UNITED REPUBLIC OF TANZANIA
MINISTRY OF ENERGY

ENERGY AND WATER UTILITIES REGULATORY AUTHORITY (EWURA)

GUIDELINES FOR WATER METER SELECTION, INSTALLATION, TESTING AND MAINTENANCE FOR WATER SUPPLY AND SANITATION AUTHORITIES

AUGUST 2021

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ABBREVIATIONS AND ACRONYMS

BPTs	Break Pressure Tanks
DMA	District Metered Area
EWURA	Energy and Water Utilities Regulatory Authority
GPS	Global Positioning System
ISO	International Organization for Standardization
MPE	Maximum Permissible Error
NRW	Non-Revenue Water
OIML	International Organization of Legal Metrology
Q	Discharge
R.E	Revised Edition
TBS	Tanzania Bureau of Standards
UFM	Utrasonic Flow Meter
WMA	Weight and Measures Agency
WSSA	Water Supply and Sanitation Authority

MEASUREMENTS UNITS AND SYMBOLS

%	Percent
mm	Millimetre
m^3	Cubic Meter
m^3/day	Cubic Meter per Day
NTU	Nephelometric Turbidity Unit

FOREWORD

As part of the performance review of water utilities conducted annually by EWURA, it has been revealed that WSSAs are facing a number of challenges related to water meter management. The challenges include, among other things, the inefficiency of water meters in measuring the right volume of water passing through. Meter inefficiencies can cause either over registration of water consumption hence over billing the customers or under registration of water consumption, leading to loss of revenue to the water utilities. It was further revealed that WSSAs use different water meter technologies and suppliers. Furthermore, WSSAs use different or lack prescribed criteria for selection of water meters and apply different practices in installation, testing and maintenance of water meters.

In this respect, these Guidelines for Water Meter Selection, Installation, Testing and Maintenance for Water Supply and Sanitation Authorities, have been prepared to guide water utilities on appropriate approaches and tools for managing water meters. The guidelines prescribe key components of water meter management which include proper selection, installation, testing and maintenance of water meters. Additionally, it provides four tools/templates, namely, Technical Specifications of Water Meters, Standard Drawing for Installation of Water Meter, Template for Pre-reverification Report of Water Meter, a Template for Water Meter Inspection Checklist, and Guidelines for Developing a Water Meter Policy.

It is my sincere expectation that WSSAs will adhere to these guidelines to ensure proper management of water meters and thereby improve billing efficiency.

EWURA wishes to acknowledge views and contributions provided by various stakeholders for their contributions in developing these Guidelines. I wish to convey special thanks to the Ministry of Water, Water Supply and Sanitation Authorities (WSSAs), Tanzania Bureau of Standards (TBS) and the Weights and Measures Agency (WMA), who fully participated in preparing these Guidelines.

Eng. Godfrey H. Chibulunje
Acting Director General
June 2021

1. INTRODUCTION

1.1. Background

The Energy and Water Utilities Regulatory Authority (EWURA) is a multi-sectoral regulatory authority established by the EWURA Act Cap 414 of the laws of Tanzania. EWURA is responsible for technical and economic regulation of the energy and water sectors in Tanzania under Cap 414 and pursuant to sector legislation. In the water sector, Water Supply and Sanitation Authorities (WSSAs) are responsible for provision of water supply and sanitation services.

Section 29 of the Water Supply and Sanitation Act 2019 mandate EWURA, among other things, to monitor the performance and quality of service standards of water authorities. Also, EWURA Act Cap 414 requires EWURA to promote technical and economic efficiency in the provision of water services.

The National Water Policy 2002 provides a directive for water service providers in Tanzania to ensure universal metering in their water supply system as one of the mechanisms to achieve full cost recovery, water demand management and implementing principles of equity. Also, Section 21 of the Water Supply and Sanitation Act of 2019 requires Water Supply and Sanitation Authorities (WSSA) to meter all production points and customer connections to measure the amount of water produced and supplied to all consumers.

Over the past twelve (12) years, EWURA has been conducting Annual Performance Reviews of the Water Supply and Sanitation Authorities (WSSAs). As part of these reviews, it was revealed that WSSAs were facing a number of challenges related to water meter management. The challenges include, among other things, the inefficiency of water meters in measuring the right volume of water passing through. Meter inefficiencies can cause either over-registration of water consumption, hence overbilling the customers, or under-registration of water consumption, leading to loss of revenue to the water utilities in terms of apparent water losses. It was further revealed that WSSAs use different water meter technologies and suppliers. Furthermore, WSSAs use different or lack prescribed criteria for the selection of water meters and apply different practices in installation, testing and maintenance of water meters.

These guidelines provide water utilities with a harmonised framework to guide WSSAs in the proper selection, installation, testing and maintenance of water meters. It is expected that application of these guidelines will provide WSSAs with tools for proper management of water meters, and consequently address the challenge of apparent (commercial) water losses caused by meter inaccuracies and customer complaints related to water meters. These Guidelines may be reviewed at any time when the review is deemed necessary.

1.2. Objective

The purpose of these Guidelines is to provide WSSAs with harmonised procedures and practices for proper selection, installation, testing and maintenance of water meters.

1.3. Scope

These Guidelines highlight key technical requirements and tools that water utilities will use to properly manage water meters. The Guidelines, therefore, describe fundamentals that will be used by WSSAs for:

i. Appropriate selection of water meters that suit the operating conditions of WSSAs' service areas;
ii. Proper installation of water meters; and
iii. Developing and implementing programmes and procedures for testing and maintenance of water meters.

1.4. Structure of the Guidelines

The Guidelines consists of seven (7) Sections, including this introductory section. Section 2 provides an overview of the legal framework for the management of water meters where the institutions providing policy guidance, regulatory oversight and roles in water meters management are outlined. Section 3 defines aspects of water metering and types of meters; describes key criteria to be considered by WSSAs when selecting water meters, and presents key technical specifications to be used by WSSAs in procuring water meters. Section 4 provides general and specific guidance that will be used by WSSAs for proper installation and protection of water meters. Section 5 guides WSSAs on the categories and the required procedures for testing of water meters. Section 6 guides WSSAs for proper maintenance of water meters by keeping a database of water meters as part of the utility asset register, meter inspection checklist and programme, and a range of facilities that will be used by WSSAs for water meters maintenance. Lastly, Section 7 presents the general Guidelines for WSSAs to monitor and evaluate water meter management programmes.

2. LEGAL FRAMEWORK FOR MANAGEMENT OF WATER METERS

2.1. Overview of National Policy and Legislations

These Guidelines will be successfully implemented if the supporting policy and legal instruments are well known to all stakeholders involved in water meters management. This section presents a highlight of key policies and legislations to be noted and complied by WSSAs in the course of implementing the Guidelines.

2.1.1. National Water Policy 2002

The National Water Policy 2002 provides a directive for water service providers in Tanzania to ensure universal metering in their water supply system as one of the mechanisms to achieve full cost recovery, water demand management and implementing principles of equity.

2.1.2. Water Supply and Sanitation Act, 2019

Section 21 (c) of the Water Supply and Sanitation Act of 2019 requires WSSAs to install water meters for the purpose of measuring the amount of water supplied to a consumer. Also, Section 29(1)(b) and (f) of the Act requires EWURA to establish standards relating to equipment attached to the water and sanitation systems; and initiate and conduct investigations in relation to the quality of water and standards of service given to consumers.

2.1.3. Water Supply Regulations, 2019

Regulation 46 of the Water Supply Regulations (2019) requires the WSSAs to install and maintain water meters in proper repair and good working order. Also, Regulation 47 emphasises that every meter shall be placed in such a position as an authorised officer may determine in consultation with the owner of the premise and as close as possible to the outside boundary of the premise. Further, every meter shall be placed in a position that is easier for inspection by an authorised officer, who shall be entitled to have free access thereto or any purpose provided for in the Act or under the Regulations. Furthermore, Regulations 48-52 provide directives and requirements concerning inaccurate meters, charges in case of inaccurate meters, inspection and removal of meters, testing of meters and tampering of meters.

