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Drinking water, wastewater and stormwater systems and services — Management of on-site domestic wastewater services

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 224, *Drinking water, wastewater and stormwater systems and services*.

This second edition cancels and replaces the first edition (ISO 24521:2016), which has been technically revised.

The main changes are as follows:

— the title has been changed to be in line with the title of ISO/TC 224 and with the title of ISO 24525:2022;

— the term "basic" has been deleted from the title and from the normative text because this document also contains guidance and requirements for systems that are not basic;

— the names and content of the clauses have been harmonized with those in ISO 24525:2022;

— Annex A in ISO 24521:2016 has been deleted;

— Annex B from the previous edition has been replaced by the new Annex A which contains examples for both basic and more advanced systems.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

0.1 Water issues: global context and policies framework

Water constitutes a worldwide challenge for the 21st century, both in terms of the management of available water resources and the provision of access to drinking water and sanitation for the world's population. In 2000, the United Nations recognized that access to water is an essential human right and, in conjunction with national governments, it set ambitious goals (the "Millennium Development Goals" MDGs) to increase access to drinking water and wastewater services, including safe disposal or reuse of treated residues (jointly referred to as "water services" in this document), particularly in developing countries.

The COVID-19 pandemic has demonstrated the critical importance of sanitation, hygiene and adequate access to clean water for preventing and containing diseases. According to the World Health Organization, handwashing is one of the most effective actions to reduce the spread of pathogens and prevent infections. Yet billions of people still lack access to safe water and sanitation, and funding is inadequate.

Reflecting an increasing international recognition of the importance of water services, in 2010 the United Nations General Assembly declared safe and clean water and sanitation as well to be a single human right. In 2015, following extensive technical discussions, new international goals (the "Sustainable Development Goals", SDGs) were set by the United Nations Assembly. The sixth SDG aims to "ensure availability and sustainable management of water and sanitation for all".

In particular, its target 6.2 intends to "achieve by 2030 access to adequate and equitable sanitation and hygiene for all" and to "end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations". The WHO/UNICEF Joint Monitoring Programme for Water, Supply, Sanitation and Hygiene (JMP), responsible for monitoring SDG target 6.2, concluded in its most recent progress report (Reference [6]) that, at current rates of progress, the world will only reach 65 % coverage by 2030, leaving 3 billion people without safely managed sanitation services. As such, achieving universal coverage of sanitation services by 2030 will require a fivefold increase of current rates of progress.

Another relevant remark related to SDGs is that target 6.2, contrary to precedent MDGs, goes beyond the types of sanitation facilities people use and introduces additional criteria related to the level of service provided.

UN agencies (including WHO, UNICEF and UNESCO) and sectoral institutions have been developing recommendations and programmes to establish a framework in which to advance in alignment with international targets.

For instance, the United Nations Commission on Sustainable Development has emphasised that governments have a primary role in promoting improved access to safe drinking water and basic sanitation through improved governance at all levels and appropriate enabling environments and regulatory frameworks, with the active involvement of all stakeholders. If public and private solutions are incorporated into this process, the water sector becomes more productive, and the management of water resources becomes more sustainable.

NOTE Governments are referred to as "relevant authorities" in ISO 24510, ISO 24511 and ISO 24512.

Examples of key issues for efficient drinking water and sanitation services policy frameworks are:

— clearly defining the roles of the different stakeholders;

— establishing how sanitary rules and organization are defined and assessed;

— establishing processes to ensure consistency between the policies regarding urban development and water utility infrastructure;

— regulating water withdrawal and treated wastewater and sludge discharge and reuse;

— providing information to users and communities;

— regularly reviewing relevant standards concerning emerging issues.

0.2 Water utilities: general objectives

In addition to public health protection, sound management of the drinking water and wastewater utilities (jointly referred to as "water utilities" in this document) is an essential element of integrated water resources management. When applied to these utilities, sound management practices will contribute, both quantitatively and qualitatively, to sustainable development. Sound utility management also contributes to social cohesion and economic development of the communities served, because the quality and efficiency of water services have implications for virtually all activities of society.

As water is considered to be a social good and activities related to water services support the three aspects (economic, social, and environmental) of sustainable development, it is logical that the management of water utilities be transparent to, and inclusive of, all stakeholders identified in accordance with the local context.

