



**NOS.MO.01
FIRST EDITION**

**NATIONAL OCCUPATIONAL STANDARD FOR HEAVY DUTY
MACHINE OPERATOR**

ZAMBIA QUALIFICATIONS AUTHORITY

APPROVING AUTHORITY

This National Occupational Standard has been prepared and published under the authority of the Zambia Qualifications Authority Board on 20th December 2023.

ZAMBIA QUALIFICATIONS AUTHORITY

The Zambia Qualifications Authority Act No. 13 of 2011 was enacted by the Government of the Republic of Zambia to ***“provide for the development and implementation of a national qualifications framework; establish the Zambia Qualifications Authority; provide for the registration and accreditation of qualifications; provide measures to ensure that standards and registered qualifications are internationally comparable; and provide for matters connected with, or incidental to the foregoing”***. Among other functions, ZAQA is responsible for ***determining national standards for any occupation***, through various sector specific National Occupational Standards Development Teams (NOSDTs).

REVISION OF NATIONAL OCCUPATIONAL STANDARDS

National Occupational Standards shall be revised every after **5 years**, or whenever necessary, by the issue of either amendments or of revised editions. It is important that users of National Occupational Standards (NOS) ascertain that they are in possession of the latest amendments or editions.

NOS DEVELOPMENT TEAM RESPONSIBLE

This National Occupational Standard was prepared by the Construction National Occupational Standards Development Team, upon which the following organisations were represented:

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2. Engineering Institution of Zambia
3. Ministry of Local Government and Rural Development
4. Road Development Agency
5. Surveyors Institute of Zambia
6. University of Zambia
7. Zambia Institute of Architects
8. Association of Building and Civil Engineering Contractors
9. Water Resources Management Authority
10. Bari Zambia Limited
11. Zulu Burrow Construction
12. Ng'andu Consulting
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TABLE OF CONTENTS

FOREWORD.....	iv
JUSTIFICATION	iv
ACRONYMS AND ABBREVIATIONS	v
GLOSSARY OF TERMS	vi
1. OVERVIEW.....	1
2. SCOPE.....	3
3. PERSONAL ATTRIBUTES (VALUES, ETHICS AND ATTITUDES).....	3
4. UNITS AND ELEMENTS	3
5. EQUIPMENT, TOOLS, AND CONSUMABLE MATERIALS	9
6. DILEMMAS/CHALLENGES AND COMPLEXITIES FOR A JOB HOLDER	9
6.1 Alternative Choices (Solutions) to Dilemmas and Complexities	9
7. WORKING CONDITIONS/ENVIRONMENT	9
8. PARTIES INVOLVED/INTERACTING WITH THE JOB HOLDER OR TRAINEE	10
8.1 Internal/Within the Organization	10
8.2 External/Outside the Organization	10
9. PHYSICAL DEMANDS ON THE BODY	10
ANNEX A	11
ANNEX B	12

FOREWORD

The Zambia Qualifications Authority (ZAQA) is a statutory body under the Ministry of Education established by ZAQA Act No. 13 of 2011 to “**develop and implement a national qualifications framework; register and accredit qualifications; and ensure that standards and registered qualifications are internationally comparable**”.

Among other functions, ZAQA is responsible for “*determining national standards for any occupation*”, through various sector specific National Occupational Standards Development Teams (NOSDTs) of experts composed of representation from appropriate authorities, government departments, industry, academia, regulators, consumer associations and non-governmental organisations, etc.

This National Occupational Standard (NOS) has been developed by the Construction National Occupational Standards Development Team in accordance with the procedures and guidelines of ZAQA. All users should ensure that they have the latest edition of this publication as National Occupational Standards are revised from time to time.

This NOS shall be used by, among others, industry, employers, quality assurance bodies, awarding and professional bodies and education and training institutions, as a benchmark to identify training needs, develop job profiles/descriptions, develop curricula and learning programmes, in various sectors where the occupation exists. In the Construction sector, demonstration of competence against this NOS may be required in order to run a business or practice a craft or profession.

JUSTIFICATION

Machine Operator is one of the critical trades in the construction industry which is common to all types of constructions. A Machine Operator drives, manoeuvres, or operates heavy construction equipment necessary in the construction of roads, bridges, tunnels, pipelines, dams, buildings, and other structures. Despite this being the case, there has been no formal standard or training for this critical trade. The development of this National Occupational Standard will promote standardisation of skills and training relevant to latest advancements in industry, resulting in adequately and appropriately skilled Machine Operators.