2.1.4. Water Supply and Sanitation Services (Licensing and Quality of Service) Rules 2020

Rules 40-47 of the Water Supply and Sanitation Services (Licensing and Quality of Service) Rules of 2020 stipulates directives and requirements which have to be complied with by WSSAs and customers with regard to water metering. The requirements include pre-installation testing and calibration of meters, meter reading, meter testing equipment, meter inspection and testing, meter seal, meter accuracy verification and removal of meters from customers. Further, the second schedule of the Rules provides for quality of services targets to be attained by WSSAs with regard to repair or replacement of water meters and meter reading. Furthermore, the fourth schedule of the Rules provides more details regarding water meter installation, verification, location of water meters and a standard drawing for water meter connection.

2.1.5. The Standards Act 2009

Tanzania Bureau of Standards (TBS) is the statutory National standards body for Tanzania established under the Standards Act No. 2 of 2009. TBS is a sole National Institution mandated to formulate, promulgate and implement National Standards. Regarding water meters, TBS has published National Standards registered as TZS 782 (1-5) as described below:

i. TZS 782– 1: Water Meters for Cold Potable Water and Hot Water — Part 1: Metrological and technical requirements.
ii. TZS 782– 2: Water Meters for Cold Potable Water and Hot Water — Part 2: Test Method.
iii. TZS 782– 3: Water meters for Cold Potable Water and Hot Water — Part 3: Test Report Format.
iv. TZS 782– 4: Water Meters for Cold Potable Water and Hot Water — Part 4: Non-Metrological Requirement not covered in TZS 782-1.
v. TZS 782– 5: Water Meters for Cold Potable Water and Hot Water — Part 5: Installation Requirements.

The above-outlined standards are compulsory standards and a mandatory requirement for all water services providers and other stakeholders, including manufacturers and suppliers of water meters.

2.1.6. Weights and Measures Act, Cap 340

The Weights and Measures Agency (WMA), established under the Executive Agency Establishment Order No. 194 of 17th May 2002, is a governmental executive agency charged with the responsibility of ensuring that all measurements involved in trade transactions are accurate, fair and just and remain to be so throughout their use. WMA performs its functions in pursuance of the Weights and Measures Act Cap.340 (R.E. 2002) together with its cognate Regulations. The Act obligates the WMA, among others, to:

i. Control the use of measuring instruments in public and private transactions;
ii. Give effect to the decisions and recommendations of the International Organization of Legal Metrology (OIML) Council and Committee with regard to Legal Metrology; and
iii. Ensure that Legal Metrology standards are traceable to national and international measurement standards.

2.1.7. Weights and Measures (Metrological Control of Water Meters) Regulations, 2014

The Weights and Measures (Metrological Control of Water Meters) Regulations, 2014 stipulates the responsibility of suppliers of water meters and water service providers; metrological requirements for water meters; verification requirements and procedures for water meters; internal control of water meters; reverification and testing laboratories; and supervision and market surveillance with regard to control of water meters. Compliance with these Regulations is compulsory for all water services providers and other stakeholders, including manufacturers and suppliers of water meters.

2.2. International Standards

These Guidelines have considered international practices in water meter management. For the successful implementation of the Guidelines, the international standards should be complied with by all stakeholders involved in water meters.

2.2.1. International Organization for Standardization (ISO)

ISO has published the following standards on water meters: -

i. ISO 4064– 1: Water Meters for Cold Potable Water and Hot Water — Part 1: Metrological and technical requirements.
ii. ISO 4064– 2: Water Meters for Cold Potable Water and Hot Water — Part 2: Test Method.
iii. ISO 4064– 3: Water Meters for Cold Potable Water and Hot Water — Part 3: Test report format.
iv. ISO 4064– 4: Water Meters for Cold Potable Water and Hot Water — Part 4: Non-Metrological Requirement not covered in ISO 4064-1.
v. ISO 4064– 5: Water Meters for Cold Potable Water and Hot Water — Part 5: Installation Requirements.

These standards have been adopted as Tanzania National Standards for water meters registered as TZS 782 (1-5).

2.2.2. International Organization of Legal Metrology (OIML)

International Organization of Legal Metrology (OIML) is a worldwide intergovernmental organisation whose primary aim is to harmonise the regulation and metrological controls applied by the national metrological services or related organisations of its member state. One of the categories of OIML is international recommendations (OIML R) which are modal regulations that establish the metrological characteristics required of certain measuring instruments and which specify methods and equipment for checking their conformity.

OIML R 49 is a document prescribing the metrological recommendations for water meters intended for the metering of cold potable water and hot water as listed below.

i. OIML R 49-1- Metrological and technical requirements;
ii. OIML R 49-2- Test methods; and
iii. OIML R 49-3- Test report format.

These recommendations (OIML R 49) have been adopted in Tanzania under the Weights and Measures (Metrological Control of Water Meters) Regulations, 2014.

3. WATER METERS SELECTION

3.1. Introduction to water meters

3.1.1. Definition

According to TZS 782-1, a water meter is defined as an instrument intended to measure continuously, memorise, and display the volume of water passing through the measurement transducer at metering conditions. For water utilities, water meters are used to measure:

- the amount of raw water that is abstracted from sources,
- how much of this water leaves the water treatment plant,
- how much is purchased from bulk suppliers or sold to other water utilities,
- how much water is distributed within the water distribution system, and
- how much of the water is delivered to individual consumers.

3.1.2. Types of Water Meters

There are several approaches for the classification of water meters that are typically based on flow measurements mechanism, mode of end-use operations or accuracy requirements. In these Guidelines, water meters have been classified into three types based on flow measurement mechanism, namely mechanical, electromagnetic and ultrasonic water meters.

Mechanical meters are categorised into volumetric, inferential and combination meters. Volumetric meters directly measure the volume of flow passing through them. Inferential meters do not measure the volume of water passing through them directly but infer the volumetric flow rate from the velocity of the water. Combination meters do not use a unique mechanism to measure the flow but are made up of two meters of different diameters that are combined to measure a particularly wide range of flow.

Types of meters are shown in Figure 1, and the description of their application is summarised in Table 1.

