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Agricultural irrigation equipment — Guideline on the implementation of pressurized irrigation systems —

Part 2: **Drip irrigation**

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Foreword

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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 documents 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 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 18, *Irrigation and drainage equipment and systems*.

A list of all parts in the ISO 24120 series can be found on the ISO website.

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

Dwindling vital natural resources, such as land and water, and rising world population, pose a constant threat that can develop into a future food and water crisis. Given the limited availability of water and land resources, the amount of food grown today needs to be increased to meet the demands of tomorrow. Reduction of available water for human consumption needs to be addressed. As direct consumption of fresh water by populations cannot be decreased, the amount of water consumed by agricultural uses needs to be reduced and allocated for domestic or industrial use.

Drip irrigation addresses water scarcity and other environmental considerations. Its use can save large amounts of water (over 50 % of water can be saved for certain crop types) and increase yields.

Drip irrigation not only addresses the need to reduce water consumption and increase yield, but also requires less labour and energy for operation, leading to lower costs to farmers due to reduced usage of labour, fertilizers and other chemicals.

Drip irrigation relates to sustainability agriculture issues, and can be used in dry areas, in saline soil with saline water, and in steep-sloped topographies, where other irrigation methods cannot be practiced without using pressure compensated units.

Drip irrigation is easy to handle and operate once installed. It is suitable for automation and remote operation by computer or mobile phone. The system's simplicity makes it easy to install, operate, maintain and repair.

Other than irrigation, the drip irrigation method is used as a delivery system for fertilizers and other agrochemicals. Drip irrigation's advantage as a delivery system is its ability to optimize fertilizer usage, and distribute it exactly where needed, in the root zone, while minimizing its release to the environment.

Adoption of drip irrigation can help achieve sufficient fresh water availability for domestic use and sufficient food quantity and quality and quality for reasonable pricing, while increasing farmers' income with yield increases and cost reduction, and ensuring food security.

Drip irrigation systems also have limitations mainly related to high investment costs and extensive maintenance requirements necessary to achieve and maintain the irrigation system performance. Maintenance routines include water filtration, field inspection, maintenance of driplines, main line flushing, and chemical water treatment.

The purpose of this document is to provide a guideline on the implementation of drip irrigation.

Agricultural irrigation equipment — Guideline on the implementation of pressurized irrigation systems —

Part 2:
Drip irrigation

1 Scope

This document provides a guideline for the implementation of pressurized drip irrigation systems.

It is applicable to both small-scale family agriculture and large-scale commercial agriculture, in open fields or within enclosed growing structures (e.g. greenhouse, net house).

This document is intended for the use of agriculture ministries, agronomists, irrigation planners, farmers and other end-users.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purpose of this document, the following terms and definitions 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
anti-siphon dripper
anti-siphon emitter
dripper (3.3) with an interior mechanism which prevents suction of pollutants from outside the dripper line

3.2
chemigation
application of any chemical through an irrigation system

3.3
emitter
dripper
device fitted to an irrigation lateral and intended to discharge water in the form of drops or continuous flow at flow rates not exceeding 24 l/h, except during flushing

[SOURCE: ISO 9261:2004, 3.1]

3.4
fertigation
injection of soluble fertilizers into the irrigation system together with irrigation water

3.5
on-line emitter
on-line dripper
emitter intended for installation in the wall of an irrigation lateral, either directly or indirectly by means such as tubing

[SOURCE: ISO 9261:2004, 3.3]

3.6
regulated emitter
emitting pipe
pressure compensating emitter/emitting pipe
emitter/emitting pipe which maintains a relatively constant flow rate at varying water pressures at the emitter/emitting pipe inlet within the limits specified by the manufacturer

[SOURCE: ISO 9261:2004, 3.7]

3.7
regulated non-leakage dripper
compensated non-leakage (CNL)
emitter/emitting pipe whose flow is zero whenever the pressure at the inlet of the emitter/emitting pipe is lower than a value (other than zero) declared by the manufacturer

[SOURCE: ISO 9261:2004, 3.9, modified — Term name has been changed.]

