve assembly
- K-2.** Explain assembling Procedure of steering control valve assembly

Critical Evidence(s) Required

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

- Capable to disassemble the steering control valve assembly of bulldozer
- Capable to assemble the steering control valve assembly of bulldozer
- Able to inspect the different components of bulldozer.
- Able to remove steering control valve assembly.
- Able to install steering control valve assembly.

List of Tools and Equipments

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools

0716-MVS&A-104: Test and adjust the steering and brake system of bulldozer.

Overview:

This learning unit is designed to provide skills and knowledge to test and adjust the steering and brake system of bulldozer.

CU1. Test steering system of bulldozer.	P1. Arrange Proper tools to Test the steering system of bulldozer. P2. Measure the lever pulling force. P3. Measure steering lever travel P4. Measure steering relief pressure. P5. Measure Left and right steering clutches disengaging pressure.
CU2. Adjust steering system of bulldozer.	P1. Adjust the lever pulling force. P2. Adjust steering lever travel P3. Adjust steering relief pressure. P4. Adjust Left and right steering clutches disengaging pressure.
CU3. Test the brake system of bulldozer.	P1. Arrange Proper tools to Test the brake system of bulldozer. P2. Measure the pedal pulling force. P3. Measure the brake pedal travel. P4. Measure left and right brake relief pressure.
CU4. Adjust the brake system of bulldozer.	P1. Adjust the pedal pulling force. P2. Adjust the brake pedal travel. P3. Adjust left and right brake relief pressure.

Knowledge & Understanding

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

- K-1.** Describe the testing and adjusting procedure of steering system of Bulldozer
- K-2.** Describe the testing and adjusting procedure of brake system of Bulldozer.

Critical Evidence(s) Required

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

- Capable to test the steering control levers.
- Capable to adjust the steering control levers.
- Able to test and adjust the steering control system.
- Able to test and adjust the brake system.

List of Tools and Equipments

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools

0716-MVS&A-105: Analyze hydrostatic steering system of Bulldozer.

Overview:

This learning unit is designed to provide skills and knowledge to Demonstrate hydrostatic steering system of tracked machine.

CU1. Demonstrate hydrostatic steering system of bulldozer.	P1. Identify the main components on model. P2. Trace the power train on machine during straight traveling. P3. Trace the power train on machine during right turn. P4. Trace the power train on machine during pivot turning.
CU2. Test and adjust the hydrostatic steering pump oil pressure of bulldozer.	P1. Read the HSS Oil pressure on dash board monitor. P2. Measure HSS Oil pressure with the help of gauge. P3. Compare the reading with maintenance standards on shop manual P4. Adjust oil pressure if needed.

Knowledge & Understanding

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

- K-1.** Describe of hydraulic steering system of bulldozer.
- K-2.** Describe testing and adjusting procedure of hydrostatic steering system.

Critical Evidence(s) Required

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

- Capable to demonstrate hydrostatic steering system of bulldozer.
- Able to test hydrostatic steering system pressure of bulldozer.
- Able to adjust hydrostatic steering system pressure of bulldozer.

List of Tools and Equipments

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools

0716-MVS&A-106: Analyze steering system of wheeled machines.

Overview:

This learning unit is designed to provide skills and knowledge to demonstrate steering & brake system of wheeled machines.

<p>CU1. Demonstrate steering system of wheel loader on machine.</p>	<p>P1. Identify steering wheel. P2. Identify steering column P3. Identify Re-circulating ball type steering gear. P4. Identify steering control valve assembly. P5. Identify two way restrictor valve. P6. Identify steering cylinder. P7. Identify steering pump. P8. Locate Hydraulic Tank</p>
<p>CU2. Identify /Draw steering circuits of wheel loader.</p>	<p>P1. Identify the steering Circuit of wheel loader in straight travelling. P2. Identify the steering Circuit of wheel loader in right turning. P3. Identify the steering Circuit of wheel loader in left turning. P4. Draw the steering Circuit of wheel loader in straight travelling. P5. Draw the steering Circuit of wheel loader in right turning. P6. Draw the steering Circuit of wheel loader in left turning.</p>
<p>CU3. Identify Different Valves inside the Steering control valve of wheel loader.</p>	<p>P1. Identify the check valve in cutaway model. P2. Locate demand spool in cutaway model P3. Identify the orifice P4. Recognize the steering spool P5. Identify the safety suction valve</p>
<p>CU4. Demonstrate steering system of motor grader on machine.</p>	<p>P1. Identify steering wheel. P2. Identify steering column. P3. Identify orbit roll type steering valve P4. Identify steering cylinder P5. Identify steering pump. P6. Point out flow control valve. P7. Locate hydraulic tank</p>
<p>CU5. Demonstrate Orbit Roll Type Steering Valve from cut away model</p>	<p>P1. Point out ports of orbit roll steering valves. P2. Point out rotor and stator of hand pump. P3. Locate drive shaft. P4. Point out center pin and x-spring P5. Locate sleeve. P6. Locate spool. P7. Point out check valve.</p>
<p>CU6. Identify /Draw Identify steering circuit of motor grader.</p>	<p>P1. Identify the steering Circuit of motor grader in straight travelling. P2. Identify the steering Circuit of motor grader in right turning. P3. Identify the steering Circuit of motor</p>

- grader r in left turning.
- P4.** Draw the steering Circuit of motor grader in straight travelling.
- P5.** Draw the steering Circuit of motor grader in right turning.
- P6.** Draw the steering Circuit of motor grader in left turning.

Knowledge & Understanding

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

- K-1.** Describe steering system of wheel loader.
- K-2.** Describe steering system of motor grader.
- K-3.** Describe orbit roll type steering valve.
- K-4.** Describe flow control valve.

Critical Evidence(s) Required

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

- Capable to identify the different components of steering system of wheel loader.
- Capable to demonstrate the steering system of wheel loader.
- Able to demonstrate the steering system of motor grader.
- Able to identify and demonstrate the different components of orbit roll type steering system of motor grader.

List of Tools and Equipments

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools

0716-MVS&A-107: Test and adjust TOE-IN of motor grader

Overview:

This learning unit is designed to provide skills and knowledge to test and adjust TOE-IN of motor grader.

- CU1. Test TOE-IN of motor grader.**
- P1.** Arrange Proper tools to Test TOE-IN of motor grader.
- P2.** Stop a machine on a level surface
- P3.** Measure distance between front wheels from front.
- P4.** Measure distance between front wheels from rear.
- P5.** Calculate difference between above

**two readings to find out TOE-IN.
P6. Compare the above TOE-IN value with
stander given in Shop Manual.**

CU2. Adjust TOE-IN of motor grader.

- P1.** Arrange Proper tools to adjust TOE-IN of motor grader.
P2. Park the grader on level ground.
P3. Loose the mounting lock nuts.
P4. Turn right side tie rod clock wise or anti clock wise to get the specified TOE-IN range.
P5. Turn left side tie rod clock wise or anti clock wise to get the specified TOE-IN range.
P6. Tighten the mounting lock nuts.

Knowledge & Understanding

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

- K-1.** Describe the testing procedure of TOE-IN of Motor Grader.
K-2. Describe the adjusting procedure of TOE-IN of Motor Grader.

Critical Evidence(s) Required

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

- Able to select the proper tools used in testing and adjusting of TOE-IN of Motor Grader.
- Capable to test TOE-IN of Motor Grader.
- Capable to adjust the TOE-IN of Motor Grader.

List of Tools and Equipments

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools

0716-MVS&A-108: Test and adjust of steering system of wheel loader.

Overview:

This learning unit is designed to provide skills and knowledge to test and adjust of steering system of wheel loader.

CU1. Measure steering wheel play	P1. Confirm the neutral position of steering wheel put mark 1 on the wheel. P2. Turn steering wheel clock wise up till tires on road begin to turn put mark 2 on steering wheel. P3. Turn steering wheel anti clock wise up till tires on road begin to turn put mark 3 on steering wheel. P4. Measure the straight distance between mark 2 and 3.
CU2. Test and adjust the free play of steering wheel of wheel loader.	P1. Inspect the steering linkages for looseness and free play. P2. Loose lock nut of steering gear box. P3. Adjust by turning adjustment screw in or out.
CU3. Measure operating force of steering wheel.	P1. Hook push –pull scale to the knob of steering wheel. P2. Raise the bucket 400mm and remove safety bar. P3. Pull push-pull scale tangentially to steering wheel. P4. Read the value when steering wheel is moving smoothly.
CU4. Measure operating time of steering wheel	P1. Start the engine and raise bucket about 400mm and remove the safety bar. P2. Turn steering wheel up till machine is turned fully right or left at low idling. P3. Turn steering wheel up till machine is

	turned fully right or left at high idling. P4. Check steering oil pressure.
CU5. Measure steering relief pressure.	P1. Fit safety bar on the frame. P2. Remove plug from takeoff port of right turn of steering circuit. P3. Install pressure gauge. P4. Start the engine and run it at high idling. P5. Turn the steering wheel to the right and measure pressure when relief valve is actuated P6. Turn the steering wheel to the left and measure pressure when relief valve is actuated
CU6. Adjust steering relief pressure	P7. Stop the engine. P8. Remove cap nut of relief valve. P9. Loose lock nut. P10. Turn adjustment screw to adjust. P11. Tighten screw to increase pressure P12. Loosen screw to decrease pressure

Knowledge & Understanding

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

- K1.** Describe the testing procedure of steering wheel play of wheel loader
- K2.** Describe the adjusting procedure of steering wheel play of wheel loader

Critical Evidence(s) Required

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

- Able to measure steering wheel play.
- Capable to test and adjust free play of steering wheel.
- Capable to measure operating force of steering wheel.
- Able to measure and adjust steering relief pressure.

List of Tools and Equipments

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools

0716-MVS&A-109: Recognize hydro vacuum brake used in motor grader.

Overview:

This learning unit is designed to provide skills and knowledge to Demonstrate cutaway model of hydro master used in motor grader brake.

CU1. Demonstrate cutaway model of hydro master used in motor grader brake.	P1. Identify main components of hydro master from cutaway model. P2. Demonstrate operation of hydro master
CU2. Identify/draw hydro master brake circuit.	P1. Identify brake paddle P2. Identify master cylinder P3. Identify Hydro Master P4. Identify Vacuum pump P5. Identify air inlet port P6. Identify High pressure brake oil lines to wheels. P7. Draw hydro master brake circuit.
CU3. Identify drum type wheel brake of motor grader.	P1. Identify wheel cylinder. P2. Identify return spring. P3. Identify brake drum. P4. Identify brake shoe and lining. P5. Identify adjuster.

Knowledge & Understanding

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

- K-1.** Describe of hydro vacuum brake used in brake system of motor grader.
- K-2.** Describe of hydro master.
- K-3.** Describe drum type brake.

Critical Evidence(s) Required

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

- Able to identify the different components used in brake circuit of motor grader.
- Capable to identify the different components of Hydro Master Cylinder.
- Capable to demonstrate the working of Hydro Master Cylinder.
- Able to rectify the leakages of brake circuit of Motor Grader.
- Able to identify components of drum type brake.

List of Tools and Equipments

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools

0716-MVS&A-110: Analyze air brake system for wheeled vehicles

Overview:

This learning unit is designed to provide skills and knowledge to Demonstrate air brake system board for wheeled machines.

CU1. Trace the air brake circuit of Motor Grader's Disc Brake System	P1. Identify brake valve. P2. Identify air compressor. P3. Identify air reservoir. P4. Identify relay valve. P5. Identify low pressure switch and stop lamp switch.
CU2. Identify components of disc type wheel brake of motor grader.	P1. Identify discs. P2. Identify plates. P3. Identify spring. P4. Identify piston. P5. Identify cage.
CU3. Trace hydraulic type brake circuit of wheel loader.	P1. Identify hydraulic tank P2. Identify brake valve P3. Identify brake and cooling fan pump P4. Identify slack adjuster for front and rear brake.

	<p>P5. Identify front and rear brake.</p> <p>P6. Identify accumulator fro front and rear brake.</p> <p>P7. Identify lines.</p>
CU4. Identify components of brake valve of wheel loader.	<p>P1. Identify inching valve spool.</p> <p>P2. Identify front brake valve spool</p> <p>P3. Identify rear brake valve spool</p>
CU5. Trace the Air brake circuit of Dump Truck	<p>P6. Identify the brake pedal.</p> <p>P7. Identify the brake valve.</p> <p>P8. Identify the compressor.</p> <p>P9. Identify the air reservoir.</p> <p>P10. Identify the relay valve.</p> <p>P11. Identify the pressure lines from relay valve to hydraulic cylinder.</p> <p>P12. Identify the brake lines from hydraulic cylinder to wheel.</p> <p>P13. Identify brake cylinder.</p>
CU6. Test and adjust the Air brake system of Dump Truck	<p>P1. Measure the brake pedal travel</p> <p>P2. Adjust the brake pedal travel.</p> <p>P3. Measure the air pressure of air reservoir</p> <p>P4. Rectify leakage in air and oil lines of air brake system.</p>

Knowledge & Understanding

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

- K-1.** Describe of air brake circuit of motor grader disc brake system.
- K-2.** Describe disc brake system of motor grader.
- K-3.** Describe hydraulic type brake of wheel loader.
- K-4.** Describe brake valve.
- K-5.** Describe air brake circuit of dump truck.
- K-6.** Describe testing and adjusting of air brake system of dump truck.

Critical Evidence(s) Required

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

- Able to trace air brake circuit of motor grader disc brake system
- Able to identify components of disc type wheel brake of motor grader.
- Able to trace hydraulic type brake circuit of wheel loader.
- Able to identify components of brake valve of wheel loader.
- Capable to trace the Air Brake Circuit of Dump Truck.
- Capable to identify the different components of Air Brake circuit of Dump Truck.
- Able to test the air brake system of Dump Truck.
- Able to adjust the air brake circuit of Dump Truck.
- Able to measure the air pressure from reservoir.
- Able to rectify the leakage of air in air brake circuit of Dump Truck.

List of Tools and Equipments

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)

Hydraulic System of Construction Machinery

0716-MVS&A-111: Demonstrate hydraulic system

Overview: This Competency Standard identifies the competencies required to Identify Hydraulic system components and visually inspect hydraulic system.

Competency Units	Performance Criteria
CU1 Identify Hydraulic system components	<p>P1. Identify tank , pumps, valves, Test ports for pressure gauges</p> <p>P2. Identify Linkages, joy stick, actuators (cylinders), sight glasses, control levers, display panels (monitors), filters, coolers, lines, hoses, fittings.</p> <p>P3. Identify switches, solenoids, relays, sensors, electronic control modules, wiring harnesses</p>
CU2 Inspect Visually hydraulic system	<p>P1. Check for worn, loose, damage hydraulic pipes and hoses.</p> <p>P2. Check visually hydraulic components like pump, cylinder and tank.</p> <p>P3. Check the level of hydraulic oil</p> <p>P4. Refill the hydraulic oil if necessary</p>

Knowledge & Understanding

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

- K-1.** State Pascal's law
- K-2.** State pressure and it's different types (Atmospheric , Gauge , Vacuum , Absolute Pressure)
- K-3.** State Flow rate methods of flow rate and types of flow meter.
- K-4.** Entrained Air, Dissolved Air, Aeration, Cavitations, Set/ Rated, Cracking and Surge Pressure.
- K-5.** The full range of hydraulic system components
- K-6.** Characteristics and operational function of each hydraulic system component
- K-7.** Procedures for inspecting and testing hydraulic system components
- K-8.** State hydraulic oil
- K-9.** Describe different grades of hydraulic oil
- K-10.** State viscosity of hydraulic oil and viscosity index of oil
- K-11.** State the causes of deterioration of oil and how to prevent them.
- K-12.** Describe difference between Pressure and Flow.