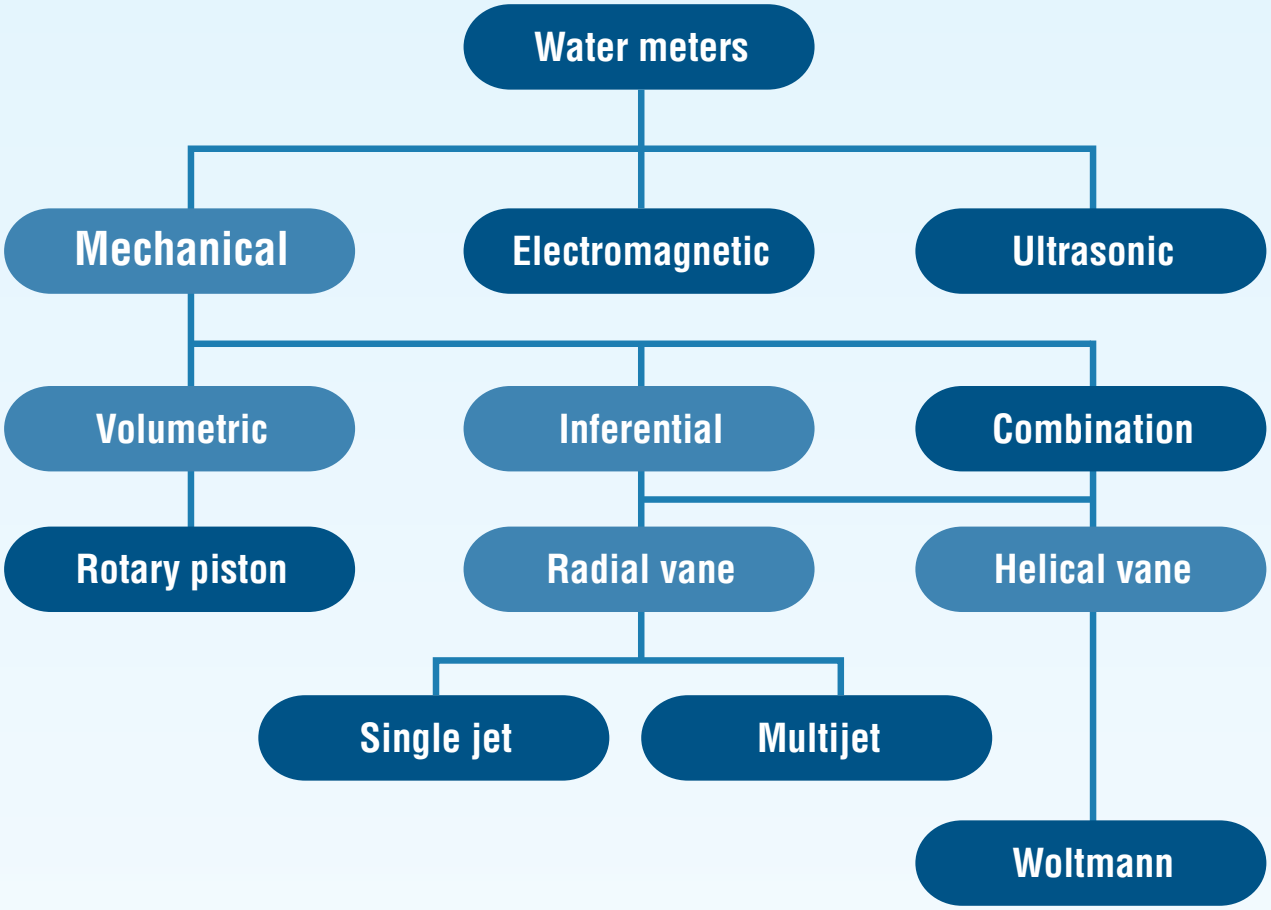

Figure 1: Classification of Common Water Meters
(Source: Van Zyl, J. E. 2011)

Table 1: Meter Types, Description and Field of Application

S/N	METER TYPE			DESCRIPTION	APPLICABILITY
1	Mechanical	Volumetric	Rotary piston/ nutating disc	Positive displacement meters that use a rotating cylindrical piston/nutating disc to measure 'packets' of water moving from the inlet to the outlet of the meter.	Applicable for residential and small commercial properties. Should only be installed in systems with very good water quality (turbidity less than 5NTU), and they should always be provided with built-in strainers.
		Inferential	Single jet	Operating principles are based on the tangential incidence of a single jet over a radial-vaned impeller placed inside the body of the meter. Available in form of a dry dial or wet dial.	Applicable for small flow rates (diameters typically range from 15 to 50 mm). Adequate for hard water with suspended particles. According to TBS standards (TZ 789:2018-EAS 12:2018), the maximum persmisible limits for Total Hardness of treated water 300mg/ lasCaCO$_3$
			Multijet	The water impacts the impeller at multiple points around its perimeter instead of doing it at a single point. Available in form of a dry dial or wet dial.	Applicable for small and medium flow rates (diameters typically range from 15 to 150 mm). Adequate for hard water with suspended particles. Mainly used for domestic applications, and are normally more cost-effective than single jet meters in diameters larger than 20 mm. The accuracy of multijet meters is not affected much by changes in the velocity profile.
			Woltman	Is an inferential meter that uses an impeller with helical vanes/ turbines.	Mainly used to measure the consumption of bulk users, or to determine the flow pattern in water distribution systems eg. at District metered Areas (DMAs). Applicable for medium and large flow rates (diameters typically range from 50 to 800mm).

S/N	METER TYPE			DESCRIPTION	APPLICABILITY
		Combination		Combination meters are not a separate class of meters, but rather a combination of two different classes, in such a way that they act as a single meter. The meters that make up the combination meter consist of a large meter, called the bulk or main meter, and a small meter, called the bypass meter. The main meter is typically a multijet or Woltmann meter, and the bypass meter is a rotary piston, single jet or multijet.	Combination meters are normally used for consumers that have a large range of flows, such as housing complexes, hospitals and schools.
2	Electromagnetic			Measures the flow rate of water by its electromagnetic properties instead of measuring it mechanically. The installation configuration should be such, that the transmission main is filled with water at all times (e.g. through installed non-return valves)	Since no moving parts are incorporated, wastewater and water even with a high amount of suspended particles can be metered accurately. More sensitive to low flows. Its usual diameter ranges from 2 to 1,800mm
3	Ultrasonic			Use sound waves to determine the velocity of a fluid flowing in a pipe. UFMs are typically supplied with a transducer that can be used in a range from 75 to 1,800 mm. By procuring a second transducer (smaller), the UFM can be used in a range of 15 to 75 mm	These meters are commonly used in large diameter pipes. Since no moving parts are incorporated, wastewater and water with larger concentrations of suspended particles can be metered accurately. UFMs are mainly used for the measurement of bulk flows (diameters typically range from 15 to 1,800 mm) and are commonly used as 'clamp-on meters to calibrate large-diameter velocity meters.

3.1.3. Classes of Water Meters

Water meters are further classified in terms of their performance in measuring the volume of water passing through them. There are old systems (conventional) and new standards of water meter classifications. Based on the conventional system, ISO 4064:2005 and OIML R49:2003 classified water meters into four classes: A, B, C and D. Each one sets a range of flow rates within which the meter must maintain its accuracy. Where A is the narrowest, D is the widest. Each meter can be considered perfect in the range of flow rates for which it has been designed. The new standards for the classification of water meters, ISO 4064:2014 and OIML R49:2013 adopted a new system based on the Reynard series. The precision class of a water meter, R, is determined by the ratio between its permanent flow (Q3) and its minimum flow rate (Q1). The relationship between the previous class A, B, C, and D is as depicted in Table 2.

Table 2: Classes of Water Meters

Conventional Classification	New Classification	Description
Class A&B	R160	Applicability: narrow range of flow rates (e.g. irrigation)
Class C	R200	Most popular since it can cover conventional flow rate ranges
Class D	R250	Applicability: wide range of flow rates

Further, meters can be classified according to their meter accuracy in terms of maximum and minimum permissible errors, as summarised in Table 3. The maximum permissible error is ±5% in the lower zone and ±2% in the higher zone.

Table 3: Meter Accuracy Classes defined by OIML R49

Accuracy Class	Applicable to	Max permissible error	
		Lower Zone	Higher Zone
1	Only meters with Qp >100 m^3/h	±3%	±1%
2	All meters with Qp < 100 m^3/h May be applied to meters with Qp > 100 m^3/h	±5%	±2%

Furthermore, working conditions of water meter meters which includes working pressure flows, temperature and accuracy can quickly indicate a range of water meter classes that suit the WSSA's water system. Table 4 presents selected working conditions for different water meter classes.