This National Occupational Standard highlights core knowledge, skills, competences, and personal attributes that Machine Operators must possess to be successful in their job.

ACRONYMS AND ABBREVIATIONS

MO	Machine Operator
CS	Core Skill
NOS	National Occupational Standard
NOSDT	National Occupational Standards Development Team
OK	Organisational Knowledge
PC	Performance Criteria
PS	Professional Skill
RK	Regulatory Knowledge
RPL	Recognition of Prior Learning
MO	Machine Operator
TK	Technical Knowledge
ZAQA	Zambia Qualifications Authority
ZQF	Zambia Qualifications Framework
OSHE	Occupational Safety, Health, and Environment

GLOSSARY OF TERMS

For the purposes of this NOS, the following terms and definitions shall apply:

Core Skills/Generic Skills: are a group of skills that are key to learning and working in today's world. These skills are typically needed in any work environment. In the context of the NOS, these include communication related skills that are applicable to most job roles.

Disability: Physical or mental impairment that substantially limits one or more major life activities.

Function: is an activity necessary for achieving the key purpose of the sector, occupation, or area of work, which can be carried out by a person or a group of persons. Functions are identified through functional analysis and form the basis of NOS.

Job Title: defines a unique set of functions that together form a unique employment opportunity in an organisation.

Knowledge and Understanding: are statements which together specify the technical, generic, professional, and organisational specific knowledge that an individual needs in order to perform to the required standard.

National Occupational Standards (NOS): are statements of the standards of performance individuals must achieve when carrying out functions in the workplace, together with specifications of the underpinning knowledge and understanding. They are precise descriptions of what an individual is expected to be able to do in his/her work role.

National Occupational Standards (NOS) Code: is a unique reference code that identifies a NOS.

National Occupational Standards Development Team (NOSDT): means an established group of national stakeholders/experts responsible for the development of National Occupational Standards within a specific economic sector or occupation.

Occupation: is a set of job roles, which perform similar/related set of functions in an industry.

Organisational Context: includes the way the organisation is structured and how it operates, including the extent of operative knowledge that managers have in their relevant areas of responsibility.

Performance Criteria: are statements that together specify the standard of performance required when carrying out a task.

Scope: is the set of statements specifying the range of variables that an individual may have to deal with in carrying out the function which have a critical impact on the quality of performance required.

Sector: is a conglomeration of different business operations having similar businesses and interests. It may also be defined as a distinct subset of the economy whose components share similar characteristics and interests.

Sub Sector: is derived from a further breakdown based on the characteristics and interests of its components.

Technical Knowledge: is the specific knowledge needed to accomplish specific designated responsibilities.

Unit Title: gives a clear overall statement about what the incumbent should be able to do.

Elements: sets out competences the incumbent should possess to carry out the day-to-day activities.

1. OVERVIEW

This is an introductory section providing a brief summary and specific information or commentary about the content of the NOS and the targeted sector and occupation to help the user judge whether it is relevant to them.

NOS Code	NOS.MO.01
Occupation	Machine Operator
Job Title	Heavy Duty Machine Operator
Job Description	A Machine Operator drives, manoeuvres, or controls the heavy machinery used to construct roads, bridges, buildings, and other structures. Machine Operator takes care of all machine-specific functions such as configuring the equipment, loading, and operating the machines, and optimizing the machine capability. The Machine Operator needs to ensure that the machine works at its full capacity, oversee its maintenance, and perform timely quality checks. In performing this task, a Machine Operator shall clean and maintain equipment, make basic repairs as necessary, report malfunctioning equipment to supervisors, move levers, push pedals, or turn valves to drive and manoeuvre equipment, and coordinate machine actions with crew members using hand or audio signals. A Machine Operator shall use the heavy-duty construction equipment to complete works as per task specifications
Job Purpose	A Machine Operator shall efficiently and safely utilise construction equipment to complete tasks such as haulage, excavation, compaction and/or hoisting of materials on a construction site.
ZQF Level	4
Sector	Construction
Sub sector	Real Estate and Infrastructure Construction
Other Economic Sector(s) in which the Occupation is Practiced	Mining, Manufacturing, Telecommunication, Energy, Education/training, Agriculture, etc.
Other Similar Jobs that can be Performed in the Occupation	Supervisors in mining and quarrying, Material Handlers, Machine Technician, Production Supervisor.
Minimum Educational Job Entry Qualification(s)	Certificate in Heavy Equipment Operation
Practicing License Requirements (if any)	No. (But Membership with the Engineering Institution of Zambia is required).

