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ΕΛΛΗΝΙΚΗ ΤΕΧΝΙΚΗ ΠΡΟΔΙΑΓΡΑΦΗ

HELLENIC TECHNICAL SPECIFICATION

Εγκατάσταση αρδευτικών δικτύων

Construction of plant irrigation networks

Pricing class:**14**

Preamble

This Hellenic Technical Specification revises and replaces ELOT TS 1501-10-08-01-00:2009.

This Hellenic Technical Specification was prepared by Experts and checked and evaluated in its field by a Curator/Special - Expert, who assisted the work of the Technical Committee ELOT/TE 99 “Specifications of Technical Works”, the secretariat of which belongs to the Directorate for Standardisation of the Hellenic Organization for Standardization (ELOT).

The text of this Hellenic Technical Specification ELOT TS 1501-10-08-01-00 was adopted on 2021-06-04 by ELOT/TE 99 in accordance with the Regulation on the drafting and publication of Hellenic Standards and Specifications

The European, international and national standards referred to in the standardisation references are available by ELOT.

HELLENIC ORGANIZATION FOR STANDARDIZATION
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Content

Introduction

This Hellenic Technical Specification (HTS) is part of the technical texts originally prepared by the Ministry for the Environment, Spatial Planning and Public Works and the Institute for Constructions Economy (IOK) and was subsequently edited by ELOT in order to be applied to the construction of national public technical works, with a view to produce works that are robust and capable of meeting and satisfying the needs which have dictated their construction, and be beneficial for the society as a whole.

Under a contract between NQIS/ELOT and the Ministry for Infrastructure and Transport (online publication number 6ΕΟΒ465ΧΘΞ-02Τ), ELOT was assigned the editing and update as 2nd Edition of three hundred fourteen (314) Hellenic Technical Specifications (HTS), in accordance with the applicable European Standards and Regulations and the procedures laid down in the Regulation on the drafting and publication of Hellenic Standards and Specifications and in the Regulation on the establishment and operation of Technical Standardization Instruments.

This Hellenic Technical Specification has been developed by the Association of Economic Operators ADT OMEGA S.A. OBERMEYER HELLAS LTD. — Consultancy Engineers, HYDROMENT Consultants ENGINEERS S.A. contractor of the restricted tendering procedure No 1/2020 for the award of the project “Revision 1st edition 314 HTS” and was audited and evaluated by a Curator/Special – Expert in its subject matter.

This HTS covers the requirements arising from the EU law, the relevant New Approach Directives currently in force and the National Law, and refers to and is compatible with harmonised European standards.

Construction of plant irrigation networks

1 Objective

The purpose of this Technical Specification is to define the requirements for the supply and installation of the required equipment and components of the plant irrigation networks of green spaces and sports facilities.

2 Standardization references

This Technical Specification incorporates –by way of references– provisions of other publications, whether dated or not. These references refer to the respective parts of the text and a list of these publications is presented thereafter. In case of references to dated publications, any subsequent amendments or revisions thereof shall apply to this document when incorporated in it by means of amendment or revision.