Table 4: Water meter classes with regard to working conditions

Conventional Classification	New Classification	DN (mm)	Minimum Flow (lph)	Maximum Flow (m3/hr)	Norminal Flow (Qn) (m3/hr)	Max-Pressure (Bar)	Temp (°C)	Accuracy Lower Zone	Accuracy Upeer Zone
A	R160	15	60	3	1.5	16	0-50	±5%	±2%
		20	100	5	2.5	16	0-50	±5%	±2%
		25	140	7	3.5	16	0-50	±5%	±2%
B		15	30	3	1.5	16	0-50	±5%	±2%
		20	50	5	2.5	16	0-50	±5%	±2%
		25	70	7	3.5	16	0-50	±5%	±2%
C	R200	15	15	3	1.5	16	0-50	±5%	±2%
		20	25	5	2.5	16	0-50	±5%	±2%
		25	35	7	3.5	16	0-50	±5%	±2%
D	R250	15	11.25	3	1.5	16	0-50	±5%	±2%
		20	18.75	5	2.5	16	0-50	±5%	±2%
		25	26.25	7	3.5	16	0-50	±5%	±2%

Water Utilities are required to use Class C and D water meters in their system to reduce commercial water losses.

3.1.4. Mode of Operation of Water Meters

The above types of water meters can be sub-categorised in terms of their mode of operation: postpaid (conventional meters), prepaid or smart water meters.

3.1.4.1. Postpaid Water Meters

Postpaid water meters are water meters whose operation is based on the principle that a customer pays for the water consumed based on meter readings collected by service providers in a specified period (usually on monthly basis).

3.1.4.2. Prepaid meters

Prepaid meters are water meters with built-in electronic processing units and a mechanism that can automatically close a valve to shut off a consumer's supply. Consumers purchase water in advance, and the amount purchased is transferred through a token or electronic signal to the meter. The prepaid meters are usually/ managed by software.

3.1.4.3. Smart Water Meters

Smart water meter (or digital water meter) is essentially a conventional water meter linked to an electronic data logging device that collects data from the meter at regular intervals and fixes it back to the service provider, where both the customer and service provider can access the information. Depending on the level of technology, smart water meters provide a range of user-friendly demand management services, including the possibility of a customer to remotely purchase and load tokens for purchasing water, real-time monitoring of consumption patterns and detecting abnormal trends/incidences such as leaks and meter tampering.

3.2. Criteria for Selection of Water Meters

This section describes the important steps a water utility has to follow while selecting a water meter suitable to the operating conditions of the respective utility's network. There are hundreds of water meters models in the market with a wide range of options in terms of technology, applications, manufacturers and capabilities. It is therefore important for water utilities to establish and fully understand their specific requirements and goals before selecting water meters.
According to TZS 782-5, the following general consideration needs to be observed in the selection of water meters:

i. The available water supply pressure;
ii. The physical and chemical characteristics of the water, including water temperature and water quality (suspended particles);
iii. The acceptable pressure loss across the meter;
iv. The expected flow rates: the flow rates Q_1 and Q_3 of the meter shall be compatible with the expected flow rate conditions of the installations, including the water flow direction(s). Q_1 is the lowest flow rate at which the meter is to operate within the maximum permissible errors, and Q_3 is the highest flow rate within the rated operating conditions at which the meter is to operate within the maximum permissible errors;
v. The suitability of the meter type for the intended mechanical, climatic, electrical, and hydraulic conditions, including ambient relative humidity, vibrations, electrostatic discharges, continuous magnetic field, and electromagnetic disturbances;
vi. The available space and pipework to install the meter and fittings;

vii. The possibility of deposition of substances from solution within the meter; and
viii. The sustainability of the power supply of the water meter (where applicable).

The following sections provide more details on the specific criteria for the selection of water meters. The specific criteria include water quality, flow rate, water pressure, meter sizing, meter type, meter class and other important technical and socio-economic considerations.

3.2.1. Water Quality

The accuracy of the meter in measuring water passing through it is significantly affected by the quality of water characterised by solid particles that may be suspended in or moving with the water. Water with suspended particles may result in depositions occurring in the water meter. Also, depositions may result from the chemical composition of the supplied water. Depositions from the suspended particles or chemical water composition can grow to the extent of preventing the water meter impeller from rotating temporarily or permanently, causing under-registration of water passing through the meter. Depositions also may cause over registration at medium to high flows and under registration at low flows. Particles may enter the system if the water treatment plant is not operating efficiently and during repair work on the system. Also, it may enter the system through leak openings when there is intermittent supply, the presence of washouts (in case lines are flushed following repairs), the height of water meter installation, the location in the network (end-of-pipe or not) and the pipe material/age/quality.

The water quality has to comply with the one specified for a meter to ensure the accuracy of water flow measurement. Water Utilities should therefore determine the quality of water before selecting water meters by taking samples and analysing the concentration of suspended particles and chemical composition of the water. The results will guide the utility in selecting appropriate water meters.

If the metered water has a high turbidity level or chemicals contents (e.g. Limescale, iron) potential for depositions, inferential water meters are recommended, as experience shows that volumetric water meters clog more easily. For highly turbid water, water meters with no moving parts (ultrasonic or electromagnetic technologies) are recommended.

3.2.2. Water Flow Rate

Water meters must be sized appropriately within the maximum flow and minimum flow that is intended to be measured. Water meters only accurately measure flow rates that fall within the minimum and peak flow rates specified by the meter manufacturer. Therefore, water utilities need to understand the water consumption pattern of customer's connections intended to be metered.

Each consumer has a certain water demand pattern that a meter will have to cater for, and it is recommended that the demand should not exceed the overload flow rate of the meter. Further, the meter should be able to register low water flows to minimise commercial losses due to under registration. Therefore, water utilities need to establish the average annual flow rate of the customer to be installed with a water meter. The flow rate can be estimated based on the water demand measured in the meter readings for existing connections or, in the case of new connections, the expected consumption. For domestic customers who generally use small quantities of water and follow typical consumption patterns, it is recommended to use empirical field studies to analyse entire groups of domestic customers, for example, those with or without tanks at different water supply levels, to determine their consumption patterns. For non-domestic customers, including industries, institutions and big commercial customers, a water utility should measure the individual varying flow rates using clamp-on ultrasonic flow meters to determine their consumption pattern.

Having established the flow rate for the intended consumers, a water utility can select the appropriate meter size and type. It is recommended that for lower flow rates, volumetric (rotating

piston) meters be used, as inferential water meters tend to be less accurate at lower flow rates. In the case of using an inferential water meter, a high-class meter should be used. If flow rates are not known, water meters with one standard diameter smaller than the supply pipe are recommended to be used.

3.2.3. Water Pressure

Water meter must be sized to ensure that the minimum and maximum pressure fall within the meter specifications. This will ensure that water meters are not subjected to pressures higher than the meter is rated to withstand. Water Utilities whose water supply systems include pumping lines or bulk pipelines with water hammer problems should take extra care in sizing their water meters to ensure that the water meters will not be subjected to pressures higher than its rating. When determining water pressure, it is important to note that pressure drop due to friction can occur when water passes through a water meter and strainers, and there can be a significant pressure drop when the strainers are blocked. Water pressure can also be affected by intermittent supply. In such a system, when restoration of water supply into the pipelines occurs, this may push air through the water meters (and leaks), leading to false meter readings (air makes the rotating parts turn much faster turning than water). Damage to the meter can also occur in this situation.

If the water utility's water supply system is characterised by low supply pressure, the respective water utility should use water meters with low-pressure losses or ensure regular maintenance of water meters. In distribution networks where the pressure is higher than 2 bar, pressure losses in the meter are not a restricting factor. Also, water meters must not have a pressure drop higher than 1 bar at the maximum flow and 0.25 bar at the nominal flow.

For water supply systems with intermittent supply, systems in which the intermittent supply cannot be avoided, water utilities are advised to use robust meter types, such as single jet or multijet meters.