Critical Evidence(s) Required

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

- Capable to inspect damages and worn.
- Capable to identify hydraulic line.
- Capable to identify hydraulic components.
- Capable to check hydraulic level and refill it.
- Capable to identify location of take of ports for hydraulic gauges.
- Capable to identify switches, solenoids, relays, modules.

List of Tools and Equipments

- 1) Bull dozer
- 2) Multimeter
- 3) Training aid /board of Pressure and flow difference.

0716-MVS&A-112: Recognize components of Hydraulic system

Overview: This Competency Standard identifies the competencies required to A1. Identify parallel and series system, Identify Open and close centre system, Understand Hydraulic Pump, Understand Hydraulic tank and Understand Hydraulic cylinder.

Competency Units	Performance Criteria
CU1. Identify parallel and series system	P1. Identify the parallel circuit P2. Identify the series circuit P3. Draw simple circuit of parallel system P4. Draw simple circuit of series system
CU2. Identify Open and close center system	You must be able to: P1. Identify the open centre system from given circuit P2. Identify the close centre system from given circuit P3. Draw simple circuit of open centre system P4. Draw simple circuit of close centre system
CU3. Understand Hydraulic Pump	P1. Identify the main components of hydraulic pump from cutaway model. P2. Types of gear pump based on pressure range P3. Disassembling of hydraulic pump P4. Assembling of hydraulic pump
CU4. Understand Hydraulic tank	P1. Identify main relief valve, suction valve, safety valve, check valve, from cutaway model of hydraulic tank. P2. Identify blade lifting spools. P3. Identify riper spool P4. Identify blade tilting spool P5. Identify filter and strainer P6. Disassembling of hydraulic tank P7. Assembling of hydraulic tank
CU5. Understand Hydraulic cylinder	P1. Identify piston valve, wear ring, U packing, piston, piston rod and dust seal from inside the cutaway model of hydraulic cylinder. P2. Disassembling of hydraulic cylinder P3. Assembling of hydraulic cylinder

Knowledge & Understanding

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

- K-1.** Define hydraulic system of Bulldozer
- K-2.** Differentiate between parallel and series Hydraulic system.
- K-3.** Differentiate between open centre and close centre Hydraulic system.
- K-4.** Describe main function of hydraulic pump, hydraulic cylinder and tank
- K-5.** Describe the purpose and operation of spool.
- K-6.** Describe the purpose of piston valve.
- K-7.** Describe function main function of control valve, filter and cooler

Critical Evidence(s) Required

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

- Capable to understand parallel and series circuit
- Capable to understand open and close centre system

- Capable to understand hydraulic pump
- Capable to understand hydraulic tank and control valve assembly.
- Capable to understand hydraulic cylinder

List of Tools and Equipments

- 1) Tools trolley (Complete set of Hand Tools)
- 2) Special Service tools.
- 3) Series and Parallel circuit board.
- 4) Cutaway model of Hydraulic Pump.
- 5) Cutaway model of Hydraulic tank.
- 6) Cutaway model of Hydraulic Cylinder.

0716-MVS&A-113: Draw hydraulic circuits (schematics)

Overview: This Competency Standard identifies the competencies required to identify symbols used in hydraulic circuit /schematics, Identify the raising circuit of blade, Identify the lower circuit of blade, Identify the hold circuit of blade and Identify the float circuit of blade

Competency Units	Performance Criteria
CU1. Identify symbols used in hydraulic circuit /schematics	P1. Identify the hydraulic symbols. P2. Draw different hydraulic symbols.
CU2. Identify the raising circuit of blade	P1. Identify the raising circuit of blade of bulldozer P2. Draw the raising circuit of blade of bulldozer
CU3. Identify the lower circuit of blade	P1. Identify the lower circuit of blade of bulldozer. P2. Draw the lower circuit of blade of bulldozer.
CU4. Identify the hold circuit of blade	P1. Identify the hold circuit of blade of bulldozer P2. Draw the hold circuit of blade of bulldozer.
CU5. Identify the float circuit of blade	P1. Identify the float circuit of blade of bulldozer. P2. Draw the float circuit of blade of bulldozer.

Knowledge & Understanding

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

- K-1.** Describe hydraulic circuit of different machines.
- K-2.** Describe the raising circuit of blade of bull dozer.
- K-3.** Describe the lower circuit of blade of bull dozer.
- K-4.** Describe the hold circuit of blade of bull dozer.
- K-5.** Describe the float circuit of blade of bull dozer.

Critical Evidence(s) Required

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

- Capable to understand hydraulic circuit of different machines
- Capable to understand hydraulic symbols.
- Capable to understand raising circuit of blade of bulldozer
- Capable to understand lower circuit of blade of bulldozer
- Capable to understand hold circuit of blade of bulldozer
- Capable to understand float circuit of blade of bulldozer

List of Tools and Equipments

- 1) Shop manual
- 2) Circuit board

0716-MVS&A-114: Maintain HYDRAULIC PUMP

Overview: This Competency Standard identifies the competencies required to Identify Hydraulic pump, Inspect hydraulic pump and Replace hydraulic pump.

Competency Units	Performance Criteria
CU1. Identify Hydraulic pump	P1. Identify the different types of hydraulic pump P2. Identify the different components of hydraulic pump from cutaway model.
CU2. Inspect hydraulic pump	P1. Inspect the performance of hydraulic pump P2. Inspect different components of hydraulic pump P3. Check the set pressure and compare with standard value P4. Measure the flow rate and compare with standard value
CU3. Replace hydraulic pump	P1. Remove hydraulic pipes of pump P2. Remove hydraulic pump from bulldozer P3. Install hydraulic pipes of pump P4. Install hydraulic pump on bulldozer

Knowledge & Understanding

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

- K-1.** State principle of hydraulic pump.
- K-2.** Explain nomenclature of hydraulic pump.
- K-3.** Enlist different types of hydraulic pump
- K-4.** Define relief recess, floating bush, side bush, radial clearances and pressure balancing groove.
- K-5.** Explain effects of discharge pressure, running clearances and viscosity/oil temperature on the pump capacity with the help of graphs
- K-6.** Describe deterioration of pump due to dirty and foamy oil and cavitations due to aeration.

Critical Evidence(s) Required

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

- Capable to understand different types of hydraulic pump
- Capable to understand different components of hydraulic pump
- Capable to understand performance of hydraulic pump.
- Capable to check set pressure of hydraulic pump
- Capable to check flow rate of hydraulic pump
- Capable to remove hydraulic pump from bulldozer
- Capable to install hydraulic pump on bulldozer

List of Tools and Equipment's

- 1) Tools trolley (Complete set of Hand Tools)
- 2) Pressure gauge set
- 3) Hydraulic pump cutaway models

0716-MVS&A-115: Recognize HYDRAULIC TANK

Overview: This Competency Standard identifies the competencies required to Identify Hydraulic tank and Inspect hydraulic tank.

Competency Units	Performance Criteria
CU1. Identify Hydraulic tank	P1. Identify the open and close type of hydraulic tank P2. Identify the different components of hydraulic tank from cutaway model. P3. Identify different spools present in hydraulic tank from cutaway model P4. Identify different valves present in hydraulic tank pressure control (relief valve, safety valve), direction control (check valve and blade lift spool) and flow control (suction valve) from cutaway model P5. Identify different position of blade lift spool like raise, lower, hold and float positions
CU2. Inspect hydraulic tank	P1. Disassembling of hydraulic tank P2. Inspect the strainer. P3. Inspect the hydraulic filter P4. Inspect the control valve assembly present in tank P5. Inspect the spools used in control valve assembly P6. Inspect the main relief valve P7. Assembling of hydraulic tank

Knowledge & Understanding

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

- K-1.** State hydraulic tank
- K-2.** State types of hydraulic tank
- K-3.** State different components of hydraulic tank
- K-4.** Describe function of pressure control valve, direction control valve and flow control valve.
- K-5.** State location, structure and function of main relief valve, safety valve, check valve and suction control valve
- K-6.** State different type of main relief valve poppet type, spool type and pilot operated type.
- K-7.** State different position of spools raise, lower, hold and float position
- K-8.** State flow control valve

Critical Evidence(s) Required

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

- Capable to understand different types of hydraulic tank
- Capable to understand different components of hydraulic tank
- Capable to understand pressure control valve
- Capable to understand flow control valve
- Capable to understand direction control valve
- Capable to assemble and disassemble the hydraulic tank
- Capable to replace different components of hydraulic tank

- Capable to remove and install hydraulic tank
- Capable to troubleshoot different components of hydraulic tank

List of Tools and Equipment's

- 1) Tools trolley (Complete set of Hand Tools)
- 2) Special Service tools
- 3) Pressure gauge set
- 4) Hydraulic tank cutaway model

0716-MVS&A-116: Demonstrate components of HYDRAULIC CYLINDER

Overview: This Competency Standard identifies the competencies required to Identify Hydraulic cylinder, inspect hydraulic cylinder and Overhauling of hydraulic cylinder.

Competency Units	Performance Criteria
CU1. Identify Hydraulic cylinder	P1. Identify the different types of hydraulic cylinder P2. Identify the different components of hydraulic cylinder from cutaway model. P3. Identify quick drop valve on machine.
CU2. Inspect hydraulic cylinder	P1. Disassembling of hydraulic cylinder P2. Inspect different components of hydraulic cylinder P3. Assembling of hydraulic cylinder P4. Inspect the hoses attached with hydraulic cylinder P5. Replace different components of hydraulic cylinder as per requirement. P6. Perform hydraulic drift test of work equipment of bulldozer
CU3. Overhaul hydraulic cylinder	P1. Replace the dust seal of hydraulic cylinder P2. Replace the U-packing of hydraulic cylinder P3. Replace the V-packing of hydraulic cylinder P4. Replace the piston rings of hydraulic cylinder P5. Replace the wear rings of hydraulic cylinder P6. Assembling of hydraulic cylinder.

Knowledge & Understanding

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

- K-1.** Define hydraulic cylinder
- K-2.** Enlist types of hydraulic cylinder
- K-3.** Enlist different components of hydraulic cylinder
- K-4.** Describe function and structure of each component of hydraulic cylinder piston ring, wear ring, U-packing, V-packing and dust seal.
- K-5.** Describe location, structure and function of quick drop valve used in hydraulic cylinder.
- K-6.** Describe the importance and procedure of hydraulic drift test. Also compare it with standard value in shop manual
- K-7.** Perform speed test of blade of bulldozer and compare with standard value in shop manual.

Critical Evidence(s) Required

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

- Capable to understand different types of hydraulic cylinder
- Capable to understand different components of hydraulic cylinder
- Capable to understand quick drop valve.
- Capable to perform creeping rate/hydraulic drift test
- Capable to disassemble and assemble the hydraulic cylinder
- Capable to replace different components of hydraulic cylinder
- Capable to remove and install hydraulic cylinder on machine

List of Tools and Equipment's

- 1) Tools trolley (Complete set of Hand Tools)
- 2) Special Service tools
- 3) Pressure gauge set

0716-MVS&A-117: Maintain HSS (Hydro Static Steering) Pump and Motor

Overview: This Competency Standard identifies the competencies required to Identify HSS (HYDRO STATIC STEERING) Pump and HSS motor, Identify CLSS (CLOSE LOAD SENSING SYSTEM) System and OLSS (OPEN LOAD SENSING SYSTEM) System and Check HSS system.

Competency Units	Performance Criteria
CU1. Identify HSS (HYDRO STATIC STEERING) Pump and HSS motor	<p>P1. Identify components of HSS system</p> <p>P2. Label the work equipment hydraulic system layout diagram</p> <p>P3. Identify work equipment controls levers</p> <p>P4. Identify scavenging pump.</p> <p>P5. Identify the HSS Pump</p> <p>P6. Identify LS, PC and PC-EPC Valves</p> <p>P7. Label the LS valve</p> <p>P8. Label the PC valve</p> <p>P9. Label the PC-EPC valve</p> <p>P10. Identify the flow of oil through diagram</p> <p>P11. Identify the HSS Motor</p> <p>P12. Identify the hydraulic circuit of HSS motor on machine</p> <p>P13. Identify the power train of HSS system on machine</p> <p>P14. Identify variable throttle valve</p>
CU2. Identify CLSS (CLOSE LOAD SENSING SYSTEM) System and OLSS (OPEN LOAD SENSING SYSTEM) System	<p>P1. Identify the CLSS system through diagram</p> <p>P2. Identify the circuit of CLSS to control Swash plate angle of HSS pump through diagram</p> <p>P3. Identify the OLSS system through diagram</p> <p>P4. Identify the circuit of OLSS to control Swash plate angle of HSS pump through diagram</p> <p>P5. Checking of HSS pressure by gauge</p> <p>P6. Checking of PPC outlet pressure by gauge</p>
CU3. Test HSS pump	<p>P1. Check HSS pressure by gauge</p> <p>P2. Check PPC outlet pressure by gauge</p> <p>P3. Check direction of rotation of radiator fan from monitor screen</p> <p>P4. Read error codes displayed on monitor screen</p>

Knowledge & Understanding

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

- K-1. Describe the function and structure of HSS Pump
- K-2. Label the sectional view diagram oh HSS Pump
- K-3. Describe scavenging Pump
- K-4. Describe the control of delivery of HSS pump by swash plate angle
- K-5. Describe the structure, operation and function of LS valve.
- K-6. Describe the structure, operation and function of PC valve.
- K-7. Describe the structure, operation and function of PC-EPC valve.
- K-8. Describe the structure, operation and function of TVC valve.
- K-9. Describe the structure, operation and function of Variable throttle valve.
- K-10. Explain circuit for increasing delivery of pump also draw it circuit diagram.
- K-11. Explain circuit for decreasing delivery of pump also draw it circuit diagram.
- K-12. Describe the function and structure of HSS Motor
- K-13. Describe the brake valve with counter balance valve, check valve and safety valve
- K-14. Describe CLSS System

K-15. Describe structure, operation and function of main relief valve of steering and work equipment

K-16. Describe structure, operation and function of steering priority valve

K-17. Describe structure, operation and function of suction safety valve

Critical Evidence(s) Required

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

- Capable to understand HSS system
- Capable to label drawing of HSS Pump and LS
- Capable to understand work equipment levers in HSS system
- Capable to understand scavenging pump.
- Capable to understand LS valve, PC valve and PC-EPC valve.
- Capable to understand the CLSS system
- Capable to understand OLSS system
- Capable to understand HSS motor
- Capable to understand main relief valve, steering priority valve and suction safety valve.

List of Tools and Equipments

- 1) Tools trolley (Complete set of Hand Tools)
- 2) Special Service tools
- 3) Pressure gauge set
- 4) Bulldozer

0716-MVS&A-118: Troubleshoot of hydraulic system

Overview: This Competency Standard identifies the competencies required to Diagnose work equipment of hydraulic system, inspect blade lift slow speed, inspect ripper lift slow speed, and inspect excessive hydraulic drift of blade lift, Diagnose excessive hydraulic drift of ripper lift.