ELOT 843	*Polyvinyl chloride insulated and sheathed power cables for rated voltage 600/1000 V -- Καλώδια ονομαστικής τάσης 600/1000 V με μόνωση και μανδύα από πολυβινυλοχλωρίδιο (PVC)*
ISO 8779	*Plastics piping systems - Polyethylene (PE) pipes for irrigation - Specifications*
ELOT EN ISO 1452-1	*Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure - Unplasticized poly(vinyl chloride) (PVC-U) - Part 1: General -- Συστήματα πλαστικών σωληνώσεων για παροχή νερού και υπόγεια και υπέργεια δίκτυα αποστράγγισης και αποχέτευσης υπό πίεση - Μη πλαστικοποιημένο πολυ(βινυλοχλωρίδιο) (PVC-U) - Μέρος 1: Γενικά*
ELOT EN ISO 1452-4	*Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure - Unplasticized poly(vinyl chloride) (PVC-U) - Part 4: Valves -- Συστήματα πλαστικών σωληνώσεων για παροχή νερού και υπόγεια και υπέργεια δίκτυα αποστράγγισης και αποχέτευσης υπό πίεση - Μη πλαστικοποιημένο πολυ(βινυλοχλωρίδιο) (PVC-U) - Μέρος 4: Βαλβίδες*
ELOT EN ISO 4064-1	*Water meters for cold potable water and hot water - Part 1: Metrological and technical requirements -- Μετρητές νερού για κρύο πόσιμο νερό και για ζεστό νερό - Μέρος 1: Μετρολογικές και τεχνικές απαιτήσεις*
ELOT EN ISO 9261	*Agricultural irrigation equipment - Emitters and emitting pipe - Specification and test methods -- Γεωργικός αρδευτικός εξοπλισμός - Διανομείς και σωληνώσεις διανομής - Προδιαγραφές και μέθοδοι δοκιμής*
ELOT EN 1074-1	*Valves for water supply-fitness for purpose requirements and appropriate verification tests - Part 1 : General requirements -- Βαλβίδες για τροφοδοσία νερού - Απαιτήσεις καταλληλότητας και σχετικές δοκιμές επαλήθευσης - Μέρος 1: Γενικές απαιτήσεις*
ELOT EN 1092-1	*Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated - Part 1: Steel flanges -- Φλάντζες και οι*

	συνδέσεις τους - Κυκλικές φλάντζες για σωλήνες, δικλείδες, ειδικά τεμάχια και εξαρτήματα, χαρακτηρισμένα με PN - Μέρος 1: Χαλύβδινες φλάντζες
ELOT EN 1092-3	*Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated - Part 3: Copper alloy flanges -- Φλάντζες και οι συνδέσεις τους - Κυκλικές φλάντζες για σωλήνες, δικλείδες, ειδικά τεμάχια και εξαρτήματα, χαρακτηρισμένα με PN - Μέρος 3: Φλάντζες από κράμα χαλκού*
ELOT EN 1515-1	*Flanges and their joints - Bolting - Part 1: Selection of bolting -- Φλάντζες και οι συνδέσεις τους - Σύνδεση με κοχλίες - Μέρος 1: Επιλογή σύνδεσης με κοχλίες*
ELOT EN 10220	*Seamless and welded steel tubes - Dimensions and masses per unit length -- Χαλύβδινοι σωλήνες άνευ ραφής και συγκολλητοί - Διαστάσεις και μάζες ανά μονάδα μήκους*
ELOT EN 12201-2 +A1	*Plastics piping systems for water supply, and for drainage and sewerage under pressure - Polyethylene (PE) - Part 2: Pipes -- Συστήματα πλαστικών σωληνώσεων για ύδρευση καθώς και για αποστράγγιση και αποχέτευση υπό πίεση - Πολυαιθυλένιο (PE) - Μέρος 2: Σωλήνες*
ELOT EN 12484-4	*Irrigation techniques - Automatic turf irrigation systems - Part 4: Installation and Acceptance -- Τεχνικές άρδευσης - Αυτόματα συστήματα άρδευσης σε εκτάσεις πρασίνου - Μέρος 4: Εγκατάσταση και Αποδοχή*
ELOT EN 12484-5	*Irrigation techniques - Automatic turf irrigation systems - Part 5: Testing methods of systems -- Τεχνικές άρδευσης - Αυτόματα συστήματα άρδευσης σε εκτάσεις πρασίνου - Μέρος 5: Μέθοδοι δοκιμών των συστημάτων*
ELOT EN 12734	*Irrigation techniques - Quick coupling pipes for movable irrigation supply - Technical characteristics and testing -- Τεχνικές άρδευσης - Σωλήνες ταχείας σύνδεσης για κινητά συστήματα άρδευσης - Τεχνικά χαρακτηριστικά και δοκιμές*
ELOT TS 1501-08-06-02-01	*Pressurized u-PVC pipe networks -- Δίκτυα υπό πίεση από σωλήνες u-PVC*.