3.2.4. Meter Sizing

Sizing of water meters requires selection of the diameter of the meter. The diameter depends mainly on the average water flow rate required by a customer. Water Utilities should avoid selecting a water meter whose size is too large because the flow rates might be lower than the minimum flow rate resulting in under-registration. Also, they should avoid selecting a water meter size that is too small as it can accelerate the degradation of the meter reading accuracy due to excessive pressure loss and reduced flow. Excessive pressure can shorten the life span of the meter through the tear and wear if operated frequently at or above its allowable maximum flow.

WSSAs are advised to select a water meter whose permanent flow rate is equivalent to the average water flow rate required by a customer. The average water flow rate should consider the existing minimum and maximum flow rate in the system.

It is recommended that the sizing of water meters should follow the below guidance:

i. For domestic consumers in a turbid water supply system, select a water meter with the same size diameter as the pipe diameter where the meter will be installed.
ii. For less turbid (less than 5NTU) water supply, select water meters with diameters typically one size smaller than their end connections for improving water meter reading efficiency.
iii. For larger customers, the diameter of water meters should be sized to coincide with the consumption level at a given pressure and demand (m^3).

Table 5 provides typical water meter sizing for water consumers based on the maximum and minimum flowrate of consumer's connections to be installed with a water meter.

Table 5: Typical Meter Sizing

S/No	DN/meter Size [mm]	Flow Range [l/min]	Application
1.	15	1-55	- Single-family house - Small business
2.	20	5-110	- Residence with garden and swimming pool - Flats with up to 6 units - Business with more than 10 employees - Churches - Small institution
3.	25	5 - 180	- Large residence with garden and swimming pool - Apartment building 6-15 units - Schools (up to 200 students) - Institution (up to 50 staff) - Churches with other activities (like schools, kindergarten, etc - Group of a commercial building (up to 10 units)
4.	38/40	10 - 380	- Apartment buildings (15 – 40 units - Schools (up to 400 students) - Hotels (up to 25 rooms) - Large petrol station with car wash - Food processing units - Shopping centres (up to 25 units) - Laundry's - Small hospitals (up to 100 beds) - Medical buildings and laboratories
5.	50	10 - 600	- Apartment building 40-120 units - Schools with irrigation/gardening (up to 1500 students) - Medium hospitals (100 – 250 beds) - Hotels (25 – to 50 beds) - Large petrol stations with car wash and workshop
6.	50	1- 600	- Schools with irrigation/gardening (up to 2500 students) - Hospitals (100 to 250 beds) - Community centres - City hall (up to 50 staff) - Nursing homes
7.	75 - 100	40- 2000	- Housing complex or apartment building (like army barracks, refugee camps (up to 150 houses) - Large institutions (like Universities) - Industrial plants - Processing plants - Larger hospitals (more than 250 beds) - Large shopping centres - High rise buildings (over 8 floors) - Buildings with fire equipment

3.2.5. Meter Type and Class

After consideration of the major selection criteria (water quality, flow rate, water pressure and meter size), a water utility will select the appropriate meter type and class. Description of meter types and classes is provided in Sections 3.1.2 and 3.1.3.

3.2.6. Other Considerations for Meter Selection

After determining the three characteristics of water flow including water pressure, flow rate and water quality, water utilities should consider other important criteria for meter selection which includes technical, economic, social and legal considerations as shown in Table 6.

Table 6: Other Considerations for Meter Selection

S/N	Consideration	Description
1.	Theft and vandalism	Social behaviours of the community should be taken when selecting appropriate water meters. For example, brass meters are often subject to theft. If plastic meters are to be installed instead must be installed in meter boxes to protect them from direct sunlight. WSSAs must take adequate measures during selection and installation to prevent theft and vandalism.
2.	Water meter installation	WSSAs must understand the environment and locations where water meters will be installed prior to selection. This must be done to ensure water meters are installed according to the manufacturer's specifications. This includes the length of straight pipe up and downstream, liners and orientation (horizontal or vertical).
3.	Meter maintenance and servicing	Water meters are instruments that need maintenance at certain intervals. The manufacturer's maintenance requirement must be considered in the selection process. Large water meter has higher maintenance requirement than small water meters. Servicing and maintenance should be done in on-site verification. Large meters (>DN 100) should have a bypass to guarantee continuous supply during servicing and maintenance. No water meter work forever without the need for servicing and maintenance.
4.	Meter reading	There are different meter reading methods. The selection of the water meter, as well as the installation position, must be suitable to facilitate easy and accurate reading by the meter reader.
5.	Water meters with dry or wet dial	Wet head water meters are completely filled with water. The cover must be closed at all times as they develop alga in the dial due to sunlight and become no longer readable.

S/N	Consideration	Description
6.	Materials	Water utilities must select a water meter constructed from material of adequate strength and durability. The material used shall not be adversely affected by water temperature variations within the working temperature range. The material should be known to be non-toxic, non-contaminating, and biologically inert. The material shall also be resistant to internal and external corrosion or which are protected by a suitable surface treatment.
7.	Electrical Supply	When selecting meters for remote locations consider whether they can run accurately on solar power, batteries or if they even need power at all. For example, electromagnetic and ultrasonic metres normally need a mains power supply. Some meters and related equipment operate with battery power (including prepaid metering systems), and in these cases, the working life and replacement possibilities of the batteries should be considered. Other related equipment, such as logging or communication equipment may also require an electricity supply.
8.	Price of water meters	The price of the water meters is an important factor. However, it is not the only one. The size and class of the water meter have a heavy influence on the cost. For instance, cheaper meters may have shorter service lives or larger apparent losses than more expensive meters. Thus the other cost considerations should be considered with the meter price. However, when meters are projected to give similar performance and other costs, the price of the meter will be the deciding factor.
9.	Water meter software management	For prepaid or smart water meters the water meter management software should provide specifications in the following functional areas: **System set-up and management:** Supports all system-related information and activities such as operators and tariff rates. **Registration:** Supports registration of meters. **Vend:** Generates credit tokens, searches meter's vending history. **Engineering:** Issues special engineering tokens for test and maintenance such as credit and does key changes for the meter. **Device:** Handles the secured module configuration and key file importation and view. **Battery life:** Indicate a reasonable design life span of a battery under normal usage (at least 5 years). **Reports:** Supports all types of reports including customer reports, vending reports and cash reports.

S/N	Consideration	Description
10.	Policy and Legal Requirements	WSSAs must ensure that all consumer water meters to be purchased comply with the applicable meter legislation and standards.
11.	Warranty	WSSAs should consider selecting water meters that have a reasonable period of warranty of not less than one year

3.3. Specifications of Water Meters

Water utilities are required to prepare specifications for the procurement of water meters in line with Tanzania Standards for water meters (TZS 782). The specifications should consider both technical and non-technical aspects of water meters and will be used by WSSAs to guide prospective suppliers of water meters. Also, WSSAs are hereby guided to submit copies of the specifications to the Weights and Measures Agency (WMA) so that WMA may use the same for verification of water meters before installation.

The specifications for procurement of water meters to be prepared by water utilities must contain the following information.

(a) Certificates

The specification must require the manufacturer of the meters to provide the specific manufacturer's authorisation for selling its product and the relevant certificate issued by the local Bureau of Standards and must hold the Quality System Certificate for the standard ISO 9001.

(b) Water Meter Selection Criteria

The technical specifications to be prepared must include all criteria established by WSSA for the water meter selection, such as meter type, class, size and construction material.

(c) Additional Requirements

Specifications should also include non-technical specifications such as spare parts/after-sales service. Therefore, the specifications should require the manufacture/supplier to:

(i) provide a complete list of available spare parts;
(ii) provide a minimum warranty period of two years;
(iii) guarantee the supply of spare parts for at least two years after the expiry of the warranty;
(iv) provide name, address, and contact details of the local agency responsible for providing spare parts and maintenance; and
(v) provide maintenance manuals (in English or Swahili language).