Competency Units	Performance Criteria
CU1. Diagnose work equipment of hydraulic system	<p>P1. Inspect/refill the oil level from hydraulic tank as per requirement</p> <p>P2. Inspect work equipment and HSS pump as per requirement</p> <p>P3. Inspect operation of unload valve as per requirement</p> <p>P4. Inspect/adjust set pressure or main relief valve pressure as per requirement</p> <p>P5. Inspect /adjust PPC valve as per requirement</p>
CU2. Inspect blade lift slow speed	<p>P1. Inspect/refill the level of the hydraulic oil as per requirement</p> <p>P2. Inspect the operation of PPC valve as per requirement</p> <p>P3. Inspect operation of blade lift control valve as per requirement</p> <p>P4. Bleed air from blade lift cylinder as per requirement</p>
CU3. Inspect ripper lift slow speed	<p>P1. Inspect /refill the level of hydraulic oil from tank as per requirement</p> <p>P2. Inspect operation of PPC valve for ripper as per standards</p> <p>P3. Inspect operation of ripper lift control valve as per standards</p> <p>P4. Bleed air from ripper lift cylinder as per requirement</p>
CU4. Inspect excessive hydraulic drift of blade lift	<p>P1. Inspect/repair the oil leakages in the hydraulic circuit as per requirement.</p> <p>P2. Inspect/replace the seal of blade lift control valve(spool) as per requirement</p> <p>P3. Inspect dust seal of blade lift cylinder as per requirement</p>
CU5. Diagnose excessive hydraulic drift of ripper lift	<p>P1. Inspect/repair the oil leakages in the hydraulic circuit as per requirement</p> <p>P2. Inspect/replace the seal of the ripper lift control valve as per requirement</p> <p>P3. Inspect dust seal of the ripper lift cylinder as per requirement</p>

Knowledge & Understanding

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

- K-1.** Describe the work equipment of the machine.
- K-2.** Explain the pilot pressure to operate the spools also draw circuit diagram.
- K-3.** Explain the structure, function and operation of PPC valve.
- K-4.** Explain how to read shop manual.
- K-5.** Explain how to read monitor screen on machine.
- K-6.** Explain how to read codes on monitor screen.
- K-7.** Explain different circuits of blades and ripper also draw their circuits

Critical Evidence(s) Required

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

- Capable to troubleshoot work equipment.
- Capable to troubleshoot blade lift slow speed.
- Capable to troubleshoot ripper lift slow speed
- Capable to troubleshoot excessive hydraulic drift of blade lift
- Capable to troubleshoot excessive hydraulic drift of ripper lift
- Capable to read the shop manual, error codes and monitor screen

List of Tools and Equipment's

- 1) Tools trolley (Complete set of Hand Tools)
- 2) Special Service tools
- 3) Pressure gauge kit

Planning and Management of Construction Machinery

0716-MVS&A-119: Prepare CPM

Overview

This competency standard covers the skills and knowledge required to prepare the critical path method diagram for management & smooth flow of activities in construction work,

Competency Units	Performance Criteria
CU-1: Identify the Need of planning & management	P1. Enlist planning & management Principles P2. Mention planning & management Requirements P3. Identify the resources and data required for planning & management P4. Apply the principles of planning & management in construction management.
CU-2. Specify Each Activity	P1. Check the whole process. P2. Figure Out different activities. P3. Categorize the activities. P4. Enlist the activities. P5. Specify each activity.
CU-3. Establish Dependencies (Activity Sequence)	P1. Point out the independent activities. P2. Point out the dependent activities. P3. Establish the relationship between activities. P4. Arrange the activities in sequence.
CU-4. Estimate Activity Completion Time	P1. Identify the nature of project. P2. Apply three point formula. P3. Interpret the data. P4. Estimate activity completion time. P5. Allot time as per nature of project.
CU-5. Draw the Network Diagram	P1. Enlist all activities in project. P2. Draft the network roughly. P3. Estimate time for each activity. P4. Write estimated time in each activity.
CU-6. Identify the Critical Path	P1. Review the network diagram. P2. Calculate the earliest start and earliest finish time. P3. Calculate the late start and late finish time. P4. Trace the critical path.

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 management.

K2. Understand the importance of management.

K3. What is CPM?

K4. Explain the importance of CPM in construction management.

K5. Describe the terminologies used in CPM.

K6. State the application of CPM.

K7. Network diagrams.

Critical Evidence(s) Required

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

- Identification of activities.
- Sequencing of activities.
- Estimation of time.
- Network diagram.
- Determination of critical path.

TOOLS AND EQUIPMENT

1. Pencil
2. Eraser
3. Sharpner
4. Calculator
5. Measuring scale
6. Drawing sheet
7. Scotch Tape

0716-MVS&A-120: Calculate depreciation of construction machinery

Overview:

This competency standard covers the skills and knowledge required to calculate the depreciation of a machine due to age, wear, deterioration, and obsolescence.

Competency Units	Performance Criteria
CU-1. Identify the need of depreciation.	P1. Assess the importance of depreciation. P2. Mention the requirements for depreciation. P3. Identify the reasons for depreciation. P4. Identify the resources and data required for depreciation.
CU-2. Estimates of the items.	P1. Identify the items to be estimated. P2. Enlist the items to be estimated. P3. Estimate The purchase price of the piece of equipment (termed P). P4. Estimate the 'Recovery' period (termed N). P5. Estimate the salvage value (termed F).
CU-3. Select suitable depreciation method.	P1. Identify the methods of depreciation. P2. Enlist the methods of depreciation. P3. Evaluate the estimated data. P4. Select the suitable method as per data.
CU-4. Compute the depreciation.	P1. Compile all the data. P2. Interpret the data. P3. Compute the depreciation by selected formula P4. Review the whole process.

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. What is depreciation?

K2. Explain the factors affecting depreciation.

K3. Understand the basic terminology's of depreciation.

K4. Understand the estimation process.

K5. Numeracy Skills.

Critical Evidence(s) Required

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

- Gathering of data.
- Compiling of data.
- Computation of data.

TOOLS AND EQUIPMENT

1. Eraser
2. Sharpner
3. Calculator
4. Measuring scale
5. Drawing sheet
6. Scotch Tape
7. Pencil

0716-MVS&A-121: Calculate the cost of owning for Construction machinery

Overview:

This competency standard covers the skills and knowledge required to calculate the cost of ownership and allied fixed cost for various construction machinery.

Competency Units	Performance Criteria
CU-1. Identify the need of cost of owning.	P1.Analyze the different factors affecting owning cost. P2.Determine the nature of cost P3.Enlist the components of owning cost. P4.Identifye the need of owning cost
CU-2. Calculate the initial cost.	P1.Study the importance of initial cost. P2.Point out the factors that affect initial cost. P3.Gather the data about initial cost. P4.Arrange the data. P5.Compute the data. P6.Calculate initial cost.
CU-3.Calculate the depreciation of machines.	P1. Identify the need of depreciation. P2. Estimates of the items. P3. Select suitable depreciation method. P4. Compute the depreciation.
CU-4.Determine INVESTMENT (OR INTEREST) COST.	P1.Study the importance of investment cost. P2.Point out the factors that affect investment cost. P3.Gather the data about investment cost. P4.Arrange the data. P5.Compute the data. P6.Determine the investment cost.
CU-5.Compute the total ownership cost	P1.Review the overall process. P2.Compute the total ownership cost. P3.Check for errors if any.

Knowledge & Understanding.

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

This includes the knowledge:

K1. What is cost?

K2. Explain the types of cost.

K3. State the importance of determining cost.

K4. Describe the steps involved in calculating the total ownership cost.

K5. Aspects of ownership cost.

K6. Need for determining ownership cost.

Critical Evidence(s) Required

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

- Collection of data.
- Selection of suitable method for finding various costs.
- Processing of data.
- Computation of total ownership cost.

TOOLS AND EQUIPMENT

- 1 Pencil
- 2 Eraser
- 3 Sharpner
- 4 Calculator
- 5 Measuring scale

0716-MVS&A-122: Calculate the operating cost for construction machinery

Overview:

This competency standard covers the skills and knowledge required to calculate the operating cost of construction machinery considering different aspects of cost.

Competency Unit	Performance Criteria
CU-1. Identify the need of operating cost.	P1.Analyze the different factors affecting operating cost. P2.Determine the nature of cost P3.Enlist the components of operating cost. P4.Identify the need of operating cost
CU-2.Determine repair and maintenance Cost of machines.	P1.Inspect machines for repair and maintenance. P2.Enlist the nature of faults. P3.Calculate the hourly repair and maintenance cost. P4.Determine annual repair and maintenance cost.
CU-3. Determine tire cost.	P1.Identify the need of tire cost. P2.Analyze the factors affecting tire cost. P3.Inspect the machines. P4.Determine tire cost.
CU-4.Verify the consumable materials cost.	P1. Enlist the consumable materials. P2.Identify the need of consumable materials. P3.Analyze the market rate.
CU-5.Calculate fuel cost.	P1.Inspect the engine of machine. P2.Identify the type of engine. P3.Observe the fuel consumption for different engines. P4.Consider factors for fuel consumption.
CU-6.Assess lubricating oil cost.	P1.Inspect the engine of machine. P2.Identify the type of engine. P3.Observe the lubricating oil consumption for different engines. P4.Consider factors for lubricating oil consumption.
CU-7. Assess mobilization and demobilization cost.	P1.Identify the need of mobilization and demobilization. P2.Observe the factors affecting mobilization cost. P3.Enlist the components of mobilization cost.
CU-8.Determine equipment operator cost.	P1.Identify the number of operators. P2.Identify the types of machines. P3.Enlist the machines. P4.Determine equipment operator cost.
CU-9. Evaluate special item cost.	P1.Identify the special items. P2.Enlist the special items. P3.Assess the need for special items.

CU-10. Select method for operating cost. suitable finding	P1. Identify methods for finding operating cost. P2. Enlist the methods for finding operating cost. P3. Analyze the data. P4. Select the suitable method as per data.
CU-11. Calculate operating cost.	P1. Review the overall process. P2. Gather all the costs. P3. Arrange the data. P4. Calculate the total operating cost. P5. Check for errors if any.
CU-12. Compare the cost calculated by different methods.	P1. Enlist the methods for calculating operating cost. P2. Calculate operating cost by different methods. P3. Compare the cost calculated by different methods.

Knowledge & Understanding.

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

This includes the knowledge of:

K1- Concept of cost.

K2- Types of cost

K3- Factors affecting cost.

K4- What is operating cost.

K5- Importance of operating cost.

K6- Components of operating cost

K7- Steps for calculating operating cost

Critical Evidence(s) Required

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

- Collection of data
- Application of suitable method
- Computation of cost
- Comparison of different methods
- Analysis of variation in cost

TOOLS AND EQUIPMENT'S

1 Pencil,

2 Eraser,

- 3 Sharpner,
- 4 Calculator,

0716-MVS&A-123: Determine the productivity of construction machinery

Overview:

This competency standard covers the skills and knowledge required to determine the productivity of various construction machinery.

Competency Units	Performance Criteria
CU-1. Conduct equipment productivity analysis.	P1. Identify the need for productivity analysis. P2. Plan the productivity analysis session. P3. Inform the relevant persons. P4. Arrange the productivity analysis session. P5. Conduct equipment productivity analysis. P6. Record the information.
CU-2. Identify the productivity methods.	P1. Inspect the machines. P2. Enlist the machines. P3. Analyze the specifications of machines. P4. Identify the productivity methods. P5. Select the appropriate method for calculation of productivity.
CU-3. Determine productivity of dozer.	P1. Consider the historical data. P2. Assess the nature of project. P3. Select the type of dozer. P4. Enlist the factors for productivity. P4. Apply the formula. P5. Compute productivity of dozer.
CU-4. Determine productivity of motor grader.	P1. Assess the nature of project. P2. Assess the calculation bases of motor grader. P3. Enlist the factors for productivity. P4. Apply the formula. P5. Compute productivity of motor grader.
CU-5. Determine productivity of Wheel Loader.	P1. Assess the nature of project. P2. Enlist the factors for productivity. P3. Apply the formula. P4. Compute productivity of Wheel Loader.
CU-6. determine productivity of Road Roller/Compactor.	P1. Consider the historical data. P2. Assess the nature of project. P3. Select the type of road roller/compactor. P4. Enlist the factors for productivity. P4. Apply the formula. P5. Compute productivity of road roller/compactor.
CU-7. determine productivity of excavator.	P1. Assess the nature of project. P2. Select the type of excavator.

P3.Enlist the factors for productivity.
P4.Apply the formula.
P5.Compute productivity of excavator

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 productivity.
- K2. Elaborate importance of productivity.
- K3. Enlist machines with their types for determination productivity.
- K4. Know the specifications of machines.
- K5. Understand the nature of projects.

Critical Evidence(s) Required

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

- Collection of data.
- Interpretation of data.
- Computation of productivity.
- Comparison with standard values.

TOOLS AND EQUIPMENT

1. Pencil
2. Eraser
3. Sharpner
4. Calculator

0716-MVS&A-124: Calculate the effect of grade on tractive effort of vehicles.

Overview:

This competency standard covers the skills and knowledge required to calculate the effect of grade and assess the factors affecting tractive effort of vehicles

Competency Units	Performance Criteria
CU-1. Identify the aspects for analysis of tractive force.	<p>P1. Observe the grade of road.</p> <p>P2. Inspect the type of pavement</p> <p>P3. Investigate the geographical features.</p> <p>P4. Monitor weather conditions.</p> <p>P5. Assess the type of machine</p> <p>P6. Observe traffic intensity.</p> <p>P7. Assess the power of machine.</p>
CU-3. Evaluate the rolling resistance of machines.	<p>P1. Identify the type of machinery.</p> <p>P2. Identify the type of pavement.</p> <p>P3. Assess the condition of road surface.</p> <p>P4. Compile all the data.</p> <p>P5. Evaluate the rolling resistance of machines.</p>
CU-4. Evaluate the impact of temperature on performance of IC engines.	<p>P1. Observe the working principle of IC engine.</p> <p>P2. Identify the variation in power of machines due to temperature.</p> <p>P3. Determine the performance of engine in labs.</p> <p>P4. Prepare performance report of IC engine.</p>
CU-4. Evaluate the impact of altitude on performance of IC engines.	<p>P1. Observe the change in air pressure with altitude.</p> <p>P2. Analyze the impact of air pressure.</p> <p>P3. Compare with sea level pressure.</p> <p>P4. Assess the impact on IC engine performance.</p>
CU-5. Evaluate the combined impact of temperature and altitude on IC engine performance.	<p>P1. Observe standard conditions for testing.</p> <p>P2. Identify the instrument required for performance evaluation.</p> <p>P3. Conduct the test as per specifications.</p> <p>P4. Gather all the data.</p> <p>P5. Apply formula.</p> <p>P6. Compute performance of engine.</p> <p>P7. Assess the overall impact on performance.</p>
CU-6. Calculate the effect of grade on tractive effort.	<p>P1. Identify the type of pavement.</p> <p>P2. Check the grade of road.</p> <p>P3. Observe the performance of machine moving upward.</p> <p>P4. Observe the performance of machine moving downward.</p>

P5.Gather all the data.

P6.Apply formula.

P7.Calculate effect of grade on tractive effort.

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 Tractive effort.

K2. Describe factors influencing tractive effort.

K3. Grade of pavement

K4. Types of pavements

K5. Describe co-efficient of traction

K6. Working of various machines

K7. Understand drawbar pull

Critical Evidence(s) Required

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

TOOLS AND EQUIPMENT

1. Pencil
2. Eraser
3. Sharpner
4. Calculator

0716-MVS&A-125: Work effectively in a customer service/ sales environment

Overview:

This Competency standard identifies the competencies required Work Effectively in a Customer Service/Sales Environment as per Organization's approved guidelines and procedures. You will be expected to work within organizational requirements, support the work team, maintain personal presentation, develop effective work habits, portray ethical behavior and acquire up to date product / service knowledge. You're underpinning knowledge about Work Effectively in a Customer Service/Sales Environment will be sufficient for you to provide the basics of the work.

