BRITISH STANDARD

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Irrigation techniques — Solid set sprinkler systems —

Part 1: Selection, design, planning and installation

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ICS 65.060.35

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National foreword

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Irrigation Techniques - Solid set sprinkler systems - Part 1: Selection, design, planning and installation

Techniques d´irrigation - Installation de couverte intégrale par asperseurs - Partie 1 : Sélection, conception, planning et installation

Bewässerungsverfahren - Ortsfest installerte Beregnungssysteme - Teil 1: Auswahl, Auslegung, Planung und Installation

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Contents

Foreword

This document (EN 13742-1:2004) has been prepared by Technical Committee CEN/TC 334 “Irrigation techniques”, the secretariat of which is held by AENOR.

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1 Scope

This document provides guidelines to choose material, to design, to prepare plans, and to install a solid set irrigation system to apply water to the irrigated area with the greatest possible efficiency.

This document covers sprinkler irrigation systems installed at the beginning of the irrigation season and removed at the end without moving any component, sprinkler or pipe, during the entire irrigation season.

It covers only solid set system components located on the field and upstream from a water supply point defined by a pressure and a flow.

This document does not cover permanent systems with buried pipes nor hand-movable portable systems.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 12734, *Irrigation techniques - Quick coupling pipes for movable irrigation supply - Technical characteristics and testing.*

EN 13742-2, *Irrigation techniques - Solid set sprinkler systems - Part 2: Test methods.*

ISO 7749-1:1995, *Agricultural irrigation equipment - Rotating sprinklers - Part 1: Design and operational requirements.*

ISO 7749-2, *Irrigation equipment - Rotating sprinklers - Part 2: Uniformity of distribution and test methods.*

ISO 9644*, Agricultural irrigation equipment - Pressure losses in irrigation valves - Test method.*

ISO 11419, *Agricultural irrigation equipment - Float type air release valves.*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
solid set irrigation system
sprinkler irrigation system installed at the beginning of the irrigation season and removed at the end without moving any component, sprinkler or pipe, during the entire irrigation season

3.2
main-line
piping of a pressurized irrigation network connecting the water supply to the sub-mains or to the laterals

3.3
sub-mains
piping connecting main-line to laterals

3.4
laterals
piping connecting main-line or sub-main to sprinklers

3.5
piping
watertight pipes that can carry a pressurized fluid from one point to another

3.6
valve
device used to totally or partially permit or prevent circulation of a fluid

3.7
filter
device used to separate and remove solid particles from a fluid

3.8
riser
rigid pipe used to connect sprinklers to laterals

3.9
riser mount
component located on the lateral to allow riser installation

3.10
riser stand
device that maintains the riser in a vertical position, i.e. tripods, stabilizers etc.

3.11
sprinkler inlet
part of the sprinkler used to connect sprinkler to riser or lateral

3.12
rotating sprinkler
device which by its rotating motion around its vertical axis distributes water over a circular area or part of a circular area

3.13
radius of throw
farthest distance measured, while the sprinkler is rotating normally, from the centreline to the point at which the sprinkler deposits water at a rate of 0,25 mm/h for a sprinkler whose discharge exceeds 75 l/h, and 0,13 mm/h for a sprinkler whose discharge is equal to or less than 75 l/h, typically measured at any arc of coverage except at arc extremes for part-circle sprinklers according to ISO 7749-1

3.14
pressure regulator
valve in which the water passage widens or narrows automatically to maintain a relatively constant pressure at the outlet of the pressure regulator under varying pressures or flow rates at the inlet of the pressure regulator

3.15
controller
device that automatically controls all or part of the operation of an irrigation system

3.16
fertilizer unit
fertilizer pump (electrical, hydraulic or other), or fertilizer injection tank, which is used to inject fertilizer solutions into an irrigation system

3.17
drain valve
valve that allows to drain irrigation pipes

3.18
air release valve
valve which opens automatically to allow air from the atmosphere to enter the water pipeline during drainage of the line and/or venting of air from the water pipeline to the atmosphere during filling or during normal operation of the pipeline under pressure

3.19
sprinkler nominal flow rate
quantity of water per unit of time discharged by a sprinkler with a specific nozzle at ambient temperature at the test pressure declared by the manufacturer in the manufacturer's data sheets according to ISO 7749-1

3.20
sprinkler test pressure (see definition in ISO 7749-1:1995, 3.6 and 3.7)
water pressure, within the range of minimum effective pressure and maximum effective pressure declared by the manufacturer as the pressure range in which the sprinkler operates effectively, used for testing the sprinkler