Further, the useful life of water meters may vary from different manufactures. Also, it may vary from one utility to another depending on the quality of water, environmental and operating conditions of a particular utility. The WSSAs are required to establish appropriate useful life of water meters and state the same in their asset management policy.

Table 7 summarises the minimum technical requirements that WSSAs should observe when issuing specifications for water meters. Further, a detailed template for specifications including the most relevant information is detailed in **Appendix 1.**

Table 7: Minimum Requirements for WSSAs' Water Meters

(i) Domestic Water Meters					
Description	**Meter Size**				
	15mm	**20mm**	**25mm**		
Overload Flowrate q_s ± 2% (m³/h)	3	5	7		
Permanent Flowrate q_p ± 2% (m³/h)	1.5	2.5	3.5		
Transitional Flowrate q_t ± 2% (l/h)	22.5	37.5	52.5		
Minimum Flowrate q_{min} ± 5% (l/h)	15	25	35		
Maximum Working Pressure (Bar)	10	16	16		
Body Length (mm)	114	165	198		
(ii) Bulk Water Meters					
Flow rates (m³/hr)	**Meter Size (mm)**				
	40	**50**	**80**	**100**	**150**
Overload flowrate (Q_s)	70	80	126	200	200
Permanent flowrate (Q_p)	35	40	63	100	100
Transitional flowrate (Q_t)	0.08	0.08	0.08	0.2	0.2
Minimum flowrate (Q_{min})	0.04	0.05	0.05	0.13	0.13
(iii) Prepaid Water Meters					
The above specifications are also applicable for prepaid water meters. Further, other considerations for water meter selection provided in Table 6 (item 9) need to be observed.					

4. WATER METERS INSTALLATION

Proper installation of water meters is critical since it will affect the meter's performance and service life. Improper meter installation may cause either under-registration of water consumption resulting in commercial losses to a water utility or over-registration, resulting in complaints from customers on unrealistic water bills. Hence, installation of water meters should be done in accordance with the manufacturer's specifications, good practice and relevant legislation, manuals and guidelines.

The Tanzania Standards TZS 782-Part 5, the Water Supply Regulations 2019 and Water Supply and Sanitation (Licencing and Quality of Service) Rules, 2020 specify requirements for installation of water meters. In order to comply with the Standards, Regulations and Rules, among other things, the following requirements need to be observed by water utilities during the installation of water meters:

(a) Meter Test and Seal

(i) Ensure that the meter has been tested and sealed by WMA before installation.

(b) Meter Installation Location

(i) Identify the location of the meter in consultation with the customer/owner of the premises. The location shall be as close as possible to the boundary of the premises; and

(ii) Install a water meter and its associated fittings in an accessible location – for reading, installation and maintenance.

(c) Meter Orientation and Fittings

(i) Install a water meter in the correct orientation of the pipe (horizontal or vertical as specified by the manufacturer);

(ii) Install a water meter in the right direction of flow as marked in the water meter. An arrow on the meter housing indicates the correct flow direction;

(iii) Provide a straight pipe length equivalent to 10 times the diameter of the meter upstream of the meter and 5 times the diameter of the meter downstream to the meter. The straight sections of pipe should be installed directly to the meter, and no reducers, valves or anything else should be installed between the meter and the straight pipe sections. Observe meter installation requirements provided in TBS Standards (TZS 782– 5: Water Meters for Cold Potable Water and Hot Water — Part 5: Installation Requirements). Also, observe the standard drawing provided in Appendix 5 of these Guidelines;

(iv) Install a separate strainer upstream of a meter (for meters that requires such an installation). The strainer should be accessible to facilitate cleaning or replacement; and

(v) Install an upstream air release valve if there is a risk of air entering the meter.

(d) Meter protection

(i) Protect the meter from the risk of damage by shock, vibration, corrosion, temperature of the water or ambient air or unfavourable hydraulic conditions such as cavitation, surging and water hammer;

(ii) Install the water meter in a manner that avoids contamination of water and flooding;

(iii) If necessary, mount the meter on a plinth or bracket so as to protect from undue stresses caused by pipes and fittings; and

(iv) Adequately anchor water pipelines and associated fittings to ensure that no part of the installation can be displaced under water thrust when the meter is dismantled or disconnected on one side.

5. WATER METERS TESTING

According to Weights and Measures (Metrological Control of Water Meters) Regulations of 2014, water meters should be subjected to three types of tests at different times namely pattern approval, verification and reverification tests. The tests are to be conducted by WMA in accordance with relevant standards and procedures. The three types of meter tests are as summarised below:

5.1. Pattern Approval

This is a method where a recognised laboratory tests an instrument against a set of recognised and published standards to determine the measurement accuracy of the instrument. The laboratory is able to determine whether the instrument retains this accuracy under a range of environmental operating conditions and further ensures that it meets the expected instrument performance. Before undergoing pattern evaluation test, each pattern of a water meter submitted shall be examined externally to ensure that it complies with the provisions of the relevant preceding clauses of the recommendation OIML R 49-1. Thus, the evaluation test shall be made on the minimum number of samples for each pattern as a function of the water meter designation permanent flowrate (Q3)

of the pattern presented. The pattern approval test is conducted by the WMA upon the request by a supplier/ manufacturer prior to the supply of the water meters to WSSAs. A certificate of pattern approval is issued by WMA upon passing the pattern approval test.

5.2. Verification of Water Meters

Verification test of water meter means the examination and testing of a water meter to determine its fitness for use in trade. Once a meter has passed the fitness test, it is sealed by WMA, and a certificate of correctness is issued. According to Regulation 5(1) of the Weights and Measures (Metrological Control of Water Meters) Regulations of 2014, a water utility shall not install water meters which have not been verified by WMA. Further, the Regulations require that the verification test shall be done to the entire consignment of water meters by considering, among other things, the permanent flowrate(Q_3) of the water meter, maximum admissible pressure, maximum admissible temperature, size of the meter, seal provision, accuracy class, serial number of the meter and flow direction.

5.3. Reverification of Water Meters

Reverification testing of water meter means the examination and testing carried out to a water meter in use or has already undergone verification, but its validity has expired, to determine its fitness for use in trade. The reverification test is conducted by WMA. Once a meter has passed the reverification test, it is sealed by WMA and a certificate of correctness is issued. Regulation 13(1) of the Weights and Measures (Metrological Control of Water Meters) Regulations of 2014, specifies the initial period and subsequent reverification of water meters which should be complied to by WSSAs.

However, WSSAs may conduct pre-reverification tests for their water meters reported in a format shown in Appendix 2. Pre-reverification means a WSSA, using a mobile meter testing kit or test bench/laboratory, examine and test a water meter in use and preliminarily assess its fitness for use and accuracy requirements. Once a utility has determined that the meter is fit for use, or has conducted repair of the same, it is obliged to submit the meter to WMA for reverification, which includes sealing and certification before the meter is reinstalled.

6. MAINTENANCE OF WATER METERS

Water meters performance tend to deteriorate over time, resulting in inaccurate readings. Furthermore, meters may be clogged, tampered or damaged. To ensure meter accuracy, WSSAs should establish and maintain a meter maintenance schedule. Maintenance of meters includes cleaning, testing, calibration and if required, replacement of meters.

6.1. Water Meter Database

A meter registry provides complete information on each meter. It is recommended to establish a meter registry within the billing system. This in turn can be integrated into or linked with a Geographical Information System (GIS) for spatial analysis purposes. Billing software is generally more robust and less sensitive to manipulation. A simplified option is the establishment of the meter registry in a separate flat file, e.g. an MS Excel file.