<i>Unit of Competency</i>	<i>Performance Criteria</i>
CU-1: Work within organizational requirements.	<p>You must be able to:</p> <p>P-1. Identify and read organization's requirements and responsibilities and seek advice from appropriate people where necessary.</p> <p>P-2. Interpret staff rosters and provide sufficient notice of unavailability for rostered hours according to workplace policy and procedures.</p> <p>P-3. Develop and use a current working knowledge and understanding of employee and employer rights and responsibilities.</p> <p>P-4. Comply with relevant duty of care and legal responsibilities, and support organizational culture.</p> <p>P-5. Identify roles and responsibilities of colleagues and immediate supervisors.</p> <p>P-6. Identify standards and values considered to be detrimental to the Organization and communicate this through appropriate channels.</p> <p>P-7. Identify, recognize and follow behavior that contributes to a safe and sustainable work environment.</p>
CU-2: Support the work team.	<p>You must be able to:</p> <p>P-1. Display courteous and helpful behavior at all times.</p> <p>P-2. Take opportunities to enhance the level of assistance offered to colleagues and meet all reasonable requests for assistance within acceptable workplace timeframes.</p> <p>P-3. Complete allocated tasks as required.</p> <p>P-4. Seek assistance when difficulties arise.</p> <p>P-5. Use questioning techniques to clarify instructions or responsibilities.</p> <p>P-6. Identify and display a non-discriminatory attitude in all contacts with customers and other staff members.</p>
CU-3: Maintain personal	<p>You must be able to:</p> <p>P-1. Observe appropriate dress code and presentation as</p>

Presentation.	<p>required by the workplace, job role and level of customer contact.</p> <p>P-2. Follow personal hygiene procedures according to organizational policy and relevant legislation.</p>
CU-4: Develop effective work habits.	<p>You must be able to:</p> <p>P-1. Interpret, confirm and act on workplace information, instructions and procedures relevant to the particular task.</p> <p>P-2. Ask questions to seek and clarify workplace information.</p> <p>P-3. Plan and organize daily work routine within the scope of the job role.</p> <p>P-4. Prioritise and complete tasks according to required timeframes.</p> <p>P-5. Identify work and personal priorities and achieve a balance between competing priorities</p>
CU-5: Portray ethical behavior	<p>You must be able to:</p> <p>P-1. Follow ethical code of conduct.</p> <p>P-2. Understand your customer's code of ethics.</p> <p>P-3. Declare conflict of interest.</p> <p>P-4. Maintain confidentiality.</p> <p>P-5. Honor your commitments (timeframe, deliverables etc.)</p> <p>P-6. Use internet for business only on company time.</p>
CU-6: Acquire up to date product / service Knowledge	<p>You must be able to:</p> <p>P-1. Gather information about your product / services.</p> <p>P-2. Identify the components of your product and services.</p> <p>P-3. Recognize the essential selling features of your products and services.</p> <p>P-4. Translate all essential features of your product and services.</p> <p>P-5. Analyze product success.</p> <p>P-6. Identify your market position.</p> <p>P-7. Familiar with all product promotions, sales manuals and product Literature.</p> <p>P-8. Keep information of latest technology advances and seek ways to use these technologies in your work.</p>

Knowledge & Understanding:

- K-1.** Define industry awards and agreements that relate to personal job role and terms and conditions of employment.
- K-2.** Differentiate between employer and employee responsibilities.
- K-3.** Explain different relevant legislation and statutory requirements.

- K-4.** Explain the importance of team work
- K-5.** Define workplace relations
- K-6.** Explain workplace policies, plans and procedures, including, Dealing with Grievances, Discriminatory, behavior, Equal opportunity, issues, Staff rosters and notification of shift Availability or nonattendance providing customer service to colleagues and customers.
- K-7.** Explain hygiene and personal presentation
- K-8.** Explain the importance of workplace ethics.
- K-9.** Explain staff counseling and disciplinary procedures
- K-10.** Describe workplace organizational structure
- K-11.** Explain the importance of ethical behavior.
- K-12.** Explain the importance of commitment in sales and customer services
- K-13.** Explain:
 - a. Price per product.
 - b. Profit per product /service.
 - c. Price flection
 - d. Product strengths
 - e. Product weaknesses.
 - f. Warranty / guarantee policies.
 - g. Packaging facilities and potential.
- K-14.** Explain how your product/service fits into your customers overall operations, business plan, sales success, operation cost etc.

Knowledge & Understanding

- K-7 Analytical techniques:** Brainstorming, Intuitions/Logic, Cause and effect diagrams, Pareto analysis, SWOT analysis, Gant chart, Pert CPM and graphs, Scatter grams.
- K-8 Problem:** Non – routine process and quality problems, Equipment selection, availability and failure, Teamwork and work allocation problem, Safety and emergency situations and incidents.
- K-9 Action plans:** Priority requirements, Measurable objectives, Resource requirements, Timelines, Co-ordination and feedback requirements, Safety requirements, Risk assessment, Environmental requirements

Critical Evidence(s) Required

- Capable to identify the hydraulic symbol.
- Capable to identify the pneumatic symbol.

0716-MVS&A-126: Develop Professionalism

Overview:

This Competency standard identifies the competencies required to Develop Professionalism as per Organization's approved guidelines and procedures. You will be expected to create a personal vision / mission, manage your attitude, practice self-discipline, manage time, manage your professional development, and participate in trainings and performance review. Your underpinning knowledge about Develop Professionalism will be sufficient for you to provide the basics of the work.

<i>Unit of Competency</i>	<i>Performance Criteria</i>
CU-1: Create a personal vision / mission	<p>You must be able to:</p> <p>P-1. Clarify / prioritize self-values and consider the value of others.</p> <p>P-2. Clarify expectations of yourself and expectations others have of you.</p> <p>P-3. Identify what you need to do to be successful (personal standards, targets, goals, principals)</p> <p>P-4. Set specific short and long term goals.</p> <p>P-5. Translate the vision into actionable steps.</p> <p>P-6. Integrate the vision into daily practice.</p> <p>P-7. Recount frequently with your vision and change accordingly.</p>
CU-2: Manage your attitude	<p>You must be able to:</p> <p>P-1. Challenge yourself, break old habits, and move out of your comfort zone.</p> <p>P-2. Practice innovative techniques for out of the box creative thinking.</p> <p>P-3. Seek out support and feedback from others on the team, in the organization / community etc.</p> <p>P-4. Identify daily, weekly accomplishments.</p> <p>P-5. Read inspirational material, audiotapes etc.</p>
CU-3: Practice self-discipline	<p>You must be able to:</p> <p>P-1. Accountable for your performance.</p> <p>P-2. Identify what you need to do to be successful.</p> <p>P-3. Communicate your priorities to others.</p> <p>P-4. Make and honor appointments with yourself and others.</p> <p>P-5. Practice relaxation and energizing techniques.</p>
CU-4: Manage time	<p>You must be able to:</p> <p>P-1. Isolate key success activities and prioritize them.</p> <p>P-2. Breakdown large tasks down into manageable action steps (set time frame).</p> <p>P-3. Create or adopt action plans and follow it.</p> <p>P-4. Set aside appropriate blocks of time for goal related activities.</p> <p>P-5. Make the best possible use of support people / recourses to accomplish tasks.</p>
CU-5: Manage your professional	<p>You must be able to:</p> <p>P-1. Take inventory of your personal interests, abilities, skills, knowledge etc.</p>

development	<p>P-2. Identify and prioritize the strengths and gaps.</p> <p>P-3. Use available assessment tools.</p> <p>P-4. Create a personal growth strategy / career path.</p> <p>P-5. Set personal goals and timeframe for achieving them.</p> <p>P-6. Learn from your mistakes.</p>
CU-6: Participate in trainings and performance review	<p>You must be able to:</p> <p>P-1. Analyze, evaluate and improve performance, and report significant issues/problems to senior management</p> <p>P-2. Demonstrate to-do attitude in profession</p> <p>P-3. Demonstrate understanding of skills requirements</p> <p>P-4. Use the competences acquired in trainings</p>

Understand and Knowledge:

- K-1.** Explain long and short term goals.
- K-2.** Explain why personal vision and mission is important for success.
- K-3.** Describe the advantages of personal vision and mission.
- K-4.** Explain the importance of personal and professional motivation
- K-5.** Identify your positive attitude.
- K-6.** Explain the advantages of innovative ideas and techniques during job.
- K-7.** Explain the importance of communication.
- K-8.** Explain the advantages of self-discipline.
- K-9.** Explain the importance of time management to achieve different tasks.
- K-10.** Explain the importance and need of professional development.
- K-11.** Define concept about performance standards.
- K-12.** Explain policies, procedures and regulations regarding human resources of the organization.
- K-13.** Explain self-planning and management techniques.
- K-14.** Define goals and strategies of self- development.
- K-15.** Explain relevant knowledge about training / job requirements.

Critical Evidence(s) Required

- Capable to identify the hydraulic symbol.
- Capable to identify the pneumatic symbol.

Power Transmission of Construction Machinery

0716-MVS&A-127: Demonstrate main clutches

Overview: This competency standard covers the skills and knowledge required to Diagnose and repair clutches and transmissions by: performing a visual inspection; diagnosing and troubleshooting, repairing and verifying the repair of clutch systems and components; manual transmissions/transfer cases and components; torque converters, lock-up clutches and components; power shift transmissions and components; power shift transmission electrical and electronic controls and components; hydrostatic transmissions and components

Competency Units	Performance Criteria
CU1. Recognize main Clutch and its components.	P1. Identify systems type and applications P2. Point out Housings P3. locate Clutches P4. Point out Discs P5. Point out Pressure plates P6. Locate Flywheels P7. Point out Shaft P8. Point out Bearings
CU2. Inspect main Clutch and its components.	P1. Disassembly of main Clutch. P2. Analyze Housings P3. Inspect Clutches P4. Analyze Discs P5. Analyze Pressure plates P6. Inspect Flywheels P7. Analyze Shaft P8. Analyze Bearings P9. Assemble Main Clutch.
CU3. Diagnose and troubleshoot main Clutch and	P1. Inspect Reservoirs P2. Inspect Hydraulic cylinders P3. Analyze Clutch discs and plates

its components.	P4. Analyze Flywheel P5. Inspect Release mechanisms P6. Inspect Pilot/release bearings P7. Analyze Input shafts P8. Inspect Drive mechanisms
CU4. Troubleshoot main Clutch and its components.	P1. Repair/replace hydraulic cylinders P2. Replace Clutch discs and plates P3. Replace Flywheel assemblies P4. Replace/repair Release mechanisms P5. Replace Pilot/release bearings P6. Replace Input shafts P7. Replace Cables and linkages

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:

- Classify different types of Clutches.
- Describe main clutches.
- Describe discs.
- Describe plates.
- Describe over center system.

Critical Evidence(s) Required

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

- Able to identify main clutch components.
- Able to inspect main clutch components.
- Capable to troubleshoot main clutch components/.

List of Machines and Tools

Sr. #	Description
1	Tool trolley(all Tools)
2	Clutch
3	Special service tool

0716-MVS&A-128: Perform mechanical Transmission

Overview:

This learning unit is designed to provide skills and knowledge to Identify Manual Transmissions
Inspect manual transmissions / transfer cases and components and Troubleshoot manual transmissions /
transfer cases and components

Unit of Competency	Performance criteria
CU1. Recognize Manual Transmissions	P1. Identify types of manual transmission. P2. Point out Housings P3. Identify Gears P4. Locate Shafts P5. Locate Synchronizers P6. Identify Shift mechanisms and linkages P7. Identify Power take-off (PTO) units P8. Point out Bearings P9. Point out Thrust washers P10. Locate Seals P11. Point out Gaskets
CU2. Inspect manual transmissions / transfer cases and components	P1. Disassemble transmission P2. Analyze Gears P3. Analyze Shafts P4. Inspect Synchronizers P5. Inspect Shift mechanisms and linkages P6. Analyze Power take-off (PTO) units P7. Inspect Bearings P8. Analyze Fluid P9. Inspect Thrust washers P10. Inspect Seals P11. Analyze Gaskets
CU3. Troubleshoot manual transmissions / transfer cases and components	P1. Replace Gears P2. Replace Shafts P3. Replace Synchronizers P4. Replace/repair Shift mechanisms and linkages P5. Replace Power take-off (PTO) units P6. Replace Bearings P7. Replace Thrust washers P8. Replace Seals P9. Replace Gaskets P10. Replace/refill Fluids.

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.** Describe manual transmissions
- K2.** Describe manual transmissions types.
- K3.** Describe transmission components.

Critical Evidence(s) Required

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

- Able to identify transmission.
- Able to identify components of transmission.
- Able to inspect components of transmission.
- Able to troubleshoot components of transmission.

List of Machines and Tools

- 1) Tool trolley(all Tools)
- 2) Transmission
- 3) Special service tool

0716-MVS&A-129: Demonstrate the torque converter.

Overview:

This learning unit is designed to provide skills and knowledge to Recognize components of torque converter on cutaway model Analyze Torque Converter and Troubleshoot torque converter.

Unit of Competency	Performance criteria
CU1: Recognize components of torque converter on cutaway model	P1. Identify Torque converter case P2. Identify Drive case P3. Identify Turbine P4. Identify Stator P5. Identify Pump P6. Identify Stator shaft P7. Identify Stator rear housing P8. Identify Stator front housing
CU2: Analyze Torque Converter.	P1. Arrange proper tools to disassemble the torque converter. P2. Disassemble torque convertor. P3. Inspect Torque converter case P4. Inspect Drive case P5. Inspect Turbine P6. Inspect Stator P7. Inspect Pump P8. Inspect Stator shaft P9. Inspect Stator rear housing P10. Inspect Stator front housing
CU3: Troubleshoot torque converter.	P1. Replace Torque converter case P2. Replace Drive case P3. Replace Turbine P4. Replace Stator P5. Replace Pump P6. Replace Stator shaft P7. Replace Stator rear housing P8. Replace Stator front housing

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.** Describe torque convertor.
- K2.** Describe Types of torque convertor.
- K3.** Describe component of torque convertor.
- K4.** Describe inspection of torque convertor.
- K5.** Describe troubleshooting of torque convertor.

Critical Evidence(s) Required

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

- Able to identify torque convertor.
- Capable to inspect torque convertor.
- Able to troubleshoot torque convertor.

List of Machines and Tools

- 1) Tool trolley(all Tools)

- 2) Torque Converter
- 3) Special service tool

0716-MVS&A-130: Perform different tests of torque converter

Overview:

This learning unit is designed to provide skills and knowledge to Practice stall test of torque converter

And Practice pressure test of torque converter on bulldozer.

CU1:Practice stall test of torque converter	P1. Arrange proper tools for stall test of torque converter on bulldozer. P2. Press brake pedal. P3. Select 3rd gear. P4. Increase Engine RPM slowly to set rpm as per manual. P5. Limit test to max 5 sec. P6. Check that the engine RPM is within limit. P7. Report the observation.
CU2:Practice pressure test of torque converter	P1. Arrange proper tools to Practice pressure test of torque converter on bulldozer. P2. Identify test points for measurement of pressures on machine. P3. Observe temperature within limit. P4. Make gear in neutral. P5. Measure torque converter outlet pressure at engine's low idle & high idle RPM. P6. Measure Torque converter inlet pressure at engine's low idle & high idle speed P7. Check that the pressure values are within limit.

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.** Describe stall test.
- K2.** Describe stall test procedure.
- K3.** Describe pressure check procedure of torque convertor.

Critical Evidence(s) Required

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

- Able to do stall test of torque convertor.
- Capable to check the pressure of torque convertor.

List of Machines and Tools

- 1) Tool trolley(all Tools)
- 2) Torque Convertor
- 3) Special service tool
- 4) Pressure test gauge

0716-MVS&A-131: Demonstrate Torque flow transmission.

Overview:

This learning unit is designed to provide skills and knowledge to Identify Torque Flow Transmission, Inspect Torque Flow Transmission and Troubleshoot Torque Flow Transmission.