3 Terms and definitions

The following terms and definitions are used in this Technical Specification:

3.1 Water distribution with drops (drip irrigation)

The distribution of water is carried out locally (local irrigation) in part of the plant's rhizosphere, using dispensers (injectors) through a surface or underground installation. It is applied for irrigation of trees, shrubs, annual plants, cover plants, etc. It is also used in irrigation of lawns in special cases:

- when neighbouring areas should not be wet to avoid accidents, etc.
- when plants that are susceptible to flushing are present on the lawn
- where water from waste water treatment is used
- in places with great traffic to avoid vandalism etc.

It shall not be used if the lawn is sown.

This method achieves better water management because it is characterised by controlled dosage and high quality of maintenance of optimal moisture in the soil.

3.2 Distribution of water by sprinkler

The water is distributed by launchers across the irrigated surface. It is mainly applied for irrigation of lawns, land cover, etc.

Note: Spray irrigation in this Technical Specification is treated as a variant of local irrigation (irrigation with drops).

It is not appropriate to apply the method:

- When strong winds prevail
- During the periods of the day when there is intense sunshine and dryness of the air
- When the water has increased salinity and fermented materials.

3.3 Plant irrigation network parts

a. Power source (water intake)

The water supply source can be drilling, well or reservoir, an open pipeline or an already existing core network with closed pipes under pressure.

The required pressure can be obtained either directly from the same water source (drilling, closed pressure networks), gravity (in the case of overhead tanks) or by installing pressure assemblies at the water source or intermediate in the transmission network to increase the pressure, if necessary.

b. Central water treatment and control head

- Controls the flow of water through check valves, manual valves, center valves (MV), pressure regulators, control valves etc.
- Cleans irrigation water from suspended solid particles through a series of filters.
- It provides the possibility of fertilising through the plant irrigation network.

c. Primary Network: it concerns the transmission lines from the water abstraction sources to the Central Head and from there to the Irrigation Control Heads

- Main or irrigation pipelines. The usual cross-sections applied are Φ 90, Φ 63 and/or Φ 50/16-10 atm and in many cases and larger.
- Primary irrigation network control and safety equipment

d. Secondary Network

- Irrigation Control Wells (ICW) and corresponding equipment (Irrigation Control Heads)
- Network of water transfer pipes from primary to tertiary network with standard cross sections Φ50, Φ40, Φ32/10 atm)
- Irrigation planning and control installations

e. Third Network

Drop water distribution lines are usually manufactured from pipes Φ16 PE 6 atm or Φ20 6-10 atm

The tertiary network includes the dripers of corresponding cross-sections and pressures as well as the microtubes of sections Φ4, Φ6, Φ8 and Φ12 with a nominal pressure of 10 atm.

Their cross-sections are selected on the basis of the required facilities, available and required pressures, terrain, water needs, etc. as defined in the Study. Includes:

- Transmission lines

- Equipment (dripers, wiring materials, wells, etc.)

Sprinkled water distribution lines are usually constructed from PE pipes with a nominal pressure of 6-10 atm, of cross section Φ25 or Φ32, depending on the available facilities, the available and required pressures, the terrain of the soil the water needs, etc. according to the provisions of the Study.

- Equipment (launchers, coupling materials, ventilation valve shafts, etc.).

Note: The above formal separation of sections and the dimensioning of materials may change in the Study

3.4 British Standard Pipe (BSP)

This is a series of British Standards for the standardisation of threaded pipe fittings that has been adopted internationally for the fittings and sealing of pipes and fittings with internal and external thread muffles (male and female). Exceptionally in North America the standardisation NPT is applied.

4 Embedded materials – Acceptance criteria

4.1 General

Before the start of the works, the Contractor should submit to the Competent Authority for approval a complete list of the materials it intends to incorporate into the project, accompanied by factory technical leaflets with their characteristics, reports of the required laboratory tests and inspections, installation instructions, etc.

The materials and components incorporated should comply with the provisions of the Study and the requirements of this Agreement. Supplies and materials not approved by the Competent Authority may not be installed in the Project.

In order to facilitate arrangements, maintenance and repairs, similar appliances are recommended to be of the same type and factory, which simplifies their replacement processes, not only during construction but also throughout the life of the network, as long as these types of components continue to be marketed.

