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Traveller irrigation machines —

Part 1: Operational characteristics and laboratory and field test methods

Machines d'irrigation mobiles —
Partie 1: Caractéristiques de fonctionnement et méthodes d'essai en laboratoire et au champ

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 8224-1 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 18, *Irrigation and drainage equipment and systems*.

This second edition cancels and replaces the first edition (ISO 8224-1:1985), which has been technically revised.

ISO 8224 consists of the following parts, under the general title *Traveller irrigation machines*:

— *Part 1: Operational characteristics and laboratory and field test methods*

— *Part 2: Softwall hose and couplings — Test methods*

This corrected version of ISO 8824-1:2003 incorporates the following corrections.

The French title has been corrected.

A redundant reference to the three travelling rate settings has been deleted from 6.2.2 b).

Cross-references have been corrected.

A typographical error in the title of Figure 6 has been corrected.

The y-axis legend fo Figure 7 d) has been corrected to indicate travel speed.

The arrows indicating pressure and flow rate in Figure 7 e) now correspond to the appropriate longitudinal variations shown on the graph.

The reference to the role of the third pressure gauge in 8.2.4 has been clarified.

In 8.4.3.1 d), the explanation of the ratio has been given its true sense. The same has been done in respect of the different ratio mentioned in 8.4.3.2.

Traveller irrigation machines —

Part 1: Operational characteristics and laboratory and field test methods

1 Scope

This part of ISO 8224 specifies the operational characteristics of, and laboratory and field test methods for, traveller irrigation machines. It includes

— user-oriented technical information for inclusion in the manufacturer's accompanying product literature,

— laboratory test procedures for evaluating the uniformity of water application on an irrigated strip by a machine operating within a specified range of conditions and for determining the maximum travelling rates the drive mechanism is able to achieve in response to specified operating conditions, and

— field test procedures for determining the uniformity of water application on a given irrigated strip under local conditions prevailing in the field at time of testing.

It is applicable only to traveller irrigation machines and not to other types of irrigation machine such as centre-pivot and moving lateral irrigation machines.

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.

ISO 7749-2:1990, *Irrigation equipment — Rotating sprinklers — Part 2: Uniformity of distribution and test methods*

ISO 8026, *Agricultural irrigation equipment — Sprayers — General requirements and test methods*

ISO 11545, *Agricultural irrigation equipment — Centre-pivot and moving lateral irrigation machines with sprayer or sprinkler nozzles — Determination of uniformity of water distribution*

3 Terms, definitions and symbols

For the purposes of this document, the following terms, definitions and symbols (see Table 1) apply.

3.1
traveller irrigation machine
machine designed to irrigate a field sequentially, strip by strip, by causing, through various coiling techniques, a cart equipped with a travelling water distribution system (sprinkler or gun-type sprinkler, combination of sprinklers and guns, boom with set of sprinklers, sprayers or other kinds of water distribution devices) to travel

across a field, and which is intended to be moved to, and operated from, several supply points established in advance in the field

NOTE There are three types of traveller irrigation machine, each having a structure that includes a reel, spool or winch and a travelling water distribution system.

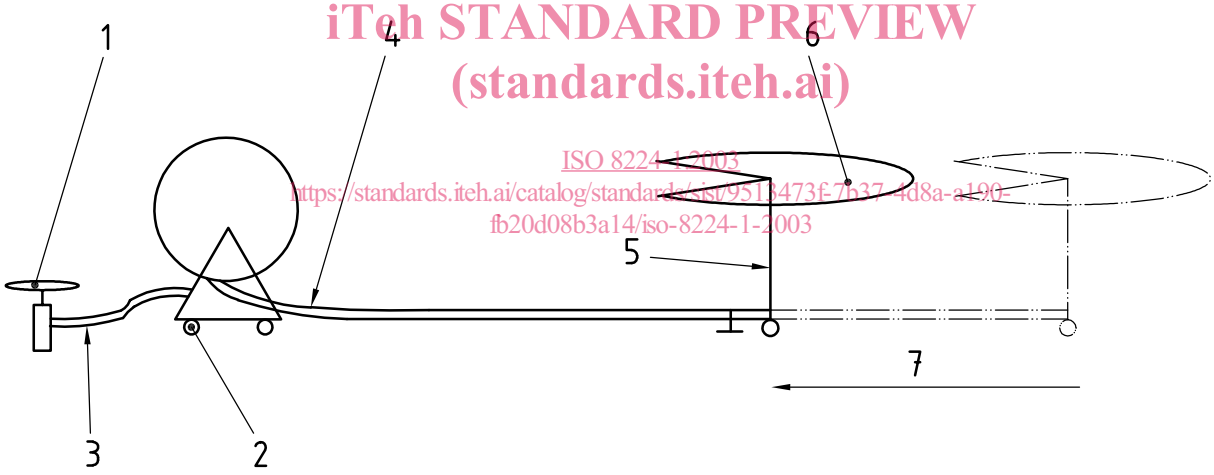
— Type 1 traveller irrigation machines feature a stationary reel with a hydraulic motor that coils and drags a distribution tube and a travelling cart that supports a water distribution system — commonly referred to as “reel machines” (see 3.2).