CU1: Recognize Torque Flow Transmission.	P1. Locate Transmission case. P2. Point out transmission clutch pack. P3. Point out direction clutch packs. P4. Locate speed clutch packs. P5. Point out transmission shaft. P6. Identify gears. P7. Point out bearings.
CU2: Inspect Torque Flow Transmission.	P1. Disassemble Transmission. P2. Analyze Transmission case. P3. Inspect transmission clutch pack. P4. Inspect Clutches. P5. Inspect Plates. P6. Analyze direction clutch packs. P7. Analyze speed clutch packs. P8. Inspect transmission shaft. P9. Inspect gears. P10. Point out bearings.
CU3: Troubleshoot Torque Flow Transmission.	P1. Disassemble Torque Flow Transmission. P2. Replace transmission clutch pack. P3. Replace Discs. P4. Replace direction clutch packs. P5. Replace speed clutch packs. P6. Replace/repair transmission shaft. P7. Replace gears. P8. Replace bearings.

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.** Describe Torque Flow Transmission.
- K2.** Describe components of Torque Flow Transmission.
- K3.** Describe inspection of Torque Flow Transmission.
- K4.** Describe Troubleshoot of Torque Flow Transmission.

Critical Evidence(s) Required

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

- Able to identify components of Torque Flow Transmission.
- Capable to inspect Torque Flow Transmission.
- Able to troubleshooting of Torque Flow Transmission.

List of Machines and Tools

- 1) Tool trolley(all Tools)
- 2) Torque Flow Transmission.
- 3) Special service tool

0716-MVS&A-132: Demonstrate control valve assembly of torque flow transmission.

Overview:

This learning unit is designed to provide skills and knowledge to Identify control valve assembly of torque flow transmission, Inspect control valve assembly of torque flow transmission and Troubleshoot control valve assembly of torque flow transmission.

CU1: Recognize control valve assembly of torque flow transmission.	P1. Locate control valve assembly. P2. Point out transmission spool valve. P3. Point out main relief valve. P4. Point out safety valve. P5. Locate Modulating and Quick Return Valve. P6. Point out reducing valve. P7. Locate direction valve.
CU2: Inspect control valve assembly of torque flow transmission.	P1. Analyze control valve assembly. P2. Inspect transmission spool valve. P3. Inspect main relief valve. P4. Inspect safety valve. P5. Inspect Modulating and Quick Return Valve. P6. Inspect reducing valve. P7. Analyze direction valve.
CU3: Troubleshoot control valve assembly of torque flow transmission.	P1. Replace control valve assembly. P2. Repair/Replace transmission spool valve. P3. Repair/Replace main relief valve. P4. Repair/Replace out safety valve. P5. Repair/Replace Modulating and Quick Return Valve. P6. Repair/Replace reducing valve. P7. Repair/Replace direction valve.

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.** Describe control valve assembly of Torque Flow Transmission.
- K2.** Describe components of control valve assembly of Torque Flow Transmission.
- K3.** Describe demand spool.
- K4.** Describe control valve assembly.
- K5.** Describe transmission spool valve.
- K6.** Describe main relief valve.
- K7.** Describe safety valve.
- K8.** Describe Modulating and Quick Return Valve
- K9.** Describe reducing valve.
- K10.** Describe direction valve.

Critical Evidence(s) Required

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

- Able to identify components control valve assembly of torque flow transmission.
- Capable to inspect control valve assembly of torque flow transmission.
- Able to troubleshooting control valve assembly of torque flow transmission.

List of Machines and Tools

- 1) Tool trolley(all Tools)
- 2) Control valve assembly
- 3) Special service tool
- 4)

0716-MVS&A-133: Analyze Hydro-shift Transmission.

Overview: This learning unit is designed to provide skills and knowledge to Identify Hydro-shift Transmission, Inspect Hydro-shift Transmission and Troubleshoot Hydro-shift Transmission.

CU1: Recognize Transmission.	Hydro-shift	P1. Locate Transmission case. P2. Point out transmission clutch pack. P3. Point out direction clutch packs. P4. Locate speed clutch packs. P5. Point out transmission shaft. P6. Identify gears. P7. Point out bearings.
CU2: Inspect Hydro-shift Transmission.		P1. Disassemble Transmission. P2. Analyze Transmission case. P3. Inspect transmission clutch pack. P4. Inspect Clutches. P5. Inspect Plates. P6. Analyze direction clutch packs. P7. Analyze speed clutch packs. P8. Inspect transmission shaft. P9. Inspect gears. P10. Point out bearings.
CU3: Troubleshoot Transmission.	Hydro-shift	P1. Disassemble Torque Flow Transmission. P2. Replace transmission clutch pack. P3. Replace Discs. P4. Replace direction clutch packs. P5. Replace speed clutch packs. P6. Replace/repair transmission shaft. P7. Replace gears. P8. Replace bearings.

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.** Describe Hydro-shift Transmission.
- K2.** Describe components of Hydro-shift Transmission.
- K3.** Describe inspection of Hydro-shift Transmission.
- K4.** Describe Troubleshoot of Hydro-shift Transmission.

Critical Evidence(s) Required

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

- Able to identify components of Hydro-shift Transmission.
- Capable to inspect Hydro-shift Transmission.
- Able to troubleshooting of Hydro-shift Transmission.

List of Machines and Tools

- 1) Tool trolley(all Tools)
- 2) Hydro-shift Transmission.
- 3) Special service tool

0716-MVS&A-134: Analyze Hydrostatic Transmission (HST).

Overview:

This learning unit is designed to provide skills and knowledge to Identify of hydrostatic transmission, Inspection of hydrostatic transmission and Troubleshoot hydrostatic transmissions.

CU1. Recognize the hydrostatic transmission.	P1. Point out Housings P2. Locate Pumps P3. Point out Motors P4. Point out Gears P5. Locate Bearings P6. Identify Seals P7. Identify Control valves P8. Locate Lines P9. Point out Hoses
CU2. Inspect hydrostatic transmission.	P1. Inspect Housings P2. Analyze Pumps P3. Analyze Motors P4. Inspect Gears P5. Inspect Bearings P6. Inspect Seals P7. Inspect Control valves P8. Analyze Lines P9. Analyze Hoses
CU3. Troubleshoot hydrostatic transmissions.	P1. Replace Housings P2. Replace/repair Pumps P3. Replace/repair Motors P4. Replace Gears P5. Replace Bearings P6. Replace Seals P7. Replace/repair Control valves P8. Replace Lines P9. Replace Hoses

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.** Describe hydrostatic transmissions
- K2.** Describe components of hydrostatic transmissions
- K3.** Describe inspection of hydrostatic transmissions
- K4.** Describe Troubleshoot of hydrostatic transmissions
- K5.** Describe Pump.
- K6.** Describe Motor.

Critical Evidence(s) Required

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

- Able to identify components of hydrostatic transmissions
- Capable to inspect hydrostatic transmissions
- Able to troubleshooting of hydrostatic transmissions

List of Machines and Tools

- 1) Tool trolley(all Tools)
- 2) hydrostatic transmissions

3) Special service tool

Hydraulic Excavator

0716-MVS&A-135: Demonstrate Hydraulic Excavator

Overview: This Competency Standard identifies the competencies required to identify components of Excavator, Differentiate Types of Excavator, and Identify Power Train of Excavator.

Competency Units	Performance Criteria
CU1 Identify components of Excavator	P-1. Identify bucket P-2. Identify arm P-3. Identify boom P-4. Identify bucket cylinder P-5. Identify arm cylinder P-6. Identify boom cylinders P-7. Identify hydraulic pipes P-8. Identify the upper carriage P-9. Identify the under carriage P-10. Identify the work equipment
CU2 Differentiate Types of Excavator	P-1. Identify Crawler type excavator P-2. Identify Wheel type excavator P-3. Identify Hybrid type excavator
CU3 Identify Power Train of Excavator	P1. Identify engine. P2. Identify damper P3. Identify hydraulic pump. P4. Identify control valve assembly. P5. Identify swing motor. P6. Identify swivel join and travel motor. P7. Identify hydraulic cylinders.

Knowledge & Understanding

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

- K-1.** Describe main components of excavator.
- K-2.** Describe types of excavator.
- K-3.** Describe power train of excavator.

Critical Evidence(s) Required

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

- Capable to understand Hydraulic excavator main components.
- Capable to understand Hydraulic excavator types.
- Capable to understand Hydraulic excavator power train.

List of Tools and Equipment's

1. Hybrid Excavator
2. Wheel excavator
3. Crawler excavator

0716-MVS&A-136: Analyse hydraulic pump of excavator

Overview: This Competency Standard identifies the competencies required to identify and inspect hydraulic pump circuit.

Competency Units	Performance Criteria
1. Identify hydraulic Pump circuit	P-1. Identify the hydraulic tank, hydraulic pump, filters, hydraulic pipes, control valve and actuators P-2. Identify different types of hydraulic Pumps. P-3. Identify the Main components of hydraulic Pump P-4. Identify the Charging Pumps/Pilot pump
2. Inspect Hydraulic Pump Circuit	P1. Inspect the hydraulic tank, hydraulic pump, filters, hydraulic pipes and control valve. P2. Inspect Hydraulic pump according to set standards. P3. Inspect the main components of hydraulic pump. P4. Inspect the Charging pump/Pilot Pump.
A3. Troubleshoot hydraulic Pump	P1. Troubleshoot the hydraulic tank, hydraulic pump, filters, Hydraulic Pipes and control valve. P2. Troubleshoot the hydraulic pump as per requirement. P3. Troubleshoot charging pump/pilot pump as per requirement. P4. Disassemble hydraulic Pump. P5. Assemble hydraulic Pump. P6. Disassemble charging pump/pilot pump. P7. Assemble charging pump/pilot pump.
A4. Adjustment of Hydraulic pump	P1. Use Hydraulic pressure gauge set. P2. Select pressure gauge per requirement. P3. Install pressure gauge. P4. Start the Engine. P5. Perform pressure adjustment. P6. Perform hydraulic system bleeding. P7. Perform hydraulic pump oil flow testing.

Knowledge & Understanding

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

- K-4.** Describe Hydraulic pump system.
- K-5.** Describe charging pump/pilot pump system.
- K-6.** Describe main pump pressure
- K-7.** Describe PPC pressure.

Critical Evidence(s) Required

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

- Capable to service Hydraulic pump and its components.
- Capable to service charging pump/pilot pump components.

List of Tools and Equipment's

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools
3	Hydraulic Gauge set

0716-MVS&A-137: Maintain control valves of excavator

Overview: This Competency Standard identifies the competencies required to identify and inspect the control valve.

Competency Units	Performance Criteria
A1. Identify control Valve	<p>P-1. Identify the hydraulic tank, Control valve, filters, lines and control valve.</p> <p>P-2. Identify different types of Control valve (OLSS, EOLSS, and CLSS).</p> <p>P-3. Identify the Main components of control valve: Spool valves for actuators, Straight travel valve/ travel junction valve/Flow combiner valve, swing priority valve, arm throttle valve, drift prevention valve/anti-drift valve, pressure compensation valve, Bucket Flow rate control valve, safety valves, safety suction valve & suction valve</p> <p>P-4. Identify main relief valve.</p> <p>P-5. Identify PPC valves (Travel, Work equipment)</p> <p>P-6. Identify two stage relief valve.</p>
A2. Inspect control valve	<p>P-1. Inspect the hydraulic tank, filters, lines and control valve.</p> <p>P-2. Inspect Hydraulic control valve according to set standards.</p> <p>P-3. Inspect the main components of hydraulic control valve.</p> <p>P-4. Inspect main relief valve.</p> <p>P-5. Inspect PPC valves (Travel, Work equipment)</p> <p>P-6. Inspect two stage relief valves.</p>
A3. Troubleshoot Control valve	<p>P-1. Troubleshoot the hydraulic tank, hydraulic pump, filters, lines and control valve.</p> <p>P-2. Troubleshoot the hydraulic control valve as per requirement.</p> <p>P-3. Disassemble control valve.</p> <p>P-4. Assemble control valve.</p> <p>P-5. Troubleshoot accumulators</p> <p>P-6. Remove accumulators.</p> <p>P-7. Install accumulators.</p> <p>P-8. Adjust the pressure of main relief valve and control valve using gauge set.</p> <p>P-9. Troubleshoot PPC valves (Travel, Work equipment)</p> <p>P-10. Troubleshoot two stage relief valves.</p>

Knowledge & Understanding

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

- Describe Main control valve.
- Describe Accumulators

- PPC valves
- **Critical Evidence(s) Required**

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

- Capable to service Main control valve.

List of Tools and Equipment's

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools
3	Hydraulic Gauge set

0716-MVS&A-138: Maintain hydraulic motors

Overview: This Competency Standard identifies the competencies required to identify and troubleshoot hydraulic Motors (Travel and Swing).

Competency Units	Performance Criteria
A1. Identify hydraulic Motors (Travel and Swing)	<p>P-1. Identify the hydraulic travel motors and lines.</p> <p>P-2. Identify different types of hydraulic travel Motor.</p> <p>P-3. Identify the Main components of hydraulic travel Motor parking brake and brake valve</p> <p>P-4. Identify the hydraulic swing motor and lines.</p> <p>P-5. Identify hydraulic swing lock.</p> <p>P-6. Identify the Main components of hydraulic swing Motor, Swing motor relief valve, reverse prevention valve</p>
2. Inspect Hydraulic Motors(Travel and Swing)	<p>P1. Inspect the hydraulic travel motors and lines.</p> <p>P2. Inspect different types of hydraulic travel Motor.</p> <p>P3. Inspect the Main components of hydraulic travel Motor</p> <p>P4. Inspect the hydraulic swing motor and Hydraulic Pipes.</p> <p>P5. Inspect different types of hydraulic swing Motor.</p> <p>P6. Inspect the Main components of hydraulic swing Motor</p>
A3. Troubleshoot hydraulic Motors(Travel and Swing)	<p>P1. Troubleshoot the hydraulic Motor</p> <p>P2. Troubleshoot the hydraulic travel motor as per requirement.</p> <p>P3. Troubleshoot hydraulic swing motor as per requirement.</p> <p>P4. Disassemble hydraulic travel motor</p> <p>P5. Assemble hydraulic travel motor</p> <p>P6. Disassemble hydraulic swing motor.</p> <p>P7. Assemble hydraulic swing motor.</p>
A4. Adjust Hydraulic motors (Travel and Swing).	<p>P1. Perform pressure adjustment.</p> <p>P2. Perform hydraulic system bleeding.</p> <p>P3. Perform hydraulic motor oil flow testing.</p>

Knowledge & Understanding

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

- K-8.** Describe Hydraulic travel motor system.
- K-9.** Describe Hydraulic swing motor system.

Critical Evidence(s) Required

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

- Capable to service Hydraulic travel motor and its components.
- Capable to service Hydraulic swing motor and its components.

List of Tools and Equipment's

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools

0716-MVS&A-139: Analyse hydraulic cylinders

Overview: This Competency Standard identifies the competencies required to Identify and troubleshoot hydraulic cylinders.

Competency Units	Performance Criteria
A1. Identify hydraulic cylinders	P1. Identify main components inside the cutaway model of hydraulic cylinder. P2. Identify Piston Valve. P3. Identify packing's. P4. Identify wear rings. P5. Identify dust seal.
2. Inspect hydraulic cylinder	P1. Inspect different components of hydraulic cylinder P2. Disassemble hydraulic cylinder P3. Assemble hydraulic cylinder P4. Inspect the hoses attached with hydraulic cylinder P5. Check creeping rate/hydraulic drift test of work equipment
A3. Troubleshoot hydraulic cylinder	P7. Troubleshoot the seals of hydraulic cylinder P8. Troubleshoot the piston of hydraulic cylinder P9. Remove hydraulic cylinder from machine P10. Install hydraulic cylinder on machine

Knowledge & Understanding

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

- K-1.** State hydraulic cylinder
- K-2.** State types of hydraulic cylinder
- K-3.** State different components of hydraulic cylinder
- K-4.** Describe function and structure of each component of hydraulic cylinder piston ring, wear ring and dust seal.
- K-5.** Describe hydraulic cylinder drift test and how to perform.
- K-6.** State speed test of Work equipment.