There is a broad array of stakeholders that can play a role in activities related to water services. Examples of such stakeholders include:

— governments or public agencies (international, national, regional, or local);

— associations of the utilities themselves (e.g. international, regional/multinational, and national drinking water or wastewater associations);

— autonomous bodies seeking to play an overview role (e.g. organizations concerned, such as non-governmental organizations);

— users and associations of water users.

The relationships between stakeholders and water utilities vary around the world. In many countries, there are bodies that have responsibility (in whole or in part) for overseeing the activities related to water services, whether the utilities are publicly or privately owned or operated, and whether they are regulated by relevant authorities or acting in a system of technical self-regulation. Standardization and technical self-regulation are possible ways of ensuring involvement of all stakeholders and meeting the subsidiarity principle.

The aim of water utilities is to offer services to everybody in the area of responsibility of the utility, to provide users with a continuous supply of drinking water and to collect and treat wastewater under economic and social conditions that are acceptable to the users and to the utility. Water utilities are expected to meet the requirements of relevant authorities and the expectations specified by the responsible bodies in conjunction with the other stakeholders, while ensuring the long-term sustainability of the service. In a context of scarcity of resources, including financial resources, it is advisable that the investments made in installations be appropriate and that necessary attention be paid to proper maintenance and effective use of the installations. It is advisable that water tariffs generally aim at meeting cost-recovery principles and at promoting efficiency in the use of the resources, while striving to maintain affordable basic access to water services.

It is advisable that the stakeholders be involved in both setting service objectives and assessing the adequacy and efficiency of service.

0.3 Objectives, content and implementation of ISO standards addressing water services

The ISO standards addressing water services are ISO 24510 (service-oriented), ISO 24511 and ISO 24512 (both management-oriented). The objective of these ISO standards is to provide the relevant stakeholders with guidelines for assessing and improving the service to users and guidance for managing water utilities, consistent with the overarching goals set by the relevant authorities.

ISO 24525 supplements and is intended to be used in conjunction with this document and with ISO 24511. While ISO 24525 brings guidance and specifications for the operation and maintenance (O&M) of on-site domestic wastewater systems and services, using appropriate technologies at any level of development, this document provides guidance for the management of on-site domestic wastewater systems and services, using appropriate technologies in their entirety at any level of development.

0.4 Deficits in sanitation services

The absence of sanitation services globally is a major inhibitor of achieving global societal goals of improving public health and economic development. This situation prevails in both developed and developing countries. Although often thought of as a rural problem, it is also a fact for many peri-urban and urbanized areas. According to the United Nations, 3,3 billion people gained access to improved sanitation facilities between 2000 and 2022, bringing the total number of people using improved sanitation facilities to 7 billion. In 2022, 3 billion people still lacked safe sanitation and of these 419 million people still practiced open defecation (see Reference [6]).

Poor sanitation facilities are often linked to contaminated water sources, which in turn are linked to transmission of diseases such as cholera, diarrhoea, dysentery, hepatitis A and typhoid. In addition, such conditions are often exacerbated by inadequate or absent health care facilities, which exposes already vulnerable patients to additional risk of infection and disease. UNICEF estimates that diarrhoea is the second largest killer of children under the age of five in the developing world and this is caused largely by poor sanitation and inadequate hygiene.

The environmental and public health impacts of the lack of sanitation facilities depend on the density of the population. In some circumstances, such as when the population density increases, a point is reached where the failure of natural absorption or decomposition processes of the surrounding environment become both a public health and an environmental risk. In such circumstances, on-site wastewater services can be installed. These can be either on the scale of a single-family unit or on a community scale, although some cases can require collection systems of some type and can include transportation and disposal. Regardless of the type of on-site domestic wastewater system (ODWS) in place, its scale or the level of technology installed, the services and processes need to be managed to ensure effective operation within the socio-economic and cultural conditions.

0.5 On-site domestic wastewater systems and services

According to WHO/UNICEF and in alignment with most recent consensus on the meaning used in the SDG target 6.2.1a, "safely managed sanitation services" are improved sanitation facilities, which are not shared with other households, and where the excreta produced is either

— treated and disposed in situ,

— stored temporarily and then emptied and transported to treatment off-site, or

— transported through a sewer with wastewater and then treated off-site.

Improved sanitation facilities can include flush/pour flush to piped sewer system, septic tanks or pit latrines, ventilated improved pit (VIP) latrines, composting toilets or pit latrines with slabs.