— Type 2 traveller irrigation machines feature a travelling winch with a hydraulic motor that supports a water distribution system, coils a tow cable and drags a distribution hose — commonly referred to as “travellers” (see 3.3).

— Type 3 traveller irrigation machines feature a travelling reel that supports a water distribution system with self-propelled wheels and coiling a stationary distribution tube — commonly referred to as “self-propelled reel machines” (see 3.4) — or they can be engine-driven machines.

3.2
reel machine
type 1 traveller irrigation machine featuring a stationary reel coiling a distribution tube that drags a travelling cart on which is installed a water distribution system (most often a gun-type sprinkler) and carries water to the water distribution system

See Figure 1.



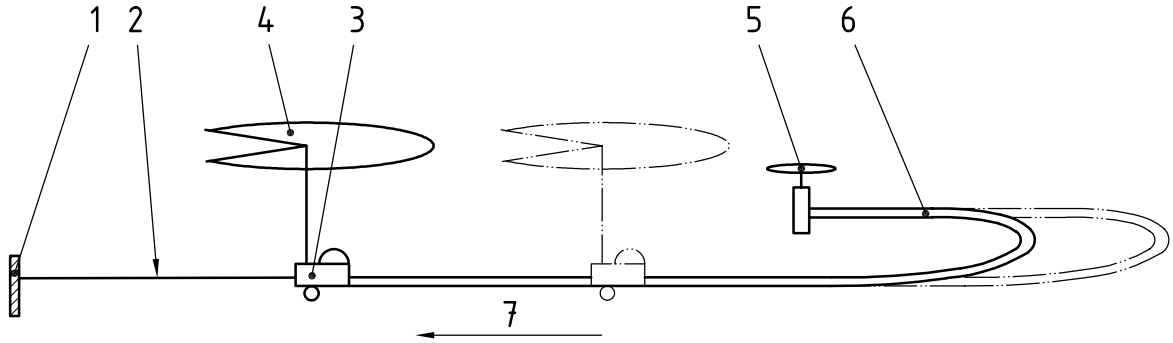
Key

1 water source
2 stationary reel
3 source connection conduit/hose
4 distribution tube — dragged
5 cart
6 water distribution device or system — gun, sprinkler, boom (on cart)
7 direction of movement

Figure 1 — Sketch of operating type 1 traveller irrigation machine — Reel machine

3.3
traveller
type 2 traveller irrigation machine featuring a travelling winch with hydraulic motor supporting a water distribution system, which coils a cable and drags a distribution hose

See Figure 2.