It is recommended that the meter attributes include the following elements:

i. GPS coordinates;
ii. Administrative zone/DMA code;
iii. Account number;
iv. Closest installed meter for a more efficient water meter reading route;
v. Serial number;
vi. Brand;
vii. Length of the meter (in mm);
viii. Meter Type;
ix. Meter Diameter;
x. Functional principle: dry or wet;
xi. Metrological class;
xii. Meter material: brass, composite;
xiii. Manufacturing date;
xiv. Meter chamber: none; locked good condition; unlocked good condition; damaged;
xv. Installation location: plot boundary; inside plot; inside the building;
xvi. Installation mode: horizontal above ground; horizontal underground; vertical;
xvii. First installation date (can be used to establish the age of the meter in combination with the manufacturing data (which may not be known);
xviii. Previous servicing date: (can be used to estimate the age of the meter (or when it was last tested/serviced/calibrated) if the first installation date is unknown);
xix. Operational status: functional; non-functional; damaged (but functional); testing request;
xx. Seal status: (original WMA) seal in-tact; (original WMA) seal broken; no seal;
xxi. Visibility: visible (above ground); partially underground; invisible (underground);
xxii. Visible defects; and
xxiii. Remarks

It is recommended to establish the meter registry as part of a door-to-door survey, which serves additionally to identify illegal connections and validate consumer data. An applicable template is found in **Appendix 3** ***(Template for Water Meter Inspection Checklist).***

Meter data should be entered into the system at the time the meter is purchased or first installed or whenever any testing or repair work is performed on the meter. These data can be entered directly into the system by the person receiving or repairing/testing the meter. Nevertheless, it is recommended to choose one person responsible for updating the database for water meters. Furthermore, meter data should be regularly analysed by a data analyst being part of the water meter management team.

6.2. Water Meter Management Team

WSSAs are required to establish a water meter management team. The team should consist of a minimum of three (3) people and can be higher depending on the size of the WSSA in terms of the number of water connections. This team will manage all required activities addressing all aspects of meter management such as meter selection/sizing, installation, maintenance and replacement. It is recommended that the water meter management team be part of the Non-Revenue Water (NRW) reduction Team or section, as the case may be. Depending on the size of the WSSA, it is recommended that the meter management team consist of: -

i. **Supervisors:** responsible for customising this Guideline to the WSSA -specific context and overseeing the implementation of a meter policy.

ii. **Meter testing specialists:** a staff member who has been trained in using portable meter testing equipment for in-situ testing of small and large diameter meters. In the case of a larger WSSA, this person would implement or coordinate the meter testing/servicing/calibration activities (with a meter test bench) in an established meter workshop.

iii. **Meter installation/servicing technicians**: one or more (subject to the number of meters) staff members responsible for new installations, (regular) meter servicing and replacement.
iv. **Data analysts:** a staff member who monitors the meter performance trends (i.e. monthly static meters), analyses the attributes of replaced (faulty) meters and refines the meter management (including replacement) policy in consultation with the supervisor.

WSSAs should conduct a training needs assessment for the meter management team and incorporate it in their business plan as part of a capacity development plan. Areas of training may include meter management, data analysis and meter calibration. Regular training can be offered by vocational training institutions to keep abreast with technological advancements. Also, manufacturers of water meters and testing equipment can offer specialised/customised training courses. Further, training can be provided in-house or through field attachments/study visits to other WSSAs or twinning programmes with other water utilities.

6.3. Maintenance Schedule for Water Meters

The duration within which water meters can retain their accuracy standards depends on many factors, including water quality, flow rate, and meter registered volume readings. WSSAs are required to establish and implement a detailed meter maintenance schedule. The schedule can be established by grouping all installed water meters according to factors influencing their accuracy (e.g. age, water quality, flow rate). This data can be either taken from the established meter database or a "door-to-door survey". The meter maintenance schedule should be compliant with the maintenance requirements for water meters as stipulated in Regulation 13(1) of the Weights and Measures (Metrological Control of Water Meters) Regulations, 2014. Also, the maintenance schedule will be an input in the preparation of WSSA's Business Plan, particularly the asset management plan (determination of maintenance and replacement requirements for water meters).

6.4. Maintenance Procedures

Each meter brand has its maintenance procedure provided by the manufacturers detailing maintenance procedures and intervals. However, the following general procedures are applicable:
i. Closing the water supply;
ii. Removal of installed meter;
iii. Exterior cleaning;
iv. Breaking of seal;
v. Dismantling of the meter into its basic components of the shell or case, usually an upper and a lower part, the register, and the measuring chamber/unit;
vi. Cleaning: sand- or bead-blasting; wire brushing; hand scrubbing;
vii. Checking of threads on the inlet and outlet of the casing;
viii. Replacement of broken components;
ix. Reassembling of the water meter;
x. Calibration/accuracy testing;
xi. Conduct pre-reverification;
xii. Submit to WMA for reverification; and
xiii. Re-installation of the water meter.

6.5. Maintenance equipment

WSSAs are advised to make use of the following equipment in testing water meters:
(i) portable clamp-on Ultrasonic Water Meters (for larger diameter meters);
(ii) meter testing kits (for smaller diameter meters) to be used for testing of water meters on-site. The advantage of the meter testing kits is that they are equipped with pressure gauges;
(iii) open vessel of known volume, e.g. bucket and stopwatch method' can be applied as the first indication of meter accuracy; and

(iv) the 'calibrated meter in series method' where a calibrated meter is installed in series with a meter to be tested and the readings are compared.

For more accurate testing and pre-reverification of meters to evaluate the reliability of water meters under all operating conditions, water test benches are recommended. It is important to note that meter test benches owned by WSSAs, should be used by sufficiently trained staff to ensure that the established maintenance schedule and procedure is followed.

6.6. Meter Disposal

During disposal of water meters, WSSAs shall ensure compliance with the Public Procurement Act and its Regulations; and other relevant legislation on disposal of public assets.

7. WATER METER POLICY

For effective implementation of these Guidelines, WSSAs shall prepare their own water meter policy, which will provide a framework for the management of water meters in their service areas. The policy shall be prepared in accordance with these Guidelines, and the minimum content of the policy is as detailed in **Appendix 4**. The policy shall be prepared by the Management of WSSA and approved by the WSSA's Board for implementation.

8. MONITORING AND EVALUATION

WSSAs shall establish a mechanism for monitoring the implementation of the water meter policy. The availability and the implementation status of the policy shall be included in the Annual Reports of the WSSAs, which will be approved by the WSSA's Board and submitted to EWURA. Further, during routine performance monitoring of WSSAs, EWURA will follow up on the implementation of the policy as part of WSSAs compliance to regulatory requirements.

9. APPENDICES

Appendix 1: Template for Water Meter Specifications

Technical Requirement	Description
Required Certificates	The manufacturer of the meters must hold the Quality System Certificate for the standard ISO 900.
	The supplier shall provide the specific manufacturer's authorisation for selling its product to be issued by TBS (Certificate of Conformity)
	The supplier shall provide the Pattern of Approval Certificate issued by WMA specific for the water meter model.
Compliance with Standards	Water Meters shall comply with TBS 782 (1-5 parts) and ISO 4064 Standard and the specifications herein.
Type of Water Meter	(to be added)
Class of Water Meter	(to be added)
Sizing of Water Meter	(to be added)
Design and Construction of a Meter	(to be added)
Material Requirements	(to be added)
Pressure and Temperature	A water meter must be designed to sustain a maximum working pressure of 16 bars and a maximum working temperature of 50 °C.
Additional Technical Requirements	In-built sieves/strainers shall be incorporated in consumer flow meters.
	(to be added)
Meter Accuracy	Water meter shall be designated at accuracy class 2 with the maximum permissible error (MPE) to be ±2 % for the upper flow rate zone and ±5 % % for the lower flow rate zone.
Calibration	The meter shall be delivered calibrated.
Adjusting device (Regulator)	Meters shall have an Internal Regulator (adjusting screw) with no easy access that allows calibration of the meter.
Meter Tests and Accuracy Verification	1) Supplier shall submit all water meters to Weights and Measures Agency (WMA) for verification. 2) Supplier shall provide a copy of the accuracy meter test certificate from Weight and Measure Agency (WMA) which state at the minimum; ■ Water Meter Class; ■ Compliance with a technical and measuring accuracy ■ Compliance with specifications requirements provided by WSSAs to WMA.