Please note that for PVC-U plastic tubes (according to ELOT EN ISO 1452-1) and PE (according to ELOT EN 12201) used in irrigation networks, the provisions of UNHCR apply. 14097/757/04.12.2012 [1], as amended by Ministerial Decision ref. no. 114233/7-9-2019 [2], “Control of technical specifications of plastic pipes and fittings for the transport of drinking water, sewerage and underfloor heating” as applicable. These tubes should be accompanied by appropriate certificates.

4.2 Main supply line

4.2.1 General

The main power line includes:

- Transfer tube from HDPE according to ISO 8779 & ELOT EN 12201
- Water abstraction & filter head
- Linkage (mechanical links)

The central head is placed in the position provided for in the irrigation study.

All connections along the central head, up to the connection to the transmission lines, as well as between the arrays, are made with metal components (fittings, crosses, tau, tubular, collectors, etc.) galvanised or – if they are to be painted – black.

4.2.2 Central valves

It should be placed at the entrance of the central head. A spherical hydrant or sliding valve is used for cross sections up to 1“and sliding valves or elastic locking valves for cross sections of 1½” and above. Spherical hydrants with a cross section of more than 1½” are not reliable and can cause a blow during handling.

4.2.3 Centrifugal water filter

A centrifugal filter or array of parallel connected centrifugal filters should be installed when the water contains sand and in all cases where the water comes from drilling, well, open pipe, etc.

Their cross-section is chosen according to their operation, so that they are within the limits given by the manufacturer, for the correct water centrifuge speed.

4.2.4 Sand filter

Sand filter (chiral filter) or array of parallel connected sand filters should be installed when the water contains organic substances (algae, etc.) and in all cases where the water comes from an open pipe, open tank, etc. The sand filter shall have the largest possible filtering area in relation to its volume. Horizontal filters or vertically low height are usually suggested. The sand shall be quartz with a particle size capable of filtering equivalent to 200 mesh.

The cross-section of the filters shall be selected so that the pressure losses in the filters are less than 0.50 atm. Depending on the organic content of the water and the possibility of non-frequent cleaning, the required filtering surface is selected.

4.2.5 Lubricating head

The Injective Lubrication Pump is a Venturi type, made of special material with high resistance to chemicals and without moving parts, so that it does not require any maintenance at all. For its operation, it does not require any form of energy other than the water of the grid.

The pressure losses of the network for its operation are particularly low, in the order of 20 %. It has a cross-section from ½“to 2” (BSP) and is connected to the network by a parallel branch (BY PASS), through a valve adjusting the required differential pressure for its operation.

The aspiration of water-soluble fertilisers or other chemicals, with a constant concentration throughout application, is carried out from an open container without the need for a specific specification in pressure, volume or construction. It has a special non-return valve attached to the suction to avoid returning the water to the lubricating vessel.

4.2.6 Screen or tray filter

Screen or disc filters or array of parallel connected screen filters or discs should be installed in all cases, regardless of whether the water is clean or not.

If irrigation is also carried out with injectors, the filter can be 120 mesh density, and if there are only launchers it should be at least 120 mesh.

The cross-section of the filters shall be selected so that the pressure losses in the filters are less than 0.50 atm. Depending on the purity of the water and the possibility of or non-frequent cleaning, the total required filtering surface is selected.

4.2.7 Master valve

It is recommended to place it in order to interrupt the water supply when watering is not carried out to protect the network.

4.2.8 Output collector

As prescribed in the plans.

4.2.9 Manometers

Mandatory manometer positions are, in addition to pressure regulators, the positions before and after the filters.

4.3 Piping

a. Polyethylene tubes (PE)

PE tubes used in the tertiary network of dripers or without drips, when made of LDPE, shall be rated pressure of 6 atm (for cross sections up to Φ 32) and when made of HDPE at a nominal pressure of 10 atm (for sections above Φ 40) and in accordance with ELOT EN ISO 9261 and ISO 8779 with appropriate connection (irrigation components, injectors, dripers).

For the secondary network, transfer tubes from HDPE according to ISO 8779 & ELOT EN 12201-2+A1 are used with appropriate connection.

For the Primary Network and for a nominal working pressure of 10 atm or more, they shall be made of 3 rd generation material in accordance with ELOT EN 12201-2+A1 and ISO 8779.