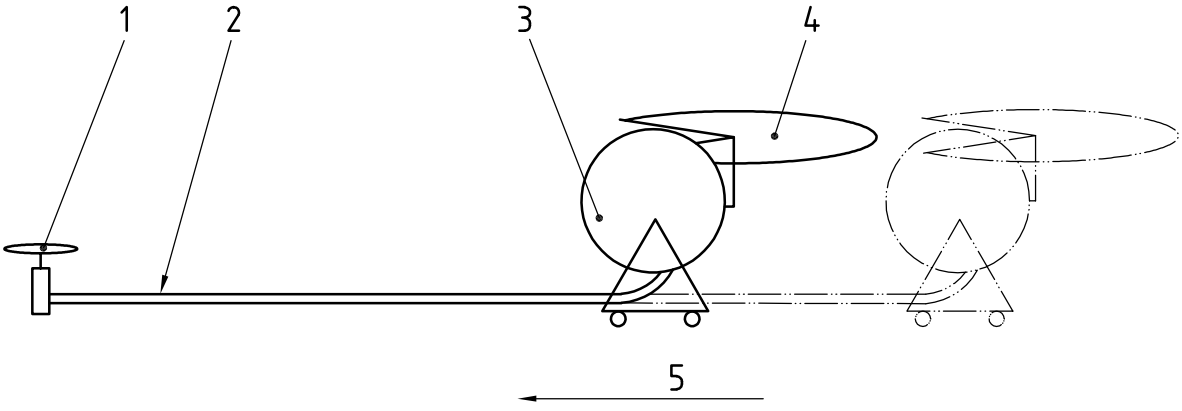
Key

1 tow cable anchor
2 tow cable
3 cart
4 water distribution device or system — gun, sprinkler, boom (on cart)
5 water source
6 distribution hose — dragged
7 direction of movement

Figure 2 — Sketch of operating type 2 traveller irrigation machine — Traveller

3.4
self-propelled reel machine
type 3 traveller irrigation machine featuring a stationary distribution tube that carries irrigation water to a travelling structure accommodating a reel on which the distribution tube is coiled, a drive train, self-propelled wheels and water distribution system

See Figure 3.



Key

1 water source
2 distribution tube
3 self-propelled structure
4 water distribution device or system — gun, sprinkler, boom (on self-propelled structure)
5 direction of movement

Figure 3 — Sketch of operating type 3 traveller irrigation machine — Self-propelled reel machine

3.5
water distribution system
sprinkling and travelling part of a traveller irrigation machine through which irrigation water is distributed and applied over a strip

EXAMPLE Sprinkler, gun-type sprinkler, combination of sprinklers and gun-type sprinklers, boom with set of sprinklers or sprayers

3.6
field resistance coefficient
α
coefficient characterizing the resistance drag force exerted by the field on a traveller irrigation machine whose water distribution system is travelling along a strip

3.7
distribution tube
in-field supply tube
polyethylene tube
supply line that conveys irrigation water along an irrigated strip to the water distribution system of a type 1 traveller irrigation machine (reel machine) and to the self-propelled structure of a type 3 traveller irrigation machine (self-propelled reel machine), and which can be partly lying on the field and partly coiled on the spool

3.8
distribution hose
softwall distribution hose
in-field supply hose
supply hose that conveys water from an irrigation water source along a strip to the water distribution system of a type 2 traveller irrigation machine (traveller)

3.9
source connection hose
source connection conduit
supply conduit or hose used to connect an irrigation water source to the stationary structure of a type 1 traveller irrigation machine (reel machine)

3.10
irrigation strip
lane
portion of a field irrigated sequentially by a traveller irrigation machine, typically consisting of a rectangle a few decametres wide by a few hundred metres long with an effective zone wetted by the water distribution system that significantly exceeds the dimensions of the strip and especially the width; some overlapping of the wetted patterns over adjacent strips often being required to maintain an acceptable uniformity of water application over the entire field

3.11
irrigation strip width
lane width
strip spacing
spacing between strips, i.e. distance between two adjacent travel paths of a cart