Management of ODWS of all types and at all levels of technology requires an understanding of the biological processes at work, the factors that can inhibit those processes and the means of ensuring those processes are functioning. It also involves a general understanding by the wider served community of the benefits provided by sanitation system use and management. In this way, the sanitation facilities work efficiently and help sustain the community in which they are located. Management of the systems is often considered to be the responsibility of the relevant authority, whether it is local or supported by larger scale water utilities. However, in many instances, the management of the ODWS is the responsibility of the user in collaboration with the local authorities.

Many ODWS are located near or adjacent to sewer systems under professional supervision and operation. In many cases, ODWS can be supported by the nearby larger scale wastewater systems, e.g. through the collection of wastewater or partially treated sanitary effluents for further treatment/disposal in the larger facility

This symbiotic relationship provides an opportunity for small scale sanitation facilities without needing to host all the technology or wastewater treatment systems and experienced staff on-site. In other cases, the management of the large-scale facility can provide supervisory technical services to the neighbouring system operators, to help train and ensure effective treatment levels.

In addition to the ODWS having minimum equipment or process required to treat wastewater ("basic ODWS") and meet discharge objectives, there are other wastewater treatment systems (ODWS) with higher

treatment performance in areas where there is a strong need for water environment improvement, where there are effluent discharge standards or where site conditions limit the options for treatment and dispersal on-site. These advanced ODWS adopt more complex wastewater treatment technologies (e.g. activated sludge process, biofilm process).

Drinking water, wastewater and stormwater systems and services — Management of on-site domestic wastewater services

1 Scope

This document provides guidance and requirements for the management of on-site domestic wastewater systems and services, using appropriate technologies in their entirety at any level of development.

This document supplements and is intended to be used in conjunction with ISO 24511 and ISO 24525. It includes guidance and requirements for the following:

— management of on-site domestic wastewater systems and services from the operator's perspective, including maintenance techniques, training of personnel and risk considerations;

— management of on-site domestic wastewater systems (ODWS) from the perspective of owners and users;

— design and construction of ODWS;

— planning, operation and maintenance, and health and safety issues.

This document is applicable to both publicly and privately operated on-site domestic wastewater (black and grey water) services, for one or more dwellings. In rural areas and areas under development, management is sometimes provided by the owners of the premises where wastewater is generated. In this document the term "services" includes "self-services" provided by the owners of the premises.

The following are outside the scope of this document:

— limits of effluent quality for wastewater discharged into the environment;

— analytical methods;

— stormwater runoff;

— content of contracts or subcontracts.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 24510, *Activities relating to drinking water and wastewater services — Guidelines for the assessment and for the improvement of the service to users*

ISO 24511, *Activities relating to drinking water and wastewater services — Guidelines for the management of wastewater utilities and for the assessment of wastewater services*

ISO 24513, *Service activities relating to drinking water supply, wastewater and stormwater systems — Vocabulary*

ISO 24525, *Drinking water, wastewater and stormwater systems and services — Operation and maintenance of on-site domestic wastewater services*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms and definitions given in ISO 24513 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 Terms and definitions

3.1.1
on-site domestic wastewater
water containing only human body waste and human liquid waste, which can contain grey water from washing but does not contain commercial or industrial discharges

3.1.2
technology
specific infrastructure or method that is designed to collect, store, treat, use and/or transport domestic wastewater and/or residues

3.2 Abbreviated terms

ATU	aerobic treatment unit
BOD	biochemical oxygen demand
ODWS	on-site domestic wastewater system
PPE	personal protective equipment
SBR	sequencing batch reactor
TSS	total suspended solids
UASB	upflow anaerobic sludge blanket reactor
VIP	ventilated improved pit

4 Objectives

4.1 General

The main objectives of ODWS are:

— protection of public health and safety;

— occupational health and safety;

— environmental protection;

— sustainable development;

— meeting the needs and expectations of users;

— provision of services under normal and emergency situations.

In addition to meeting the above noted objectives, ODWS should consider the following:

— optimization of the use of resources in terms of nutrients, water, and energy;

— simplicity of construction, use, operation, maintenance, and repair;

— affordability and willingness to pay;

— existing institutional and financial support, particularly for operation and maintenance work;

— existing best practice, experience, and infrastructure;

— development of ownership, involving property owners, users of all kinds, public water utilities and the private sector in design and planning;

— cultural sensitivity, taking into account values, attitudes, and the behaviour of the user.

In the use of this document, users shall follow the requirements of ISO 24510, ISO 24511 and ISO 24525.