3.21
minimum effective pressure
lowest working pressure declared by the manufacturer, measured near the base of the sprinkler, at a point situated about 0,2 m below the main nozzle of the sprinkler, but with the pressure gauge situated in the same plane as the main nozzle

3.22
maximum effective pressure
highest working pressure declared by the manufacturer, measured near the base of the sprinkler, at a point situated about 0,2 m below the main nozzle of the sprinkler, but with the pressure gauge situated in the same plane as the main nozzle

3.23
system test pressure
water pressure, within the range of effective pressure used for testing the system

3.24
nominal pressure
operating pressure of a sprinkler equipped with a given nozzle, operating at ambient temperature and giving the nominal flow indicated by the manufacturer's performance charts. It is within the operating pressure range

3.25
system pressure
the approximate operating pressure of the sprinklers used in the project to dimension the different pipes

3.26
quick coupling pipe
a portable pipe with coupling parts which give a safe connection with the pipe of the same kind in a few seconds mostly without a tool and which can be loosened in the same easy way according to EN 12734.

3.27
quick coupling valve
movable valve equipped with fittings allowing a secure connection between two pipes with the same quick couplers. Connection and disconnection is rapid and requires no tools

3.28
sub-unit
number of sprinklers fed by the same water source and operating at the same time

3.29
potential evapotranspiration (ETP or ET)
maximum quantity of water capable of being evaporated in a given climate, by a continuous expanse of vegetation covering the whole ground and well supplied with water. It includes evaporation from the soil and transpiration from the vegetation in a specific region during a 24 h period, expressed as a depth of water [EN 12484-1]

3.30
crop coefficients (Kc)
factors correcting the evapotranspiration ratio according to the plant and its growing stage [EN 12484-1]

4 Characteristics of principal components of a solid set irrigation system

4.1 General

Besides the necessity to resist to the operating pressure, the different system components shall also durably withstand other operational conditions during use, such as mechanical stress factors from transport and moving, abrasion by ground contact or dirty water corrosion and chemical influence from aggressive water and soil, fertilizers or chemical products usually mixed into the irrigation water.

4.2 Pipes

4.2.1 General

Main characteristics are:

4.2.2 Mainlines and sub-mains

Those pipes shall be made of steel, aluminum, PVC, PE or any other material suitable for eventual mixing fertilizers or chemicals in the irrigation water.

They shall be manufactured and sized to carry irrigation water at a suitable flow and pressure to ensure correct system operation.

They can be laid on the ground or buried. Their maximum admissible operating pressure shall be 1,5 times higher than project maximum pressure.

4.2.3 Laterals

Laterals shall be manufactured according to the relevant European standard or equivalent national standard.

Laterals shall consist of pipes 6 to 12 meter long made out of steel, aluminium alloy or plastics material connected together with fittings.

Fittings can be built into the pipe or be separate. Couplings can be hook or twist locks. Fittings can have a built- in outlet for sprinkler risers.

Laterals shall be sized according to the subunit (diameter and maximum length) to accept a maximum 10 % flow variation between two sprinklers operating respectively at the highest and lowest pressure. This represents a 20 % pressure variation.

Maximum operating pressure will be 1,5 times higher than the planned project pressure in the pipe.

4.2.4 Fittings

In a given installation, the fittings for same diameter pipe shall be of the same type and shall be made of the same material and shall accept the same pressure conditions.

4.2.5 Pressure gauge tapings

A sufficient number of pressure gauge tapings, conforming to ISO 9644, shall be installed in different parts of the system in order to enable checking system pressure.

4.3 Valves

4.3.1 Manual valves

They shall be accessible, easy to operate, and compatible with fertilizers in irrigation water. Their diameter shall be large enough to allow the required project flow without excessive pressure loss.

4.3.2 Automatic valves

They shall be accessible, easy to operate, compatible with fertilizers or chemicals in the irrigation water, and have a manual operation feature.

Their operating power requirement shall be compatible with the controller power capability.

Their diameter shall be large enough to allow the necessary project flow without excessive pressure loss.

4.3.3 Programmable valves

They shall be accessible, compatible with fertilizer or chemicals in the irrigation water, easy to operate and have a manual operation feature.

4.3.4 Float equipped type air vent and vacuum relief valves

These valves shall meet the specifications defined in ISO 11419 standard.

They shall be located at network high points.