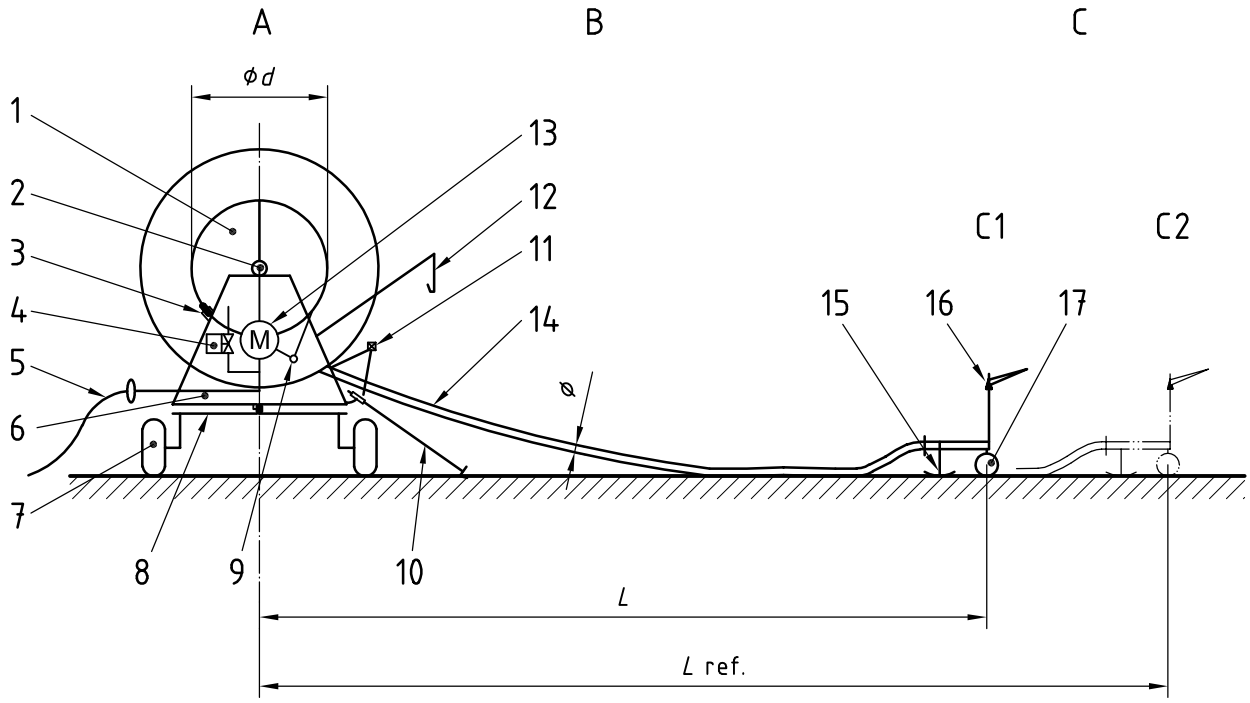
3.12
travel path
path within a strip where the water distribution system is supported during its irrigation travel on wheels or skids and where the distribution tube, distribution hose or tow cable is laid in contact with the field and dragged

3.13
length of travel
distance a traveller irrigation machine moves along its travel path within a strip, from starting point to final stop position, not exceeding the length of the distribution tube in the case of types 1 and 3 irrigation machines or twice the length of the distribution hose in the case of type 2

3.14
spool
component of a traveller irrigation machine, consisting of a drum with flanges, rotating on an axial shaft and designed for storing the part of the distribution tube (types 1 and 3 irrigation machines) or tow cable (type 2 irrigation machines) not lying in contact with the field; in the case of certain type 2 traveller irrigation machines, an additional component designed for storing the distribution hose when the machine is not irrigating

See Figure 4.

3.15
coefficient of variation
C_v
ratio of the standard deviation to the mean of a variable that is repeatedly measured



Key

A structure
B distribution tube
C cart or trolley
C_1 current cart or trolley position
C_2 most distant cart or trolley position

1 spool drum
2 shaft of spool
3 brakes of spool
4 control device for water distribution system travel
5 machine-source connection hose (supply hose)
6 spool support — fixed or orientable turntable
7 wheel
8 chassis
9 external power shaft
10 stabilizer legs
11 distribution tube guide mechanism
12 cart (or trolley) lifting device
13 hydraulic drive (turbine or piston) and drive train
14 distribution tube (usually polyethylene tube)
15 cart skid
16 water distribution system — irrigation sprinkler(s), sector-adjustable gun-type sprinkler, boom or other system
17 cart wheel

d spool drum diameter
∅ distribution tube outer diameter
L_{ref} distribution tube reference length
L current length of moving portion of distribution tube laid down and dragged on field