Training/RPL (Suggested)	<ol style="list-style-type: none"> 1. First Aid 2. ICTS 3. Basic Mechanics 4. Occupation Health and Safety
Minimum Job Entry Age	20 years
Prior Experience (Recommended)	<ol style="list-style-type: none"> 1. Non trained worker: 4 years site experience in the same occupation 2. Trained worker: 1 year site experience as an apprentice Machine Operator
Performance Criteria	As described in the Units under Section 4

2. SCOPE

This National Occupational Standard highlights core knowledge, skills, competences, and personal attributes that Machine Operators must possess to be successful in their jobs. The NOS is limited to operation and maintenance of heavy-duty construction equipment such as excavators, loaders, graders, dozers, compactors, reclaimers, and cranes.

3. PERSONAL ATTRIBUTES (VALUES, ETHICS AND ATTITUDES)

This job requires ability to do basic planning and prioritisation of activities, ability to work in a team, physical fitness required to sustain strenuous conditions, exposure to handle various equipment, tools and materials, sensitivity towards safety for self, others and equipment, willingness to work across various locations in ongoing construction work environment whilst working at the site, be well versed with tasks, functions, standards, specifications, codes of practice and safety norms applicable to construction works, be honest and results oriented, etc.

4. UNITS AND ELEMENTS

This National Occupational Standard is divided into 2 Units representing the tasks that a jobholder should undertake in his/her day-to-day work. Each unit is further broken down into elements depicting the number of activities to be carried out for the successful execution of a particular task.

UNIT 1 [This unit describes the knowledge, skills and competences required to efficiently operate heavy duty equipment on a construction site].

Unit No.	01
Unit Title	Efficiently operate heavy construction equipment
Description	This Unit describes the skills and knowledge required to operate heavy equipment safely and efficiently.
Scope	This Unit covers the following: <ul style="list-style-type: none"> • Basic Function of Equipment and Operation • Construction Drawings and Measurements • Equipment Handling and Safety • Communication and Signals
Performance Criteria (PC) with respect to the Scope	
Element	Performance Criteria (PC)
Basic Function of Equipment and Operation	To be competent, the individual must be able to: PC1. Demonstrate understanding of the basic function of heavy equipment. PC2. Demonstrate ability to use the hands and feet to control the heavy equipment smoothly and accurately. PC3. Demonstrate versatility in handling more than one type of heavy-duty equipment.
Construction Drawings and Measurements	To be competent, the individual must be able to: PC4. Demonstrate ability to read or interpret construction drawings and gauges required to complete construction tasks.
Equipment Handling and Safety	To be competent, the individual must be able to: PC5. Demonstrate ability to load and unload heavy equipment on and off the carrier in a safe manner. PC6. Demonstrate ability to identify safe working conditions and potential hazards. PC7. Demonstrate knowledge and ability to perform firefighting techniques.
Communication and Signals	To be competent, the individual must be able to: PC8. Demonstrate understanding of basic audio and/or hand signals required to coordinate with co-workers and supervisors. PC9. Demonstrate ability to document tasks, hazards, accidents, etc. and report to superiors.
Knowledge and Understanding (K)	
A. Organisational Context (Knowledge of the company/ organisation)	The individual on the job must demonstrate knowledge and understanding of: OK1. The organisation's work policies, conditions, and operating procedures.

and its processes)	
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: TK1. Basic construction techniques and processes. TK2. Scheduling and time management. TK3. Process control and quality management.
C. Regulatory Knowledge	The individual on the job must demonstrate knowledge and understanding of local construction codes and mandatory standards inclusive of the provisions of: RK1. Road Traffic (Amendment) Act, 2022. RK2. Occupational Health & Safety Act No. 36 of 2010. RK3. Factories Act, 1966, CAP 441.
Skills (S)	
A. Core Skills/ Generic Skills	Writing Skills
	The individual on the job must be able to: CS1. Write in English (at least working level) and be able to or have the means to give simple instructions in the local language used at the site. CS2. Prepare and provide clear and simple instructions, details, and sketches to co-workers
	Reading Skills
	The individual on the job must be able to: CS3. Read and be able to comprehend operating manuals for the specific equipment. CS4. Read and interpret sketches, drawings or instructions provided for the required work. CS5. Read and interpret various safety protocol and general signage, safety rules and tags, etc., provided at the workplace, including directions for exit routes during emergencies.
B. Professional Skills	Oral Communication (Listening and Speaking skills)
	The individual on the job must be able to: CS6. Speak in English (at least working level) and be able to or have the means to give simple instructions in the local language used at the site. CS7. Listen attentively and interpret communication/instructions from the supervisor and other co-workers. CS8. Convey information clearly and concisely to co-workers.
B. Professional Skills	Decision Making
	The individual on the job must be able to: PS1. Determine and report to the superior whether the working space is safe for operations.