3.8
unregulated dripper
non-pressure compensating emitter
emitter/emitting pipe whose flow rate varies with inlet water pressure

[SOURCE: ISO 9261:2004, 3.10]

4 Principles of drip irrigation

4.1 General

This document relies on the main principles of drip irrigation as set forth in ISO/IWA 20 and ISO 9261.

The main principles of drip irrigation are described in ISO 24120-1.

4.2 Water sources

The main types of water sources for drip irrigation are:

— surface water sources,

— groundwater sources,

— brackish water,

— treated wastewater (TTW), and

— desalinated water.

Many existing and potential water supply sources for irrigation systems are derived from surface water, which does not tend to have high levels of salts (with the exception of some coastal areas), and thus the irrigation systems are usually less prone to formation of precipitates in drippers when using a surface water source.

Some surface water sources, however, tend to introduce biological hazards, as well as silt. If TWW is considered as a source, quality and clogging potential will vary depending upon the extent of treatment.

Groundwater is generally of higher quality than surface water. However, iron, manganese, hydrogen sulfide, pH, soluble salts, hardness, and alkalinity levels should be measured, as levels that are higher than values determined as acceptable irrigation water quality can lead to dripper clogging and treatment can be required.

4.3 Water distribution network

4.3.1 Main line, sub-main, distribution pipes

Main lines carry water through the entire irrigation system, from the pump through the filters, valves and drippers.

All main line and fittings should be properly sized to withstand maximum static and operating pressures and convey water without excessive pressure loss or gain.

PVC piping may be used throughout the system, or in combination with steel piping at the pump station. Polyethylene (PE) or flexible pipes may be used for sub-mains and distribution pipes. PE and PVC piping should be UV protected or buried. Pipes from other materials are permitted if they comply with local requirements.

Thermal expansion and contraction that occur under normal on-surface operating conditions should be taken into consideration (each type of pipe material is affected to a different degree), when designing and installing the system.

Main lines are connected to one another with welds, glue or friction fittings, according to the type of piping in use, and are anchored to the infrastructure supporting them. All main lines should be properly secured and anchored.

In a subsurface drip irrigation (SDI) system, the main line is more difficult to access and repair. All fittings should be secured at installation, to save significant repair issues later. After the initial growth stage of the crop, on-going maintenance should be implemented.

In irrigation design, pipe sizes are specified based on water quality and water velocity, economic considerations, friction loss, water hammer considerations and flushing concerns. As pipe size increases, friction loss decreases (with reduced pumping cost) but initial cost increases.

If water quality is poor, particularly in wastewater, the designer should consider increasing the water velocity in mains and submains to avoid sedimentation in the pipes. In most cases, the distribution pipe is installed above the elevation of the dripper lines.

Irregular field shapes are common due to topography and property boundaries. At the planning stage, care should be taken to properly size sub-main and distribution lines where field shape varies. Sub-main and distribution lines for irregularly shaped fields are designed based on actual flow rates of the dripper lines.

The piping system should be designed not only to allow the flow rate necessary for normal irrigation but also to allow sufficient flow rate for proper flushing velocities in the system (recommended minimum: 1 m/s).

Design objectives for drip system flushing can result in the selection of different pipe diameters than those selected in the design process for normal operation. This is because the flushing flow rate required for achieving a desired flushing velocity in any section of a main, sub-main or distribution pipe can be different than the design flow rate for regular operation.

4.3.2 Drip irrigation laterals (dripper lines)

Dripper lines are the heart of a drip irrigation system. In any irrigation system, the design process starts at the last plant and proceeds to the head system.

In the design of a dripper line, the following should be considered: dripper line selection, wall thickness, diameter, nominal pressure, dripper flow rate, spacing between drippers, spacing between dripper lines, and specification of dripper line insertion depth (in SDI).

4.3.3 Weather conditions

4.3.3.1 General

For surface and subsurface main pipe, attention should be given to two operating conditions listed in 4.3.3.2 and 4.3.3.3.