4.4 Irrigation controller

Main characteristics are:

a) Operation mode (sequential or independent);

b) power supply voltage;

c) total number of controlled stations;

d) output voltage for of each station;

e) capability to start a pump and open or close a master valve;

f) automatic fertilization control capability;

g) presence of binary inputs for shut off devices (i.e. wind, rain, etc. ...);

h) use data from external sensors (i.e. climatic data, agronomic data, etc. ...).

4.5 Fertilizer unit

4.5.1 Main characteristics are:

4.5.2 Fertilization tank

a) Model and type.

b) Maximum operating pressure.

c) Material.

d) Means to control filling level.

4.5.3 Venturi injectors

a) Model and type.

b) Relationship between pressure, flow and volume of injected solution.

4.5.4 Hydraulic injection pumps

a) Model and type.

b) Minimum operating pressure.

c) Maximum operating pressure.

d) Irrigation water / fertilizer ratio.

4.5.5 Electric injection pumps

a) Power supply voltage.

b) Maximum and minimum injection flow.

4.6 Sprinklers

4.6.1 Characteristics

Solid set sprinklers are generally made of plastics, sometimes of metal, and should operate 2 000 hours without any major change in their initial characteristics.

A sprinkler is characterized by:

a) Number of nozzles (one or two);

b) nozzle diameter(s) and operating pressure. Those two items define sprinkler flow that has to be compatible with project requirements;

c) precipitation rate that has to be compatible with soil intake rate;

d) outlet trajectory angle suitable for crop types;

e) radius of throw that determines spacings between consecutive sprinklers and laterals.

Precipitation rate and distribution uniformity test data shall be supplied by an approved test laboratory.

Sprinkler characteristics according to ISO 7749-2 may be provided by the manufacturer as shown in the Table 1.

Table 1 — Sprinkler characteristics

- Manufacturer: .....

- Model: .....Type:.....

Nozzle diameters (mm)	Pressure (kPa)	Throw (m)	Flow (m^3/h)	Spacing (m)		Precipitation rate (mm/h)		Uniformity Coef. Christiansen (%)	
				■	▲	■	▲	■	▲

4.6.2 Sprinkler rises

Risers can be made of aluminium, galvanized steel, PVC or any other material compatible with the use of chemical products in irrigation water. They shall be rigid enough to support the sprinkler without vibrating during operation. Riser fittings shall be compatible with the sprinkler at one end and with the pipe connection at the other end.

To obtain the best distribution uniformity, risers shall be kept in vertical position and their height shall be adapted to crop height.

4.6.3 Stabilizers

Stabilizers can be used to maintain the sprinkler risers in a vertical position. If necessary their shape and their size shall be adapted to the riser high to ensure a stable vertical position.

They shall be made of corrosion-resistant material.

4.6.4 Pressure regulator

Pressure regulators can be installed at the inlets of various sprinklers according to the design requirements.. They can also be installed at the inlet of one or several laterals to regulate pressure for a group of sprinklers. They reduce pressure from the lateral to the sprinkler by creating a pressure loss in a way to obtain a pressure close to sprinkler project design pressure.

They shall be adapted to the sprinkler flow rate and operate within the regulation range specified by the manufacturer.

5 Data necessary for project design

5.1 General

Design shall allow the supply of a sufficient amount of water to satisfy crop needs.

To design a suitable project for each specific case, it is first necessary to collect relevant data and information. In case of large or difficult projects, it is often necessary to make a preliminary design to take specific considerations into account.

To design a project correctly, it is necessary to take into account the shape, the slope and the elevation of the areas to irrigate as well as any other specific characteristics that can have an effect on the irrigation project.

5.2 Project location

Provide a legible drawing in metric scale showing:

a) Size of the area to irrigate (All future planned extensions shall be included and taken account of in the initial project).

b) Topography (Contour lines every 5 meters as well as system elevation reference points).

c) Project and property boundaries.

d) Existing / buried networks.

e) Existing and planned buildings.

f) Water supply points.

g) Electric power supply points with indication of voltage and power available.

5.3 Crop characteristics

5.3.1 To correctly design a project, it is necessary to know peak crop water needs. Information to collect includes:

5.3.2 Crop description

a) Type

b) Species

c) Variety

d) Plant layout

e) Root depth

5.3.3 Water needs

For each irrigated crop collect the following data for periods within the irrigation season:

a) crop coefficient (Kc);

b) ET value (expressed in mm per days or mm per weeks or mm per months or mm per season or mm per year).