Critical Evidence(s) Required

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

- Capable to understand different types of hydraulic cylinder
- Capable to understand different components of hydraulic cylinder
- Capable to perform hydraulic cylinder drift test
- Capable to assemble and disassemble the hydraulic cylinder
- Capable to replace different components of hydraulic cylinder
- Capable to remove and install hydraulic cylinder on machine

List of Tools and Equipment's

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools

0716-MVS&A-140: MAINTAIN HYDRAULIC CONTROL CIRCUIT

Overview: This Competency Standard identifies the competencies required to Identify and adjust hydraulic control circuit.

Competency Units	Performance Criteria
A1. Identify hydraulic control circuit	<p>P1. Identify the CLSS (Closed centre load sensing system)</p> <p>P2. Identify the OLSS (Open centre load sensing system)</p> <p>P3. Identify the EOLSS (electronic load sensing system)</p> <p>P4. Identify the LS valve</p> <p>P5. Identify the PC valve</p> <p>P6. Identify EPC valve.</p> <p>P7. Identify TVC valve.</p> <p>P8. Identify CO valve.</p> <p>P9. Identify servo motor.</p> <p>P10. Identify NC valve.</p> <p>P11. Identify Servo valve.</p> <p>P12. Identify pump regulator & speed sensing control</p> <p>P13. Identify sensors, solenoids and switches.</p>
2. Inspect Hydraulic control Circuit	<p>P1. Inspect the CLSS (Closed centre load sensing system)</p> <p>P2. Inspect the OLSS (Open centre load sensing system)</p> <p>P3. Inspect the LS valve</p> <p>P4. Inspect the PC valve</p> <p>P5. Inspect EPC valve.</p> <p>P6. Inspect TVC valve.</p> <p>P7. Inspect CO valve.</p> <p>P8. Inspect NC valve.</p> <p>P9. Inspect Servo valve</p> <p>P10. Inspect servo motor.</p> <p>P11. Inspect pump regulator & speed sensing control</p> <p>P12. Inspect sensors, solenoids and switches.</p>
A3. Troubleshoot hydraulic Control circuit	<p>P-1. Troubleshoot the CLSS (Closed centre load sensing system)</p> <p>P-2. Troubleshoot the LS valve</p> <p>P-3. Troubleshoot the PC valve</p> <p>P-4. Troubleshoot EPC valve.</p> <p>P-5. Troubleshoot TVC valve.</p> <p>P-6. Troubleshoot CO valve.</p> <p>P-7. Troubleshoot NC valve.</p> <p>P-8. Troubleshoot Servo valve</p> <p>P-9. Troubleshoot /replace servo motor</p> <p>P-10. Troubleshoot pump regulator</p> <p>P-11. Troubleshoot/replace sensors, solenoids and switches.</p>
A4. Adjust Hydraulic control circuit	<p>P1. Adjust the CLSS (Closed centre load sensing system)</p> <p>P2. Adjust the LS valve</p> <p>P3. Adjust the PC valve</p>

Knowledge & Understanding

The candidate must be able to demonstrate underpinning knowledge and understanding

required to carry out the tasks covered in this competency standard. This includes the knowledge of:

- K-10.** Describe OLSS, CLSS and EOLSS.
- K-11.** Describe LS valve.
- K-12.** Describe PC valve
- K-13.** Describe EPC valve.
- K-14.** Describe Servo valve
- K-15.** Describe TVC valve
- K-16.** Describe Solenoids, sensors and switches
- K-17.** Describe CO, NC valve.
- K-18.** Describe servo motor.

Critical Evidence(s) Required

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

- Capable to differentiate between OLSS and CLSS.
- Capable to diagnose CLSS.
- Capable to inspect LS, PC and EPC valves.
- Capable to inspect CO and NC valve.

List of Tools and Equipment's

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools

0716-MVS&A-141: Maintain air conditioning system

Overview: This Competency Standard identifies the competencies required to Identify and troubleshoot Air conditioning system.

Competency Units	Performance Criteria
A1. Identify Air conditioning system	<p>P1. Identify the Evaporator P2. Identify the Condenser P3. Identify the Compressor P4. Identify the Blower P5. Identify the expansion valve P6. Identify the pressure sensor P7. Identify the thermostat P8. Identify the low and high gas pressure hose.</p>
A2. Inspect Air conditioning system	<p>P1. Inspect the Evaporator P2. Inspect the Condenser P3. Inspect the Compressor P4. Inspect the Blower P5. Inspect the expansion valve P6. Inspect the pressure sensor P7. Inspect the thermostat P8. Inspect the low and high gas pressure hose.</p>
3. Troubleshoot Air conditioning system	<p>P1. Troubleshoot the hydraulic tank, hydraulic pump, filters, lines and control valve. P2. Troubleshoot the Evaporator P3. Troubleshoot the Condenser P4. Troubleshoot the Compressor P5. Troubleshoot the Blower P6. Troubleshoot the expansion valve P7. Troubleshoot the pressure sensor P8. Troubleshoot the thermostat P9. Troubleshoot the low and high gas pressure hose.</p>
A4. Perform Assembly and Disassembly of Air conditioning system	<p>P1. Disassemble of Evaporator, Condenser, Compressor, Blower, Expansion valve, pressure sensor, thermostat P2. Assemble Evaporator, Condenser, Compressor, Blower, Expansion valve, pressure sensor, thermostat P3. Adjust AC refrigerant pressure and volume. P4. Add refrigerant</p>

Knowledge & Understanding

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

- K-1. Describe the refrigerant cycle
- K-2. Describe the heat, Temperature, scale of temperature
- K-3. Describe Vacuum
- K-4. Describe pressure
- K-5. Describe the Receiver
- K-6. Describe the Evaporator
- K-7. Describe the Condenser
- K-8. Describe the Compressor
- K-9. Describe the Blower

K-10. Describe the expansion valve

K-11. Describe the pressure sensor

K-12. Describe the thermostat

Critical Evidence(s) Required

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

- Capable to service Compressor
- Capable to service Condenser
- Capable to service evaporator
- Capable to service refrigerant

List of Tools and Equipment's

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools

0716-MVS&A-142: Analyze HEATING system

Overview: This Competency Standard identifies the competencies required to Identify and troubleshoot Heating system.

Competency Units	Performance Criteria
A1. Identify Heating system	P1. Identify the heating core P2. Identify the water pump P3. Identify the hot water valve P4. Identify heater hose
A2. Inspect Main control valve	P1. Inspect the heating core P2. Inspect the water pump P3. Inspect the hot water valve P4. Inspect heater hose
A3. Troubleshoot Heating system	P1. Troubleshooting the heating core P2. Troubleshooting the water pump P3. Troubleshooting the hot water valve P4. Troubleshooting heater hose

Knowledge & Understanding

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

- Describe hot water cycle
- Describe water pump

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

- Capable to service water pump, Heating core and hoses.

List of Tools and Equipment's

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools

0716-MVS&A-143: Analyse ventilation system

Overview: This Competency Standard identifies the competencies required to Identify and troubleshoot ventilation system.

Competency Units	Performance Criteria
A1. Identify Ventilation	P-1. Identify the Ducts P-2. Identify Motor P-3. Identify Blower P-4. Identify controller P-5. Identify AC Heater switches, Relays, Resistors
A2. Inspect ventilation	P-1. Inspect the ducts P-2. Inspect the motor P-3. Inspect the blower P-4. Inspect the controller P-5. Inspect AC Heater switches, Relays, Resistors
3. Troubleshoot ventilation	P1. Troubleshoot the motor P2. Troubleshoot the blower P3. Troubleshoot the controller P4. Troubleshoot AC Heater switches, Relays, Resistors

Knowledge & Understanding

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

- K-19.** Describe motor.
- K-20.** Describe blower
- K-21.** Describe controller
- K-22.** Describe ac heater switches relays and resistors.

Critical Evidence(s) Required

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

- Capable to service motor.
- Capable to service blower.

List of Tools and Equipment's

S No.	Descriptions
1	Tools trolley (Complete set of Hand Tools)
2	Special Service tools

Final Drive, Under Carriage and Power Train/Line

0716-MVS&A-144: Recognize the power train and track group

Overview:

This learning unit is designed to provide skills and knowledge to identify the power train and demonstrate the track group

Unit of Competency	Performance criteria
CU1. Identify the power train	P1. Identify Damper Unit P2. Identify Torque Converter P3. Identify PTO P4. Identify Transmission Unit P5. Identify Steering Assembly P6. Sort out the power train units in sequence.
CU2. Demonstrate the track group	P1. Identify track frame. P2. Identify sprocket. P3. Identify idler wheel. P4. Identify carrier and track roller. P5. Identify track shoe. P6. Identify different types of track shoe. P7. Identify track link, pin and bushes. P8. Identify equalizer bar.

Knowledge & Understanding

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

- K-1.** Describe Power Train
- K-2.** Describe structure and function of components of Track Group.
- K-3.** Describe Equalizer bar, Track Roller, Idler Roller, Sprocket, Track Chain, Track Shoes, Recoil Spring Assembly and Track Link Assembly.

Critical Evidence(s) Required

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

- Capable to the power train
- Able to identify the different components of power train
- Able to understand the track group.
- Able to understand the sprocket, idler wheel, carrier roller and track roller.
- Able to understand the track link, pin, bushes and track shoe.

List of Tools and Equipment's

- 1) Bulldozer

0716-MVS&A-145: Perform inspection of track group

Overview:

This learning unit is designed to provide skills and knowledge to Inspect under carriage components and Measure Inspect track group

Unit of Competency	Performance criteria
CU1. Inspect under carriage components.	P1. Inspect the sprocket. P2. Inspect the idler wheel. P3. Inspect the carrier roller and track roller. P4. Inspect the track shoe and different type of shoe. P5. Inspect the track link, pin and bushes.
CU2. Measure the track group	P1. Arrange proper tools to measure the track roller. P2. Measure the track roller by keeping in view the Standard size and wear limits. P3. Measure the Carrier roller by keeping in view the Standard size and wear limits. P4. Measure the Idler wheel by keeping in view the Standard size and wear limits. P5. Measure the track chain link pitch by keeping in view the Standard size and wear limits. P6. Measure the pin and bushing by keeping

in view the Standard size and wear limits.
P7. Measure the track chain tension by keeping in view the Standard size and wear limits.

Knowledge & Understanding

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

- K-1.** Introduction to measuring tools used for undercarriage components
- K-2.** Measurement procedure for diameter of carrier and track roller.
- K-3.** Measurement procedure for idler roller.
- K-4.** Measurement procedure for measure link pitches and link height.
- K-5.** Measurement procedure for pin and bushes.
- K-6.** Measurement procedure for grouser and plates.
- K-7.** Explain fundamentals of sprocket
- K-8.** Explain causes and remedies of wear of Links, pin boss side faces.
- K-9.** Explain causes and remedies of wear Pin, bushings and cracks in bushings
- K-10.** Explain causes and remedies of wear of Grouser and Plates of Track Shoes.
- K-11.** Explain causes and remedies of wear of Roller Tread and Roller Flanges.
- K-12.** Explain the techniques to prolong life of undercarriage parts from operational point of view.
- K-13.** Explain the techniques to prolong life of undercarriage parts from service manual and maintenance point of view.

Critical Evidence(s) Required

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

- Capable to inspect the track group.
- Capable to inspect the sprocket, idler wheel, carrier roller and track roller.
- Able to inspect the track link, pin, bushes and track shoes.
- Able to measure the weariness of track group.
- Able to measure weariness of sprocket, idler wheel, carrier roller and track roller.
- Able to measure the weariness of track shoes, track link, pin and bushes.
- Able to read the manual and compare the measurement with standers.

List of Tools and Equipment's

- 1) Measuring tools
- 2) Special Service tools
- 3) Bulldozer
- 4) Excavator

0716-MVS&A-146: Adjust the Track chain tension

Overview:

This learning unit is designed to provide skills and knowledge to adjust the Track chain tension and align the track chain.

Unit of Competency	Performance criteria
CU1. Adjust the Track chain tension	P1. Arrange Proper Tools for adjust the track chain tension P2. Check track chain tension P3. Pump grease through grease nipple with the grease pump.(if needed) P4. Check track tension; continue pump grease until tension is according to requirement. P5. Loose lubricator to release the grease if track is tight. P6. Test the machine for above adjustment by moving a machine forward and reverse direction. P7. Readjust the Track tension (if needed).
CU2. Align the track chain	P1. Arrange Proper Tools to Align the track chain P2. Inspect the deviation of track with respect to center of sprocket and rollers. P3. Adjust Idler Clearance in Sideways direction. P4. Test the machine for above adjustment by moving a machine forward and reverse direction. P5. Readjust the Idler Clearance (if Needed).

Knowledge & Understanding

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

- K-1.** Describe how to adjust track chain tension.
- K-2.** Explain structure and function of recoil spring assembly.
- K-3.** Explain procedure to adjustment of track tension of track chain of Bulldozer.

Critical Evidence(s) Required

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

- Capable to check the tension of track chain.
- Able to adjust the tension of track chain.
- Able to align the track chain.

List of Tools and Equipment's

- 1) Tools trolley (Complete set of Hand Tools)
- 2) Special Service tools
- 3) Grease Pump
- 4) Bulldozer

0716-MVS&A-147: Disassemble and assemble the final drive

Overview:

This learning unit is designed to provide skills and knowledge to Disassemble and assemble the final drive

Unit of Competency	Performance criteria
CU1. Disassemble the final drive	<p>P1. Arrange Proper tools to Disassemble the final drive</p> <p>P2. Drain oil of final drive.</p> <p>P3. Remove drive shaft and final drive assembly.</p> <p>P4. Dismantle Sprocket hub assembly with the help of SST.</p> <p>P5. Remove wear guard of sprocket assembly.</p> <p>P6. Remove Cover Assembly.</p> <p>P7. Remove Carrier Assembly.</p> <p>P8. Remove Planetary Gear set.</p> <p>P9. Remove hub and case assembly.</p> <p>P10. Remove Cage assembly.</p> <p>P11. Remove Gear Assembly.</p> <p>P12. Remove outer race and oil seal from case.</p>
CU2. Assemble the final Drive	<p>P1. Arrange Proper tools to assemble the final drive</p> <p>P2. Inspect, clean and replace faulty parts of final drive assembly</p> <p>P3. Press fit oil seal and outer race to case.</p> <p>P4. Install Gear Assembly.</p> <p>P5. Install Cage assembly.</p> <p>P6. Install hub and case assembly.</p> <p>P7. Install Planetary Gear set.</p> <p>P8. Install Carrier Assembly.</p> <p>P9. Install Cover Assembly.</p> <p>P10. Install wear guard of sprocket assembly</p> <p>P11. Assemble Sprocket hub assembly with the help of SST.</p> <p>P12. Install drive shaft and final drive assembly</p> <p>P13. Refill oil of final drive Assembly.</p>

Knowledge & Understanding

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

- K-1.** Describe structure and function of Final Drive system
- K-2.** Describe structure of Single reduction Final Drive system
- K-3.** Describe structure of Double reduction Final Drive system
- K-4.** Describe structure of planetary type Final Drive system
- K-5.** Describe disassembling procedure of final drive system
- K-6.** Describe assembling procedure of final drive system

Critical Evidence(s) Required

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

- Capable to disassembling the final drive
- Capable to assembling the final drive

List of Tools and Equipment's

- 1) Tools trolley (Complete set of Hand Tools)
- 2) Special Service tools
- 3) Final Drive

0716-MVS&A- 148: Recognize cutaway and differential assembly of a wheeled vehicle.