4.3.3.2 High temperature areas

The operating temperatures recommended by the manufacturer should not be exceeded. The manufacturer's responsibility normally applies to the pipe and all its connectors.

4.3.3.3 Low temperature area

In countries where temperatures in winter can be below 0 °c, water should be drained from the pipes of any irrigation system and dripper lines, to protect the main and submain pipes.

5 Drippers classification

5.1 General

Drippers incorporated at uniform spacing along the dripper line deliver water and nutrients directly to the plant root zone.

A typical drip irrigation system includes thousands of drippers. Each dripper should be durable, resistant to clogging, and emit the same amount of water under the same conditions and over time. Good design of the emitter can increase its long-term trouble-free performance.

The flow rate, working pressure and spacing of the drippers should be considered in determining the wetting pattern and to prevent runoff or deep percolation.

A properly operated and maintained drip irrigation system provides water and nutrients to the crop root zone without runoff or deep percolation.

Two types of integral drippers are available, as described in 5.2 and 5.3.

5.2 Unregulated drippers

Unregulated drippers supply a flow rate that is based on the working pressure.

As long as the working pressure remains within the allowable pressure range, unregulated drippers provide uniform irrigation by maintaining a limited differential flow that was designed and installed for (10 % desirable, or in accordance with national or international standards), from the first lateral dripper to the last one in the same cycle operation.

The dripper flow rate, pipe inside diameter, dripper spacing, and dripper design determine the pressure head losses within the dripper line.

Differences in elevation also affect the system.

5.3 Regulated drippers

5.3.1 General

As long as the working pressure remains within the allowable pressure range, regulated drippers provide uniform irrigation by maintaining a constant flow rate regardless of the working pressure.

A regulated dripper contains a diaphragm, which is activated by the continual differential pressure created by the dripper's labyrinth, thus maintaining a constant dripper flow within the limits specified by the manufacturer.

Due to the free-floating diaphragm, the dripper’s action can be precise, immediate, sensitive, continually self-adjusting and constantly self-flushing. Particles that cause clogging will either be flushed out through the wide water passages or increase the pressure differential. This causes the diaphragm to momentarily increase the cross-section area for outgoing water, and thus flush the dirt out of the system.

The diaphragm movement maintains constant differential pressure within the water passage, resulting in a uniform flow rate at a wide pressure range.

Regulated drippers deliver the same flow rate regardless of the dripper line length (as long as the drippers operate within its working range as specified by the manufacturer).

5.3.2 Regulated drippers for particular applications

5.3.2.1 Anti-siphon (AS) drippers

The mechanism of anti-siphon (AS) drippers prevents suction of the outside dirt into the dripper line, providing critical protection against dripper clogging. It is ideal for subsurface drip irrigation (SDI) and can be used in on surface (orchards, plantation) and subsurface (SDI).

Irrigation systems do not usually operate during rain. Rain often causes saturation of the soil or standing water around the dripper lines. Between irrigation cycles, when the system is not pressurized, it acts as a drainage system. If particles are drawn into the dripper under negative pressure, it can lead to the drippers clogging.

To overcome this problem, the mechanism of anti-siphon drippers seals the dripper when the system is not pressurized, thus preventing pollutants from entering the system**.**

Suction of contaminants into the pipe can also happen when the dripline is emptying, creating a vacuum that sucks dirt through the hole onto the dripper, which risks clogging it.

5.3.2.2 Regulated non-leakage drippers/ CNL drippers

The compensated non-leakage (CNL) feature prevents system drainage between irrigation cycles, when the system is not fully pressurized. It ensures uniform water and nutrient distribution during pulse irrigation.

Dripper lines remain full between irrigation cycles, eliminating drainage and refill of the dripper lines, thus making the application more uniform.

It is recommended to use pressure-compensating (PC) drippers when the terrain slope is greater than 2 %.

CNL drippers are more sensitive to clogging and require more frequent maintenance routines, particularly for crops sensitive to excessive or insufficient irrigation.

For subsurface systems, AS drippers are be preferred.