Figure 4 — Type 1 traveller irrigation machine (reel machine) — Main parts

Table 1 — Symbols

Symbol	Description	Unit
d	Spool drum diameter	m
E	Irrigation strip width, also called strip spacing	m
F	Field resistance force	N
F_{bench}	Actual resistance force applied using the bench	N
F_{ref}	Desired resistance force	N
h_{Ai}	Mean application depth at line i collected while the water distribution system travels a segment equal to the wetted radius	mm
h_{As}	Mean application depth averaged over the strip	mm
h_{GA}	Gross application depth	mm
h_{GAseg}	Gross application depth over a segment	mm
I_i	Reference application rate for line i	mm/h
I_s	Reference application rate for the strip	mm/h
L	Length of part of the distribution tube or distribution hose lying on the field and dragged (types 1 and 2), or length of part of distribution tube lying on the field (type 3)	m
L_{ref}	Length of the distribution tube or hose	m
L_s	Length of the strip	m
L_{travel}	Travel distance of the water distribution system	(m)
P	Weight per unit length of the distribution tube or hose when full of water	N/m
P_{Total}	Total weight of the traveller irrigation machine when full of water	N
q	Test flow rate	m^3/h
R_{wet}	Wetted radius	m
s	Spacing between collectors on a line	m
T	Duration time for irrigation	h
v	Travel speed of the water distribution system	m/h
v_i	Travel speed of the water distribution system at line i, computed as the mean travel speed over a segment equal to the wetted radius	m/h
v_s	Travel speed of the water distribution system computed as the mean travel speed over the strip	m/h
α	Field resistance and slope coefficient	(dimensionless)
ΔL_{seg}	Segment length (travel distance across a segment)	m
ΔV_{seg}	Volume of water distributed over a segment	m^3
$\varnothing$	Distribution tube or hose diameter	mm

4 Functional aspects and technical information

The recommended range of operation and other functional aspects relevant for the users of the traveller irrigation machine shall be specified and included in the documentation accompanying the traveller irrigation machine. These shall include at least the following specifications:

a) recommended minimum and maximum working pressures at the machine inlet connection;

b) recommended maximum permissible pressure in any situation at the machine inlet;

c) recommended minimum and maximum flow rates;

d) distribution characteristics of the recommended water distribution system or systems;

e) length, diameter and wall thickness of the distribution tube or distribution hose;

f) recommended maximum road towing speed;

g) recommended maximum land gradient when operating;

h) recommended maximum coiling speed;

i) recommended maximum external power shaft speed, if applicable;

j) safety instructions;

k) operating instructions.

5 Test specifications

5.1 General

The tests include

— laboratory uniformity tests (see Clause 6),

— laboratory drive tests (see Clause 7), and

— field uniformity tests (see Clause 8).

Conduct the tests in accordance with the following specifications for test liquids and machine sampling and preparation.

5.2 Test liquid

5.2.1 General

Traveller irrigation machines are intended to operate with unfiltered or coarsely filtered irrigation water that may occasionally or continuously carry clogging materials of various types, sizes and concentrations. Consequently, traveller irrigation machine hydraulic control lines or hydraulic drive circuits are often equipped with filters or centrifugal separators.

5.2.2 Field uniformity tests

For the standard test liquid in field uniformity tests, use the irrigation water available on the test field, unmodified for the purpose of the test by filtration, injection of chemicals or by any other process, unless specifically requested by the client.

5.2.3 Laboratory uniformity and drive tests

For the standard test liquid in laboratory uniformity tests and laboratory drive tests, use irrigation water at a temperature of between 4°C and 35°C, in which the concentration of clogging materials is not more than 1 g/l and which has passed through

— a 5 mm aperture screen, if the water distribution device is a gun-type sprinkler, or

— a 500 µm aperture screen, if the water distribution device is not a gun-type sprinkler.

Optionally, upon client request, after running the traveller irrigation machine reference tests with the standard test liquid, the tests may be run again with water having an increased range of sizes or concentrations, or both, of clogging materials, or with other liquids together with extended information on the traveller irrigation machine's performance.

5.3 Calculation of field resistance coefficient

Calculate the value of the coefficient, α, characterizing the resistance drag force exerted by the field on a traveller irrigation machine when its water distribution system travels along a strip, as follows.

— For types 1 and 2 traveller irrigation machines: as the ratio between the field resistance force and the weight of the part of the distribution tube or hose lying on the field and being dragged at that time, using the equation

$$\alpha = \frac{F}{P \times L}$$

where

α is the field resistance coefficient (dimensionless);

F is the field resistance force, in newtons;

P is the weight per unit length of the distribution tube or hose full of water, in newtons per metre;

L is the length of that part of the distribution tube or hose lying on the field and dragged, in metres.

— For type 3 traveller irrigation machines: as the ratio between the field resistance force and the weight of the machine inclusive of the coiled part of the tube, using the equation

$$\alpha = \frac{F}{\left[P_{\text{Total}} - (P \times L)\right]}$$

where

α is the field resistance coefficient (dimensionless);

F is the field resistance force, in newtons;

P is the weight per unit length of the distribution tube or hose full of water, in newtons per metre;

L is the length of that part of the distribution tube or distribution hose lying on the field, in metres;

P_{Total} is the total weight of the traveller irrigation machine full of water, in newtons.