In road or rail works, the irrigation lines of the tertiary network – due to their particular durability requirements over time and mechanical stresses, combined with the smaller wall thickness for the safe placement of the recessed drip and the creation of greater tensions in the dripping area – may consist of tubes with a minimum wall thickness of 2.0 mm for cross sections Φ16 and 2.3 mm for sections Φ20 (SDR 11 series tubes).

Pipes shall be marked per metre in length with their nominal diameter, working pressure, manufacturer and length numbering from the beginning of the bun. Optionally, the name of the Lord of the Project may also be indicated.

In pipe – cable passages PE and PVC pipes of 4 or 6 atm may be used.

b. PVC tubes (see Technical Specification of ELOT TS 1501-08-06-02-01).

PVC-U pipes used in the primary network should have a nominal pressure of 10 atm and meet the requirements of ELOT EN ISO 1452-1.

c. Pipes galvanised seamlessly (tubo) according to ELOT Standard EN 10220.

Connections between different types of pipes and fittings should be made with case-specific fittings, approved by the Competent Authority.

- Iron tubes

  Connections between metal fittings and iron tubes should be sealed with a dense mixture of graphite and oil, inert play and oil, a mixture of graphite or hemp and Teflon, hemp and mini or hemp and grease.

- PVC pipes

  Connections should be made according to the type of pipes and in accordance with the manufacturer's instructions (see also ELOT TS 1501-08-06-02-01: Pressurized u–PVC pipe networks

- PE pipes

  See Chapter 3.12

4.4 Support stakes

- Concrete reinforcement steel piles with a diameter Φ 8 mm and a length of approximately 0.40 m, bent at the top in the shape of a hook.

- Plastic piles supporting tertiary irrigation pipes made of hard PVC or PE.

4.5 Fittings of metal

a. Galvanised connection accessories.

b. Special cast iron pieces.

c. Flanges.

d. Iron pipe collectors.

They are made of seamless tube (tubo), according to ELOT EN 10220, are threaded and have adhesive stoppers and the necessary inlet-outlets for ventilation valves etc. The system after construction is subject to immersion in a galvanising bath. The cross-section of the body is the immediately larger of the inlet orifice cross section.

4.6 Network control and security devices

- Spherical hydrants made according to ELOT EN 1704-1 Standard
- Elastic locking valves.
- Stripped brass drawers with threaded.
- Brass hydrometers, dry, multiple burst, according to ELOT EN ISO 4064-1
- WOLTMAN Hydrometers.
- Water Meter Electric Outlet.
- Mobile ventilation valves, plastic or metallic (excluding spherical type).
- Automatic ventilation valve, plastic or metallic (excluding spherical type).
- Double-energy ventilation valve, plastic or metallic (excluding spherical type).
- Elastic locking check valves suspended disc type.
- Tweet check valves or with spring or other mechanism.
- Pressure reducers.
- Glycerin manometers Φ63.

4.7 Hydraulic valves

4.7.1 General

Hydraulic valves incorporated into the network need to have the following characteristics:

- It shall be of acceptable construction quality and should be accompanied by the corresponding technical characteristics leaflets and instructions for adjustment and maintenance. The manufacturer shall have a complete series of valve guides to configure any function (or combination of functions) of the valve, e.g. pressure adjustment, pressure retention, flow control, etc.

- They shall bear engravings or signs attached to their bodies with at least the following information: Factory, country of production, manufacturing material, nominal diameter, nominal operating pressure, kind of valve and year. Pilots should indicate the pressure range for the respective operation, e.g. in the case of pressure adjustment: P_{Input} 16 Bar – $P_{outp.}$ 16 Bar.

- They shall have a maximum operating temperature of at least 80 °C.

- Valves made of PVC-U (non-laminated polyvinyl chloride) should meet the requirements of ELOT EN ISO 1452-4 standard

4.7.2 Valve body

It will be spherical and hydrodynamically configured, without standing pockets for low pressure losses. The passage area shall not be less than 80 % of the nominal diameter of the valve and shall not insert a mesh in the transit area for reduced maintenance. Also have an evacuation exit with a cap at the bottom for evacuation in case of frost.