4.2 Protection of public health and safety

Safe disposal of wastewater and sludge should be a public health priority and provide an effective disease barrier. Wastewater or sludge shall be disposed of in a manner that ensures that:

— drinking water supplies are not threatened;

— direct human exposure is not possible;

— wastewater and sludge are inaccessible to vectors, insects, rodents, or other possible carriers;

— risks from pathogens and chemicals are minimized or eliminated;

— odour or aesthetic nuisances are not created.

The following should be considered.

— Discharges of untreated or partially treated wastewater and sludge from ODWS cause public health risks and negative environmental impacts. The risk of a seasonal reduction in the efficiency of wastewater treatment, for instance in winter, should be taken into consideration.

— The presence of nitrates or bacteria in the drinking water well can indicate that liquid is flowing into the well through the ground or over the surface. Water analyses can help indicate whether this is a problem of the ODWS.

— The reuse of reclaimed water (treated wastewater) and sludge is encouraged; however, the relevant authority should establish that the extent of treatment, the method of application and the reuse purpose for reclaimed water does not create public health risks and adverse environmental impacts before approval is granted. Reuse is only permitted for non-potable (not for human consumption) purposes.

4.3 Occupational health and safety

All users and operators shall adhere to hygienic safety standards and use protective equipment when handling wastewater and sludge. Appropriate training should be available for users and operators.

Health protection of the owners of the premises or workers providing emptying services shall also be accounted for.

The health and safety precautions for users and operators should be documented and reviewed periodically. The actual health and safety situation should be reviewed at prescribed intervals.

4.4 Environmental protection

Improper discharge of wastewater or sludge from the system into the natural environment can lead to high levels of pollution. Aquatic organisms living in surface waters can be endangered when untreated wastewater or sludge is discharged.

Many of the environmental impacts, e.g. salinization of soil and contamination of water resources, can be minimized through systems that are environmentally friendly.

Only ODWS that do not have a negative effect on the environment should be set up. Whenever possible, specific product quality criteria should be standardized, as well as testing and certification procedures, to ensure that all manufactured or constructed ODWS meet the required level of quality.

Competent authorities should ascertain the compatibility of the system for the environment. Where necessary, pre-approval for on-site domestic wastewater disposal can be required before home construction. The process can require site-evaluation by environmental health experts or other competent authorities.

Management should ensure that failing ODWS do not have negative environmental effects as a result of discharge of partially treated or untreated wastewater and sludge.

Designs should include safeguards to ensure that failing ODWS do not cause accumulation of wastewater and sludge on the ground, its percolation into ground water or its flow into waterways that are close to the failing system.

From the perspective of water environment conservation, existing ODWS that are found to have negative effect on the environment should be replaced by systems that meet relevant environmental requirements and are affordable.

NOTE Chemical additives containing strong acids, bases, or toxic chemicals are generally discouraged or banned because of the potential adverse effects that these chemicals can have on system components, the soil structure, or ground water quality.

4.5 Sustainable development

Whenever possible, treated effluents and treated sludge should be used beneficially or disposed of in a safe and appropriate way. The focus should be on the outputs of systems and their (potential) value.

It should be determined if there is a real or potential demand for reuse of sanitation system products. Reuse systems should be designed according to guidelines and standards relevant to the objectives of the reuse system, including health and safety requirements.

When possible, nutrients recovered from faeces and urine should be recycled and used at household level as fertilizer or soil improver. Safety and hygiene issues should be taken into consideration.

The system assets should be maintained and should provide the capacity to meet current and future needs. Preventative maintenance of the facility and desludging should be identified and performed regularly so that the asset meets its performance criteria during its functional lifespan.

Revenue sources should be developed in order to ensure cost recovery of services and financial sustainability. In addition, subsidy schemes should be considered to encourage good practices, for example to provide incentive for regular maintenance work, maintain performance, and maximize the useful working lifespan of the system

Specifically, integrated water resources management, renewable energy, electricity production, industrial uses and utilization of treated wastewater residues should be taken into consideration.

Another advantage of ODWS is the reuse of treated wastewater residues in agriculture for the provision of food, when applicable and safely managed.

NOTE ISO/TC 275 covers uses of sludge, which also encompass sludges from ODWS.

4.6 Meeting the needs and expectations of users

In many cases, a favoured technology is chosen, and little attempt is made to include the views of users. Users are most interested in seeing improvements to their living conditions, e.g. due to health issues, matters of privacy and safety for family members.