	Plan and Organise
	The individual on the job should be able to: PS2. Plan work and organise the required fuel, lubricants, and other consumables in coordination with team members and superiors.
	Customer Centricity
	The individual on the job must be able to: PS3. Complete tasks as per agreed time schedule and quality.
	Analytical Thinking and Problem Solving
	The individual on the job should be able to: PS4. Resolve problems related to working in confined spaces and challenging terrains. PS5. Analyse worksite conditions and recommend to the superior safe working manoeuvres to overcome obstacles and impediments.
Critical Thinking	
The individual on the job should be able to: PS6. Identify problems with work site and creatively find the best solutions for operations.	

UNIT 2 [This unit describes the knowledge, skills and competences required to conduct routine inspections and maintenance of heavy-duty equipment on a construction site].

Unit No.	02
Unit Title	Inspection and Basic Equipment Maintenance
Description	This Unit describes the skills and knowledge required to perform routine inspections and basic maintenance of heavy equipment.
Scope	This Unit covers the following: <ul style="list-style-type: none"> • Conducting routine monitoring and inspection of equipment. • Undertaking basic equipment repairs and scheduling of maintenance. • Reporting and documentation.
Performance Criteria (PC) with respect to the Scope	
Element	Performance Criteria (PC)
Conducting routine monitoring and inspection of equipment	To be competent, the individual must be able to: PC1. Demonstrate understanding of the basic routine inspections required prior to operating any equipment.
Undertaking basic equipment repairs and scheduling of maintenance	To be competent, the individual must be able to: PC2. Demonstrate possession of basic mechanical skills required to undertake minimal repairs on equipment. PC3. Demonstrate understanding of equipment planning and scheduling with respect to maintenance. PC4. Demonstrate ability to conduct routine inspections and maintenance
Reporting and documentation	To be competent, the individual must be able to: PC5. Demonstrate ability to document information of equipment purchase, repairs and maintenance for record keeping.
Knowledge and Understanding (K)	
A. Organisational Context (Knowledge of the company/ organisation and its processes)	The individual on the job must demonstrate knowledge and understanding of: OK1. The organisation's standard equipment maintenance procedures.
B. Technical Knowledge	The individual on the job must demonstrate knowledge and understanding of: TK1. Basic mechanics of heavy equipment. TK2. Basic routine maintenance procedures of heavy equipment.
C. Regulatory Knowledge	The individual on the job must demonstrate knowledge and understanding of local construction codes and mandatory standards inclusive of the provisions of: RK1. Road Traffic (Amendment) Act, 2022.

	<p>RK2. Occupational Health & Safety Act No. 36 of 2010. RK3. Factories Act, 1966, CAP 441.</p>
Skills (S)	
A. Core Skills/ Generic Skills	Writing Skills
	<p>The individual on the job must be able to: CS1. Write in English (at least working level) and be able to or have the means to describe the fault signal displayed by the equipment. CS2. Prepare and provide clear and simple maintenance schedule for the equipment.</p>
	Reading Skills
	<p>The individual on the job must be able to: CS3. Read English and be able to or have the means to interpret the equipment operator's maintenance manual.</p>
	Oral Communication (Listening and Speaking skills)
	<p>The individual on the job must be able to: CS4. Convey information clearly and concisely to supervisors regarding maintenance requirements.</p>
B. Professional Skills	Decision Making
	<p>The individual on the job must be able to: PS1. Determine and report to the superior whether the equipment is fit for use.</p>
	Plan and Organise
	<p>The individual on the job should be able to: PS2. Plan work and organise required tools, service parts and/or maintenance schedules in coordination with and superiors</p>
	Customer Centricity
	<p>The individual on the job must be able to : PS3. Complete tasks as per agreed time schedule and quality.</p>
	Analytical Thinking and Problem Solving
	<p>The individual on the job should be able to: PS4. Resolve potential faults or problems with the heavy equipment using diagnostic tools and manuals to find the cause and solution of an issue.</p>
Critical Thinking	
	<p>The individual on the job should be able to: PS5. Identify and deal with or report violation of any warning signals which may lead to machine damage or accidents.</p>

5. EQUIPMENT, TOOLS, AND CONSUMABLE MATERIALS

Equipment, tools, and consumable materials used by the job holder include, but are not limited to:

Hand and Power Tools: Hammer, Spanners, Screwdrivers, wrench, and sockets.