Overview: This learning unit is designed to provide skills and knowledge to Identify power train of wheel vehicle, Identify differential assembly of a wheeled vehicle and demonstrate cutaway model of differential assembly.

Unit of Competency	Performance criteria
CU1. Identify power train of wheel vehicle	P1. Identify engine. P2. Identify clutch/Torque convertor. P3. Identify transmission. P4. Identify universal joint. P5. Identify slip joint. P6. Identify CV (Constant velocity) joint. P7. Identify propeller shaft. P8. Identify differential assembly. P9. Identify axel shaft. P10. Identify hub.
CU2. Identify differential assembly of a wheeled vehicle.	P1. Identify open type differential assembly. P2. Identify LSD (limited slip differential) assembly P3. Identify Auto LSD differential assembly. P4. Identify Lock Type differential assembly.
CU3. Demonstrate cutaway model of differential assembly	P1. Identify Coupling P2. Identify bevel pinion and bevel gear. P3. Identify star pinion. P4. Identify side gears. P5. Identify cage and spider.

Knowledge & Understanding

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

- K-1.** Explain power line of wheeled vehicle.
- K-2.** Explain universal joint, slip joint, propeller shaft and differential assembly.
- K-3.** Explain structure and function of differential assembly used in wheeled vehicles.
- K-4.** Explain working principle of differential assembly during straight travelling and turning.
- K-5.** Explain structure and function of different types of differential assemblies used in wheeled vehicles.

Critical Evidence(s) Required

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

- Capable to understand the power train of wheel vehicle.
- Capable to identify different types of different assemblies.
- Capable to identify different components of differential assemblies.
- Able the understand the working of differential assembly

List of Tools and Equipment's

- 1) Cutaway model
- 2) Differential Assembly

0716-MVS&A-149: Disassemble & assemble inter-axle differential assembly

Overview:

This learning unit is designed to provide skills and knowledge to Disassemble & assemble inter-axle differential assembly

Unit of Competency	Performance criteria
CU1. Disassemble inter-axle differential assembly	<p>P1. Arrange Proper tools to Disassemble inter-axle differential assembly</p> <p>P2. Drain oil from differential and final Drive Case.</p> <p>P3. Dismantle Wheel Assembly.</p> <p>P4. Pull out Drive shaft</p> <p>P5. Remove inter-axle differential assembly.</p> <p>P6. Remove Coupling</p> <p>P7. Remove Bevel Pinion and cage assembly.</p> <p>P8. Remove Differential gear Assembly from Differential case.</p> <p>P9. Dismantle the differential gear assembly.</p>
CU2. Assemble inter-axle differential assembly	<p>P1. Arrange Proper tools to assemble inter-axle differential assembly.</p> <p>P2. Inspect, clean and replace faulty parts of inter-axle differential assembly</p> <p>P3. Assemble the differential gear assembly.</p> <p>P4. Install Differential gear Assembly on Differential case.</p> <p>P5. Adjust preload on bearings.</p> <p>P6. Install Bevel Pinion and cage assembly.</p> <p>P7. Install Coupling of differential.</p> <p>P8. Install inter axle differential assembly on machine.</p> <p>P9. Refit Drive shaft</p> <p>P10. Assemble Wheel Assembly.</p> <p>P11. Refill oil in differential and final Drive Case.</p>

Knowledge & Understanding

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

- K-1.** Explain structure and function of inter axle differential assembly
- K-2.** Explain testing and adjustment of inter axle differential assembly

Critical Evidence(s) Required

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

- Capable to disassembling the inter axle differential assembly
- Capable to assembling the inter axle differential assembly

List of Tools and Equipment's

- 1) Tools trolley (Complete set of Hand Tools)

- 2) Special Service tools
- 3) Dump Truck

0716-MVS&A-150: Recognize structure and type of OFF road Tires.

Overview:

This learning unit is designed to provide skills and knowledge to Identify structure, type of OFF-road Tires and Identify different coding of tires.

Unit of Competency	Performance criteria
CU1. Identify structure of OFF road tires	P1. Identify Tread P2. Identify Crown P3. Identify Groove. P4. Identify Breaker P5. Identify Car case P6. Identify Bead Section P7. Identify Sidewall P8. Identify different Tire coding
CU2. Identify different types of OFF road Tires	P1. Identify Traction type tires P2. Identify Block type tires P3. Identify Rock type tires P4. Identify Rib type tires P5. Identify Snow pattern tires P6. Identify Smooth pattern Tires
CU3. Identify different coding of tires	P1. Identify coding of OFF road Tires. P2. Identify coding of ON road Tires. P3. Identify coding of Tires in Inches System P4. Identify coding of Tires in Metric System

Knowledge & Understanding

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

- K-1.** Nomenclature of OFF Road Tires
- K-2.** Explain structure / parts of OFF Road Tires.
- K-3.** Explain different types of OFF Road Tires and their application on construction machines.
- K-4.** Selection of appropriate tire according to load and road condition.
- K-5.** Explain Traction and Flotation properties of OFF Road Tires.
- K-6.** Explain Blasting of Tires.
- K-7.** Describe importance of Ton Kilo meter per Hour (TKPH) value of a Tire.
- K-8.** Describe correct way to use Tires.
- K-9.** Compare Tube Type and Tube less Type Tires.
- K-10.** Explain special type Tires.

Critical Evidence(s) Required

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

- Capable to identify structure of tire.
- Capable to identify different type of tires.
- Able to understand the different coding of tire

List of Tools and Equipment's

- 1) Tools
- 2) Tires

Entrepreneurship

0716-MVS&A-151: Investigate micro business opportunities

Overview: This competency describes the performance outcomes, skills and knowledge required to develop business ideas, and to investigate market needs and factors affecting potential markets.

Competency Unit	Performance Criteria
CU-1. Describe business ideas	P1. Gather information for business ideas from appropriate sources P2. List details of business ideas and opportunities P3. Research alternative business ideas in light of the resources available P4. Specify and list products and services to match business ideas P5. Identify and research potential customer information for business ideas P6. Identify and take into account financial, business and technical

	skills available when researching business opportunities
CU-2. Identify market needs	<p>P1. Collect information regarding market size and potential from appropriate sources</p> <p>P2. Investigate market trends and developments to identify market needs relative to business ideas</p> <p>P3. Gather market information from primary and secondary sources to identify possible market needs in relation to business ideas</p> <p>P4. Identify ethical and cultural requirements of the market and their impact on business ideas</p> <p>P5. Identify new and emerging markets and document their features</p> <p>P6. Identify and organize information on expected market growth or decline and associated risk factors</p>
CU-3. Investigate factors affecting the market	<p>P1. Identify projected changes in population, economic activity and the labor force that may affect business ideas</p> <p>P2. Identify movements in prices and projected changes in availability of resources</p> <p>P3. Review trends and developments and identify their potential impact on business ideas</p>

Knowledge and understanding

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

- K1.** Define entrepreneurship.
- K2.** Explain the concept of entrepreneurship.
- K3.** Explain the various types of enterprise that exist in the community
- K4.** Identify and interpret the terms and elements involved in the concept of enterprise
- K5.** Appreciate that the advancement of individual and society in general when entrepreneurship is adopted
- K6.** Explain various motivational factors that entrepreneurs possess and utilize.
- K7.** Exhibit the skills needed to assess and evaluate a risk
- K8.** Describe the outline of small enterprise
- K9.** Describe the creativity and innovation
- K10.** Apply the techniques for developing creative abilities
- K11.** Explain the resources of business idea
- K12.** Explain the collective and creative thinking
- K13.** Explain how to generate a business idea

- K14.** Appreciate the importance of, and possess techniques for identifying and assessing business opportunities.
- K15.** Identify the various entrepreneurial characteristics
- K16.** Access personal potential for becoming future entrepreneurs.
- K17.** Identify leadership qualities which are essential to the success of entrepreneurs
- K18.** Identify self- management skills and how they are important to be enterprising
- K19.** Apply a rational approach to make personal and business decisions
- K20.** Explain the steps for decision making and rating of decision making skills
- K21.** Apply the rules of negotiation for resolving business issues

Critical Evidence(s) Required

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

Evidence of the following is essential:

- Thorough investigation of business opportunities and ideas
- Clearly identified products/services and customer information for each business idea
- Thorough collection and analysis of market information and associated factors relating to business ideas
- Knowledge of ethical and cultural requirements.

Instruments & Consumables

S No.	Description (Instruments)
1	Calculator
2	Ruler
3	Papers and Pencil

0716-MVS&A-152: Develop a micro business proposal

Overview: This competency describes the performance outcomes, skills and knowledge required to develop an identified business idea, to research the feasibility of the business opportunity and to present a business idea in formats that suit a range of stakeholders

Competency Unit	Performance Criteria
CU1. Evaluate business opportunities	<p>P1. Identify and research key factors that influence viability of business ideas</p> <p>P2. Analyze business ideas in terms of personal or family needs and commitments</p> <p>P3. Evaluate impacts of emerging or changing technology, including e-commerce, on the business</p> <p>P4. Determine viability of business opportunity in line with perceived risks, resources available, financial returns and other outcomes sought</p> <p>P5. Assess and match personal skills/attributes against those perceived as necessary for a particular business opportunity</p> <p>P6. Identify and assess business risks according to resources available and personal preferences</p>
CU2. Detail the business idea	<p>P1. .Develop an accurate description of the business idea for key stakeholders</p> <p>P2. Develop an accurate summary of the major products and/or services required to suit personal needs and requirements</p>
CU3. Prepare the business overview to suit different stakeholders	<p>P1. Present an accurate list of key stakeholders and their information requirements</p> <p>P2. Determine an acceptable method of presentation of information for each stakeholder</p> <p>P3. Provide accurate customized information to target audiences</p>

Knowledge and understanding

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

- K1. State and local government legislative requirements relating to business operation, especially in regard to occupational health and safety (OHS) and environmental issues,
- K2. Income and expenditure costing •
- K3. Principles of risk assessment relevant to the business opportunity

Critical Evidence(s) Required

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

Evidence of the following is essential:

- accurate and complete outline of the business idea that considers the major elements of:
 - products/services
 - customers
 - operations and processes
 - income and expenditure
 - resources
 - marketing
 - location

Instruments & Consumables

S No.	Description (Instruments)
1	Calculator
2	Ruler
3	Papers and Pencil

0716-MVS&A-153: Develop a marketing plan

Overview: This competency describes the performance outcomes, skills and knowledge required to research, develop and present a marketing plan for an entrepreneurship business

Competency Unit	Performance Criteria
CU-1. devise marketing strategies	<p>P1.Evaluate <i>marketing opportunity options</i> that address organizational objectives, and evaluate their risks and returns in the selection process</p> <p>P2. Develop <i>marketing strategies</i> that address strengths and opportunities within the organization’s projected capabilities and resources</p> <p>P3. Develop strategies which increase resources or organizational expertise where gaps exist between current capability and marketing objectives</p> <p>P4.Develop feasible marketing strategies and communicate reasons that justifies their selection</p>

	<p>P5. Ensure strategies align with organization's strategic direction</p> <p>P6. Develop a marketing performance review strategy, incorporating appropriate marketing metrics to review of organizational performance against marketing objectives</p>
<p>CU-2. Plan marketing tactics</p>	<p>P1. Detail tactics to implement each marketing strategy in terms of scheduling, costing, accountabilities and persons responsible</p> <p>P2. Identify coordination and monitoring mechanisms for scheduled activities</p> <p>P3. Ensure tactics are achievable within organization's projected capabilities and budget</p> <p>P4. Ensure tactics meeting legal and ethical requirements</p> <p>P5. Ensure tactics provide for ongoing review of performance against objectives and budgets, and allow marketing targets to be adjusted if necessary</p>
<p>CU-3. Prepare and present a marketing plan</p>	<p>P1. Ensure marketing plan meets organizational, as well as marketing, objectives and incorporates marketing approaches and a strategic marketing mix</p> <p>P2. Ensure marketing plan contains a rationale for objectives and information that supports the choice of strategies and tactics</p> <p>P3. Present marketing plan for approval in the required format and timeframe</p> <p>P4. Adjust marketing plan in response to feedback from key stakeholders and disseminate for implementation within the required timeframe</p>

Knowledge and understanding

The candidate must be able to demonstrate underpinning knowledge and understanding required to carry out the tasks covered in this competency standard. This includes the knowledge of: Culturally appropriate communication skills to relate to people from diverse backgrounds and people with diverse abilities

K1. Describe the market & marketing

K2 Differentiate between sellers and buyers' market

K3. Describe the five 'w' of market

K4. Explain the procedure for assessing the market size and demand

K5. Explain the major factors to be considered when selecting a location for a business

- K6. Describe the basic types of business ownership and the limitation of each
- K7. Explain the computation of initial and working capital needed to start an enterprise
- K8. Identify the advantages and disadvantages of using various sources of capital to start an enterprise
- K9. Explain the component of cost of product
- K10. Explain the break-even analysis for a new business
- K11. Calculate the breakeven point for various new businesses

Critical Evidence(s) Required

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

- Devising, documenting and presenting a marketing plan
- Detailing approaches and
- The marketing mix to achieve organizational marketing objectives.

Instruments & Consumables

S No.	Description (Instruments)
1	Calculator
2	Ruler
3	Papers and Pencil

0716-MVS&A-154: Develop and review a business plan

Overview: This competency standard covers the process of developing and reviewing business for a small business enterprise. It requires the application of knowledge and skills to determine the scope of the business plan, prepare a business plan, determine goals, trial systems, and document, monitor and review the business plan.

Competency Unit	Performance Criteria
CU-1. Determine scope of business	<p>P1. Determine scope of the business plan and associated systems is determined in consultation with specialist personnel.</p> <p>P2. Access accurate information for inform business plan development</p> <p>P3. Account for and incorporate trends and seasonal variations into the business plan.</p> <p>P4. Account for strategic goals, targets and directions of the enterprise in the development of the business plan</p> <p>P5. Comply Legal obligations in developing the business plan.</p>
CU-2. Prepare business plan	<p>P1. Develop operational goals and targets to meet the enterprise strategic plan.</p> <p>P2. Identify and incorporate supply chains into the business plan.</p> <p>P3. Identify risk management needs are within the business plan.</p> <p>P4. Incorporate trial systems in order to test budgetary impact and operational potential prior to full implementation of the business plan.</p> <p>P5. Set clear and measureable indicators of operational performance to allow for realistic analysis of performance.</p>
CU-3. Document and review business plan	<p>P1. Include fiscal and operational systems that enhance performance management and suit enterprise requirements.</p> <p>P2. Incorporate resource considerations the business plan.</p> <p>P3. Document accurately and clearly communicate business Plan to all relevant parties.</p> <p>P4. Monitor to identify strengths, weaknesses and areas for</p>

improvement performance against the business plan
P5. Make recommendations to improve the business plan and associated systems as required.

Knowledge and understanding

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

- K1.** Appreciate the importance of business plan
- K2.** Explain the process of writing a business plan
- K3.** Develop feasibility for a business idea
- K4.** Realize the problem that may be encountered when starting a small business/Enterprise
- K5.** Develop a business plan for a small business on the standard format
- K6.** Evaluate the business plan in a real market situation.

The knowledge requirements for this competency standard are listed below:

K7. budgeting

K8. forecasting

K9. operational systems

K10. relevant industrial awards and agreements

K11. communication techniques

K12. logical and analytic methods

K13. profit and loss and cash flow systems

K14. working knowledge of environmental, OHS, industrial relations, taxation, corporate and industry legislation as they relate to the enterprise

Critical Evidence(s) Required

The candidate needs to produce following critical evidences in order to competent in this competency standard.

Competence in develop and review a business plan requires evidence that demonstrates ability to scope the business plan and determine key objectives and targets. It also requires competence in specifying key performance targets, assessing the relevance of the business plan, and trial systems. The business plan also needs to be documented and reviewed.