Water needs will be calculated with the formula:

Kc x ET

If such data is not available, water need charts published by the national weather service or professional agricultural organizations may be used.

5.4 Climatic characteristics

5.4.1 Required climatic data are:

5.4.2 Wind

Wind is very influential in water distribution uniformity.

Its characteristics are to be indicated for the irrigation season and approached if possible in a statistical way which should include:

a) Dominant wind direction

b) Range of wind speed and its duration

5.4.3 Rainfall

Indicate minimum monthly rainfall during the irrigation season calculated over a five or ten year period.

5.5 Water supply characteristics

5.5.1 To choose equipment and irrigation schedule, the following data are needed:

5.5.2 Water supply characteristics

Indicate the kind of water supply or supplies:

a) Pressurized or natural pressure

b) Water source

5.5.3 Water quality

Provide analysis results for water quality characteristics:

a) Physical

b) Chemical

c) Bacteriological

5.5.4 Water availability

Provide following characteristics:

a) Available flow at peak period

b) Dynamic pressure

c) Available volume during irrigation season

d) Total volume available annually

e) Continuous water availability (free demand) or discontinuous (rotation system)

f) Water point locations

5.6 Soil characteristics

Main characteristics to know are:

Soil types

Indicate nature and main agronomic characteristics of the soil(s) on the project area:

a) Usual soil designation in the area

b) Analyses and/or estimations of texture and structure of the soil

c) Soil depth usable by roots

d) Usable reserve characteristics

e) Soil intake rate

f) Existing drainage

6 Hydraulic performance of the installation

6.1 General

The installer has to take into account the following recommendations.

6.2 Sprinkler application characteristics

When choosing a sprinkler and its spacings the following have to be taken into consideration:

a) Hydraulic performance of the equipment, given by the manufacturer.

b) Characteristics of the soil, the climate and of the crop.

The uniformity of water application shall be evaluated according to EN 13742-2, using the Christiansen uniformity coefficient. System design shall provide a uniformity meeting the requirements of the user. An approximately 80 % Coefficient of Uniformity is recommended for shallow root crops and minimum 75 % for deep root crops. Fruit trees and vine should need only a 70 % minimum coefficient due to their well developed root system. If the system is intended for applying chemicals trough the irrigation water to the crops the Coefficient of Uniformity shall be higher than 80 %.

Sprinklers may be placed in triangular, square or rectangular pattern.

For areas with high wind speed, spacings between sprinklers and laterals shall be adapted to the local climatic conditions, e.g. for wind speeds between 10 km/h and 15 km/h, the maximum recommended sprinkler spacings shall be 40 % of the radius of throw between sprinklers and 60 % of the radius of throw between laterals.

6.3 Pipe water transport characteristics

For one subunit the number of sprinklers per lateral as well as the lateral and main-line or sub-main-line diameters shall be designed to obtain a 10 % maximum nominal flow variation for sprinklers on the same subunit, representing a 20 % pressure variation.

When this cannot be achieved, pressure in the subunit shall be increased and pressure regulators shall be installed on the sprinklers where the pressure is too high.

Angles allowed between pipes should always ensure system water tightness.

If drainage is necessary or when freezing risk occur, draining devices should be supplied. They shall be located at the system lowest points.

On the lateral design layout plan the following shall be indicated:

a) Sprinkler location

b) Sprinkler and lateral spacings. Valves and special components locations.

c) Minimum and maximum values of pressure and flow for each irrigation subunit.

7 System description

7.1 General

For installation the installer shall supply a detailed design layout plan indicating the following elements:

7.2 Description of sprinklers

For each model indicate:

a) Manufacturer

b) Model

c) Diameters of nozzle(s)

d) Flow in function of the pressure

7.3 Description of pipeline network

For each type of pipeline indicate:

a) Nominal pressure

b) Diameter

c) Type of coupling used

7.4 Description of valves and special components

For each component indicate:

a) Manufacturer

b) Size

c) Type (i.e. manual, automatic, etc.)

7.5 Localization of equipment

For each component used in the installation indicate its exact location on the design layout plan.

8 Legal authorizations

Many agencies, associations and organizations are involved in water resource use.

All parties concerned shall be identified in advance and necessary authorizations shall be obtained to ensure the availability of a sufficient flow for the project under consideration.

Bibliography

[1] ISO 8026:1995, Agricultural irrigation equipment - sprayers – General requirements and test methods.

[2] EN 12484-1, Irrigation techniques – Automatic turf irrigation systems – Part 1: Definition of the programme of equipment by the owner.

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