Measuring Instruments: measuring devices such as tapes, lasers, etc.

Consumables and General requirements: Fuel, Lubricants, First aid kit, Fire extinguishers, etc.

Personal Protective Equipment: Safety helmet, Safety goggles, Safety shoes, Safety belt, Cotton gloves, Ear plugs, Reflective jackets, Dust mask, Fire prevention kit, etc.

6. DILEMMAS/CHALLENGES AND COMPLEXITIES FOR A JOB HOLDER

Dilemmas associated with the job of Machine Operator include: working around and with machinery having moving parts, working in dangerous areas with likelihood of sharp or falling materials and objects, working in confined spaces and at heights with likelihood of falls, working in extreme weather such as hot and cold conditions, working in noisy, wet and dusty environments, lifting/pulling/pushing heavy materials, long working hours, pressure from supervisors and colleagues, pressure from government regulators, etc.

6.1 Alternative Choices (Solutions) to Dilemmas and Complexities

Solutions to dilemmas include wearing protective clothing and ensuring their availability and use by other employees, exercising regularly to maintain physical fitness, exercising proper work ergonomics, participating in workplace safety sensitisation and awareness meetings/training sessions, adhering to company's safety and standard operating procedures at all times, consulting extensively within and outside one's department/team on construction safety issues, planning and prioritising work, etc.

7. WORKING CONDITIONS/ENVIRONMENT

Working conditions include indoor and outdoor construction sites as well as workshops and factories, may also work in commercial buildings or private homes, confined spaces, handling machines with moving parts, working at heights, working in conditions that may be dirty and noisy, exposure to seasonal heat and cold or adverse weather conditions, emergency callouts, standing or squatting for long hours and lifting relatively heavy objects. In most cases, the job involves working normal hours, but in some instances, shift work and regular overtime may be required. The job also requires wearing suitable protective clothing such as works suits, ear protectors, safety visors or goggles, gloves and hardhats, safety harnesses etc.

8. PARTIES INVOLVED/INTERACTING WITH THE JOB HOLDER OR TRAINEE

8.1 Internal/Within the Organization

Parties involved/interacting with the job holder who are internal to the organization include supervisors/superiors, trainers, occupational health and safety team, other colleagues, etc.

8.2 External/Outside the Organization

Parties involved/interacting with the job holder who are external to the organization include government regulators, trainers, clients, suppliers of equipment/ tools/ consumables, fellow Machine Operators from other companies, labour unions/ occupational health and safety associations, etc.

9. PHYSICAL DEMANDS ON THE BODY

The physical demands on the body include:

- strenuous conditions such as climbing heights, walking, sitting, and standing for long periods of time;
- bending, stretching, twisting, or reaching out;
- lifting, carrying, pushing, and pulling heavy objects;
- using fingers, hands, and feet with ease to complete the assigned task (dexterity); and
- strenuous works that may cause musculoskeletal disorders.

ANNEX A

Criteria for Assessments based on this NOS

A.1 Guidelines for Assessment

A.1.1 Criteria for assessment for curricula and learning programmes based on this NOS will be created by curricula and programmes developers. Each Performance Criteria (PC) will be assigned marks proportional to its importance in the NOS. Curricula and programmes developers will also lay down proportion of marks for theory and practical skills for each performance criteria, giving more weight to practical skills.

There shall be allocated the 'Total Mark', which will be the sum of all marks in each Unit, distributed across the number of PCs in that particular Unit. The 'out of' mark will be the mark allocated to each PC, which will be shared between theory and skills practical assessments.

A.1.2 Individual awarding/assessment bodies or institutions and other users of the NOS will create unique question papers for the theory part and evaluations for skill practical part for their respective candidates.

ANNEX B NOS Version Control

This Annex gives details necessary for the tracking of the NOS versions based on the number of revisions.

NOS Code	NOS.MO.01		
ZQF Level	4	Version Number	01
Sector	Construction	Date of Approval	December 2023
Sub Sector	Real Estate and Infrastructure Construction	Date of Last Review	N/A
Occupation	Machine Operator	Date of Next Review	December 2028