The skills and knowledge required to develop and review a business plan must be **transferable** to a different work environment. For example, if competence is demonstrated in developing a business plan for a small enterprise, it must also be evident in reviewing a business plan in medium or large enterprise environment.

Instruments & Consumables

S No.	Description (Instruments)
1	Construction Lab Tools
2	Rule, tape, square, hammer, hand saw, hand plane, chisel, shovel, wheelbarrow, sledge hammer, pick, mattock and crowbar and pinchbarfor given tasks.

0716-MVS&A-155: Organize finances for the micro business

Overview: This competency standard describes the performance outcomes, skills and knowledge required to investigate the financial capacity to enter into a micro business, to determine the projected cash flow, to source finances and to monitor the profitability of the business.

Competency Unit	Performance Criteria
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<p>CU-1. Ascertain own financial position and the ability to provide capital/equity for the business</p>	<p>P1. Realistically detail personal, family or community financial situation in terms of funds available and commitments already incurred</p> <p>P2. Determine equity finance and assets available for micro business from personal, family or community sources</p>
<p>CU-2. Determine projected cash flow for the business</p>	<p>P1. Determine the level of forecast business activity over a year and the business mix</p> <p>P2. Estimate establishment costs for the business and repayment schedule for borrowings</p> <p>P3. Calculate the monthly variable and fixed costs needed to conduct business activity over a year</p> <p>P4. Estimate personal drawings needed to be taken from the business</p> <p>P5. Estimate the monthly income generated by the business for a year based on price per unit item or hourly charge rate for labor</p> <p>P6. Develop a cash flow budget for the first year of business operation</p> <p>P7. Seek professional advice to estimate goods and services tax and operating finance required for the business</p>
<p>CU-3. Source the required funds to establish the business</p>	<p>P1. Estimate required funding to establish and run the business based on expected sales and activity levels, available finances and commitments</p> <p>P2. Investigate methods of accessing alternative sources of finance</p> <p>P3. Identify strategies for meeting financial obligations</p> <p>P4. Implement plans to access available funds as required</p>
<p>CU-4. Monitor profitability of the business</p>	<p>P1. Maintain and review monthly expenditure and income records</p> <p>P2. Compare equity at beginning and end of a year to estimate business performance</p> <p>P3. Assess the financial viability of the business after a year of operation</p> <p>P4. Seek professional advice on depreciation, insurance and tax implications of the business</p>

Knowledge and understanding

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

- K1.** Basic budgeting
- K2.** basic costing for the business
- K3.** financial commitments and requirements
- K4.** financial reports and terminology
- K5.** methods and relative costs of obtaining finance
- K6.** own financial position
- K7.** Sources of advice and assistance.

Critical Evidence(s) Required

The candidate needs to produce following critical evidences in order to competent in this competency standard.

Evidence of the following is essential:

- investigation of own financial position and needs
- investigation of projected cash flow for the business
- estimation of the funding needed to establish and operate the business
- assessment of the financial viability of the business
- Knowledge of basic budgeting.

0716-MVS&A-156: Manage human resources

Overview: This competency standard covers the skills and knowledge required to manage human resources and to manage and develop human resources to achieve organization's operational objectives

Competency Unit	Performance Criteria
CU-1. Lead and motivate people	<p>P1. Establish goals for people and teams to optimize achievement in work tasks.</p> <p>P2. Take into account the capabilities of people and teams.</p> <p>P3. Provide advice and support sensitive to the individual's needs to people in the performance of their duties.</p> <p>P4. Undertake activities to achieve commitment to common goals.</p> <p>P5. Recognize and encourage initiative and innovation</p> <p>P6. Recognize and communicate achievements within the organization.</p>
CU-2. Undertake human resource planning	<p>P1. <i>Determine human resource needs</i> within the anticipated operational needs and allocated budget.</p> <p>P2. Analyze alternatives to staffing levels which clearly demonstrate returns to the organization.</p> <p>P3. Develop contingency plans for staffing which meet key provisions of the human resources plan.</p> <p>P4. Compare existing competencies of staff with the needs of the work group.</p> <p>P5. Plan staffing levels and negotiate with <i>stakeholders</i> within the organisational framework to achieve maximum efficiency of operations.</p>
CU-3. Develop and facilitate performance	<p>P1. Negotiate performance criteria individuals, teams and work groups.</p> <p>P2. Review performance criteria as circumstances change.</p> <p>P3. Conduct <i>performance appraisal</i> based on clearly established and agreed performance criteria.</p> <p>P4. Identify and propose the total performance development system strategies to rectify performance shortfalls and recognize success.</p> <p>P5. Address performance problems confidentially and in a constructive and timely manner, in line with relevant organizational procedures.</p>

	<p>P6. Make <i>selections, transfers and promotions</i> in accordance with organization policies and supported with documented information.</p> <p>P7. Develop and implement mechanisms for the identification of human resource development needs within the work group taking account of the strategic plan for the organisation.</p>
<p>CU-4. Facilitate training, education and development opportunities</p>	<p>P1. Make information on planned training events widely available throughout the organization.</p> <p>P2. Include training, education and development plans as part of individual/team performance plans.</p> <p>P3. Facilitate individual/team access to, and participation in, training, education and development opportunities.</p> <p>P4. Contribute coaching and mentoring effectively to the training, education and development of personnel in an environment of change.</p> <p>P5. <i>Enhance training, education and development opportunities</i> of individual, team and organizational performance.</p> <p>P6. Create workplace environment in which facilitates training, education and development</p>

Knowledge and understanding

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

K1. Describe the hiring method/Procedures

K2. Describe the term & conditions of services and job description for various employments

K3. Describe the characteristics of successful sales personals

- K4. communication principles
- K5. conflict resolution principles and practice
- K6. Equal Employment Opportunity
- K7. grievance procedures
- K8. interpersonal relations
- K9. leadership theory and principles
- K10. management principles and practice
- K11. Occupational Health and Safety
- K12. training and education principles
- K13. training need analysis

Critical Evidence(s) Required

The candidate needs to produce following critical evidences in order to competent in this competency standard.

- It is essential that competence be demonstrated in the application of human resource management in a wide range of contexts in achieving the organisation's objectives.
- Evidence should be gathered over a period of time in a range of actual or simulated workplace environments.
- Evidence of competent performance should be obtained by observing an individual in a management role within the workplace or exercise or operational environment. Knowledge may be accessed through written assignments, project reports, debriefings and action learning projects.

0716-MVS&A-157: Market the products and services

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

Competency Unit	Performance Criteria
CU-1. Analyze market information	<p>P1. Identify, research and analyze existing or new markets for existing or new products or services using techniques to ensure reliable data</p> <p>P2. Analyze past trends and developments to determine market variability and associated risks</p> <p>P3. Develop gross margin budgets to account for market variability</p> <p>P4. Identify and evaluate competing products to determine strengths and weaknesses of own products</p> <p>P5. Monitor market environment to ensure information is current and reliable</p> <p>P6. Identify the legal, ethical and environmental constraints of the markets and their effect on the enterprise</p> <p>P7. Identify product specifications that suit market requirements and price advantage at the time</p> <p>P8. Present clear and concise information to the enterprise management team.</p>
CU-2. Identify and evaluate factors to include in a marketing plan	<p>P1. Identify and evaluate production processes to ensure required product specifications are met</p> <p>P2. Identify and assess alternative selling strategies and techniques to identify marketing targets and methods</p> <p>P3. Identify and assess distribution channels and their role in your marketing strategies</p> <p>P4. Ensure the data used is reliable and the market environment and trends are substantiated</p> <p>P5. Evaluate the role of marketing professionals in providing advice</p>
CU-3. Develop a marketing plan for your products and services	<p>P1. Establish marketing objectives based on current and potential product specifications</p> <p>P2. Select appropriate production processes to ensure product specifications are met</p> <p>P3. Select selling strategies to ensure required prices are</p>

	<p>achieved</p> <p>P4. Select appropriate distribution channel options to ensure access to target markets is achieved efficiently and appropriately</p> <p>P5. Establish time-frames for production, distribution and selling activities</p> <p>P6. Develop a gross margin budget to demonstrate the cost effectiveness of the marketing plan</p> <p>P7. Develop partial gross margin budgets to account for market variability</p>
<p>CU-4. Determine promotional strategies</p>	<p>P1. Prepare and record detailed plans for promotional activities</p> <p>P2. Outline objectives, level of exposure and available markets</p> <p>P3. Ensure strategies take account of time management and scheduling issues, and resource constraints</p> <p>P4. Create promotional materials that enhance the product and commercial presentation</p> <p>P5. Record and communicate priorities, responsibilities, timelines and budgets for promotional activities.</p>
<p>CU-5. Implement marketing activities</p>	<p>P1. Schedule planned marketing activities within appropriate timeframes</p> <p>P2. Develop measurable performance targets that meet business plan objectives</p> <p>P3. Organize distribution channels and ensure product and service information is accurate and readily available to clients</p> <p>P4. Implement marketing activities within budgetary constraints to meet legal, ethical and enterprise requirements</p>
<p>CU-6. Evaluate marketing performance.</p>	<p>P1. Review the established marketing objectives to ensure they remain viable</p> <p>P2. Make an objective assessment of the marketing plan and its implementation by a comparison of valid and reliable data against the established objectives</p> <p>P3. Assess product, pricing and distribution policies in relation to market changes, marketing objectives and enterprise requirements</p> <p>P4. Identify areas of positive marketing performance and take corrective action to remedy poor marketing performance areas</p> <p>P5. Document and distribute information for continual analysis</p>

Knowledge and understanding

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

- K1.** Describe the life cycle of product
- K2.** Identify the various ways of selecting suppliers,
- K3.** Explain the inventory management of stock, raw material and finished goods etc.
- K4.** Appreciate the importance of financial record keeping in a small business
- K5.** Explain techniques to keep cost as low as possible
- K6.** Develop balance sheet for a small enterprise
- K7.** Explain the operating cycle concept
- K8.** Explain the income tax computation procedure for a small business
- K9.** Explain the basic scheme of sales tax
- K10.** Explain the assessment procedure for returns and filling of returns.

Critical Evidence(s) Required

The evidence required to demonstrate competency in this unit must be relevant to workplace operations and satisfy holistically all of the requirements of the performance criteria and required skills and knowledge and include achievement of the following:

- identify the marketable features of the product and potential markets
- develop a range of marketing alternatives
- collect and analyses data to assess alternatives in a marketing plan
- evaluate performance targets and recommend modifications or improvements
- implement and evaluate a marketing plan
- Plan to manage promotional activities.

0716-MVS&A-158: Monitor and review business performance

Overview: This competency standard covers the skills and knowledge required to monitor and review business performance

Competency Unit	Performance Criteria
CU-1. Evaluate commercial performance	<p>P1. Gather and analyze data relating to enterprise performance to identify historical and current performance.</p> <p>P2. Review and analyze operational structures to determine the suitability of organizational processes to enterprise objectives.</p> <p>P3. Evaluate enterprise strengths and weaknesses against market conditions to determine current and future capacities.</p> <p>P4. Evaluate enterprise objectives are to identify variations and scope for future development.</p>
CU-2. Allocate and co-ordinate business resources	<p>P1. Identify and communicate roles and responsibilities of personnel.</p> <p>P2. Identify resource requirements for enterprise and cost them using standard financial analysis techniques.</p> <p>P3. Calculate costs of ensuring sustainability of enterprise operations and factor into business planning for the enterprise.</p>
CU-3. Identify performance requirements	<p>P1. Develop realistic performance indicators within available timeframes and resources</p> <p>P2. Identify and minimize factors inhibiting performance against objectives.</p> <p>P3. Monitor and assess market conditions based on relevant data.</p> <p>P4. Prepare and incorporate strategies and programs to promote the sustainability of operations into enterprise procedures.</p>
CU-4. Review business performance	<p>P1. Review regularly enterprise operations to identify opportunities for improvements in performance.</p> <p>P2. Monitor and anticipate impact of natural conditions on enterprise to assess sustainability of resource use.</p> <p>P3. Compare costs and estimates with resource allocation.</p> <p>P4. Determine operational plans to determine schedule of</p>

Knowledge and understanding

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

- K1.** rates of return for products and/or services
- K2.** financial analysis techniques
- K3.** structure and operation of small businesses relevant State/Territory Occupational Health and Safety (OHS)
- K4.** legislative requirements
- K5.** environmental conditions, positive environmental practices and negative impact minimization measures
- K6.** human resource requirements for the enterprise
- K7.** transport requirements for the enterprise
- K8.** Enterprise/property improvement requirements.
- K9.** market performance in commodities
- K10.** statutory marketing requirements

Critical Evidence(s) Required

The evidence required to demonstrate competency in this unit must be relevant to workplace operations and satisfy holistically all of the requirements of the performance criteria and required skills and knowledge and include achievement of the following:

- gather and analyze data relating to enterprise performance
- review operational structures to determine effectiveness
- identify available resources to assess capacity
- develop realistic performance indicators
- review enterprise operations against performance indicators
- Plan to improve business performance by addressing results of review.

0716-MVS&A-159: Negotiate for resolving business issues

Overview: This competency standard covers the skills and knowledge required to negotiate for resolving business issues

Competency Unit	Performance Criteria
CU-1. Develop and implement issue resolution and grievance procedures	<p>P1. Establish problem solving/issue resolution procedures within legislative requirements and organization's guidelines.</p> <p>P2. Manage grievances and complaints are in a timely and caring way to optimize likelihood of a favorable outcome for all parties and in line with organizational objectives and procedures.</p> <p>P3. Document and communicate individual's rights and obligations under industrial awards/agreements and legislation are in a clear and concise manner and in appropriate language.</p> <p>P4. Conduct hearings, interviews and meetings within the principles of industrial democracy and participative, consultative processes.</p> <p>P5. Identify and invite all relevant industrial parties to participate in the resolution process.</p>
CU-2. Manage disciplinary matters	<p>P1. <i>Implement disciplinary matters</i> in accordance with organization's procedures.</p> <p>P2. Conduct investigations in a caring and confidential manner to maintain performance and morale.</p> <p>P3. Provide feedback promptly.</p> <p>P4. Institute appeals processes in accordance with organizational procedures.</p> <p>P5. Recognize and recommend deficiencies in procedures for changes made</p>

Knowledge and understanding

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

- K1.** Describe Concrete ingredients ratio
- K2.** Explain batching and finishing techniques
- K3.** Identify concrete materials
- K4.** Explain methods of concrete placement

- K5. State curing times for concrete.
- K6. Describe fresh concrete levelling techniques
- K7. Describe types, characteristics, uses and limitations of plant, tools and equipment

Critical Evidence(s) Required

The candidate needs to produce following critical evidences in order to competent in this competency standard.

- Use hand trowel and power trowel to finish a minimum of 10 square meters of concrete in foundation.

Instruments & Consumables

S No.	Description (Instruments)
1	Construction Lab Tools
2	<ul style="list-style-type: none"> • Chutes, Line pumps • Measuring tapes and rules, mechanized dumpers • Rakes, Screed boards, shovels, stipple devices • Trowels trowelling machines • Vibrators, Wheelbarrows, kibble, pump or hopper.

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 (NAVTTTC) Act-2011, NAVTTTC 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 NAVTTTC's website



(Muqeem Islam)

Director General (Skill Standards & Curricula)

Phone: 051-9215385

Distribution:

1. Federal Secretary, Ministry of Federal Education & Professional Training, Govt of Pakistan
2. Federal Secretary, Ministry of Overseas Pakistanis and Human Resource Development, Govt of Pakistan, Islamabad
3. Federal Secretary, Ministry of Industry and Production, Govt of Pakistan, Islamabad
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
4. Staff Officer to Chairman, NAVTTC
5. PS to Executive Director, NAVTTC Islamabad
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