Technical Requirement	Description
Marking	■ The marking must indicate the following information ■ Direction of flow of water on both sides of the meter housing ■ Nominal size of the meter ■ Serial number ■ Model ■ Manufacturer/Trademark ■ Flow rate ■ Meter Class
Maintenance of the Meter	The manufacture/supplier should: 1) mention and prove the availability of spare parts; 2) provide a complete list of available spare parts; 3) provide a minimum warranty period of two years; 4) guarantee the supply of spare parts for at least two years after the expiry of the warranty; 5) provide name, address, and contact details of the local agency responsible for providing spare parts and maintenance; and 6) provide maintenance manuals (in English or Swahili language).
Water Meter Bypass Lines	Large meters (>DN 100) should have a bypass to guarantee continuous supply during servicing and maintenance. The meter bypass lines shall have a line-sized water meter installed to detect unauthorized use.
Water Meter Equipped with Electronic Devices	Must comply with TBS 782 (1-5 parts) and Weights and Measures, (Metrological Control of Water Meters) Regulations, 2014
Water meter software	For Prepaid or smart water meters the management software should specify: **System set-up and management:** Supports all system-related information and activities such as operators and tariff rates. **Registration:** Supports registration of meters. **Vend:** Generates credit tokens, searches meter's vending history. **Engineering:** Issues special engineering tokens for test and maintenance such as credit and does key changes for the meter. **Device:** Handles the secured module configuration and key file importation and view. **Battery life:** Indicate a reasonable design life span of a battery under normal usage (at least 5 years). **Reports:** Supports all types of reports including customer reports, vending reports and cash reports. **Cybersecurity:** Software protection
Performance Guarantee	The supplier of water meters should submit a written guarantee signed by an authorised executive of the company that provides the supply of replacement water meters at no cost should the water meter not comply with the service life guaranteed in the tender and/or: 1) Fails to remain readable at any time (or weather condition) within its service life, and/or; 2) Fail to retain its accuracy within the maximum permissible error parameters when tested in accordance with TBS Standard 782 (1-5 parts)

Appendix 2: Template for Pre-reverification Report of Water Meter

WATER UTILITY NAME AND LOGO

TEMPLATE FOR PRE-REVERIFICATION REPORT

METER DETAILS

Customer Name:		Meter No.		Meter class:	
Date:		Meter type:		Brand:	
Reason for Test:		Readings:		Zone:	
Q3: Permanent flowrate as indicated on a meter					

TEST PARAMETERS (STANDARDISED TEST BENCH)

Actual flowrate	Second reading	First reading	Calculated volume	Vessel Volume	Meter erro	PE
L/H	Ltrs	Ltrs	Ltrs	Ltrs	%	%
Q_1 (.....)						
Q_3 (.....)						

TEST PARAMETERS (CALIBRATED OPEN VESSEL)

Second reading	First reading	Calculated volume	Vessel Volume	Actual flowrate	Meter erro	PE
Ltrs	Ltrs	Ltrs	Ltrs	L/H	%	%

Note: PE is a permissible error (minimum and maximum) as specified in OIML R 49

PARTS INSPECTED

Meter Part	**Remarks**
Seal	
Strainer	
Pivot	
Gears	
Meter lock	
Cape	
Propeller	
Setting	
Non Return	

General Observation:	
Recommendations:	

Tested by: Name and Signature	
Checked by: Name and Signature	
Approved by: Name and Signature	

Appendix 3: Template for Water Meter Inspection Checklist

Zone	Account No	Meter Serial No	Brand	Size (mm)	Type	Housing Material	First Installation Date	Meter chamber
				DN		Brass		locked
						Polymer		unlocked damage
								none
kaloleni	1233	009987	baylan	15	multijet	polymer	20june 20	none

Previous Servicing Date	Condition			Sealed	Installation mode	Location	Remarks
	Functional status	Visibility	Defaults				
	Functional	Yes	Leakages Tampering Broken cover Display Counter not readable	Yes	Horizontal	On plot boundary	
	Non-functional	No		No	Vertical	Inside Plot	
						Outside plot boundary	
10jan 21	Non-functional	Yes	Leakage	No	horizontal	inside	Need maintenance Relocate a meter to on plot boundary Require Sealing by WMA

Appendix 4: Minimum Content of Water Meter Policy

This template provides a format for preparation of Meter Policy by WSSA as part of the implementation of guidelines for the Management of Water Meters.

1. INTRODUCTION

1.1. Background (Mandate, Vision, Mission and Core Values)

1.2. Objective

1.3 Scope

This policy applies to Meters installed by WSSAs and covers;

(i) Definitions and specifications
(ii) Acquisition
(iii) Issuance
(iv) Installation
(v) Responsibilities for the WSSA
(vi) Responsibilities for the customer
(vii) Disposal
(viii) Policy Review

2. DEFINITIONS AND SPECIFICATIONS

Definition of Terms as used in this Policy

Technical Specifications of Bulk Water Meters (as per these Guidelines)

Technical Specifications for Consumer Water Meters (as per these Guidelines)

3. ACQUISITION, STORAGE AND ISSUANCE

Procurement of Meters and installation accessories

This section includes the preparation or reference to the WSSA procurement for meters

Receiving of Meters at the Central Store

Issuance from Store

This sub-section covers the procedures that are followed by WSSA during the issuance and replacement of new meters from the stores.

New Issuance

Replenishment

Issuing Meters to installation Staff

This sub-section covers the procedures that are followed by WSSA when issuing meters to the installation staff

4. INSTALLATION

Installation of Bulk Meters (as per these Guidelines)

Consumer Meter Installation (as per these Guidelines)

Rules Governing Consumer Meter installation (as per these Guidelines)

5. RESPONSIBILITIES AND METER PROTECTION

WSSA's Responsibility
Physical Alteration

Only a designated WSSA staff has authority to physically alter an already installed water Meter to:
(a) Service
(b) Relocate
(c) Replace
(d) Test for accuracy
(e) Repair leaks at Meter connectors.

The WSSA must ensure that workmanship during installation is of high standard and there is no leakage at the Meter. This is to safeguard both the WSSA and Customer from water losses.

Disconnection of a Meter
The disconnection of a Meter shall be done by the designated staff due to the following reasons:
(a) It fails a credibility test
(b) Due to accrued debt
(c) Request for temporary disconnection
(d) Request for permanent disconnection.

Responsibilities of a Customer and WSSA on the Installed meter (as per these guidelines)
Meter Security
Safeguarding against tampering and damaging
Illegal Connections

6. DISPOSAL OF WATER METERS

Modes of disposal (as per PPR Act and these Guidelines)
Plastic Meters
Metallic Meters

7. MONTHLY REPORTS

Records of maintenance of bulk/customer meters
Monthly reports on usage and stock levels to be submitted to Commercial Manager on a monthly basis

8. REVIEW OF THE POLICY

Effective Date and Amendment;
This policy comes into effect on the …….. of ……
This policy was approved by the Board on …….. under minute number……
Amendments have been done on …….. under minute number ……..

Signed:

MANAGING DIRECTOR …… Date……

CHAIRMAN- BOARD OF DIRECTORS……… Date……

Appendix 5: Standard Drawing for Installation of Water Meter