All valves shall be capable of being maintained in situ by removing the top cap.

4.7.3 Pilot circuit

All valve control tubes shall be copper, even if there is no reason to press, to ensure their mechanical strength, the pilot's body is brass, its inner parts of stainless steel and the polyamide-coated neoprene diaphragm. The method of construction shall be such as to enable the circuit to be interfered with even when the valve is in operation.

The valve shall have an appropriate manual bypass mechanism.

4.7.4 Types of valves

a. Single chamber hydraulic valves (PN 16)

   The body of the valve should be made of cast iron with strong epoxy dye for antioxidant protection. The valve (when it is flange) shall be such that it is interchangeable with drawer valves (oval type) with length L=200+DN, with flanges according to ELOT EN 1072-1. The diaphragm shall be of non-toxic rubber, suitable for drinking water, and the spring shall be made of stainless steel class AISI 304. The valve should carry a filter for the control water and be suitable for non-purified water, with a mexmaximum working pressure of 16 bar.

b. Double chamber or equivalent hydraulic valves (PN16 and PN25)

   The body should be of malleable cast iron of minimum quality GGG40, painted with suitable epoxy dye (e.g. polyurethane resin) at a thickness of at least 150 μm.

4.8 Filters

a. Plastic water filters (mesh or discs)

   The central line filter can be made of polyamide reinforced with glass fibres, or ABS. Its working pressure shall not exceed 10 atm and shall be fitted with suitable manometer sockets at the inlet and outlet as well as a cleaning valve.

   Other line filters may be made of PP with an operating pressure of up to 6 atm.

b. Metallic water filters (mesh or discs)

   They are horizontal or angular, flange or threaded and at an operating pressure of 8 atm. They are painted with epoxy paint after special anti-corrosion treatment (galvanising) of an appropriate thickness. They should be fitted with manometer sockets at the entrance and exit to check their purity, a lid with easy opening and a van for cleaning.

c. Sand filters

   Vertical or horizontal, metallic with epoxy dyed or galvanised, 8 atm, simple or double chamber, with assembled by-pass cleaning system and quartz sand.

d. Centrifugal water filters, galvanised or stainless, Lakos type, rated pressure 8 atm.

e. Centrifugal cyclone water filters, metallic epoxy-painted or galvanised, with a nominal pressure of 8 atm.

4.8.1 Plastic tanks made of hard polyethylene (PE)

The tanks shall be made of hard polyethylene (HDPE), with a cleaning valve and a threaded lid.

4.9 Distributors

4.9.1 Top-end injectors

Self-adjusting injectors, self-cleaning (with pressure compensation)

The body should be made of polyethylene resin or equivalent materials resistant to low pH values, as well as chemicals, fertilisers and chlorine.

The flow adjustment is done with a silicone diaphragm or other suitable material. It shall be possible to self-clean at the compression stage and open and clean the injector without affecting its hydraulic characteristics.

The supply capacity is 2, 4, 8, 165 or 24 l/h. The flow rate should not be affected by fluctuations in water temperature. Permissible operating pressures range from 0.6 to 4.0 atm, with an upper permissible deviation of ± 10 per cent from the nominal flow rate. The coefficient of variation between injectors shall not be greater than 5 %. The entrance stalk shall be of cross section Φ 4 or 6 mm in the visiting injectors and Φ 6 mm in non-visible.

4.9.2 Dripers

- Stroller Φ16-20 with long track injectors

  From PE, with built-in short or long-distance injectors, with labyrinth, uniformity in the supply of injectors with operating pressure 1-3 atm.

- Driper Φ16-20 with self-adjusting injectors

  From linear PE, with built-in long-track injectors, including a labyrinth and self-regulating chamber with a silicone membrane uniformity in the delivery of stilets with a self-regulating pressure range between 0.8 – 3.50 atm.

- Driper Φ16-20, with self-adjusting drips and runoff deterrence mechanism

  From linear PE, with built-in long trip drimmers with labyrinth, self-regulating chamber with silicone membrane and water drain prevention mechanism from the tube. The uniformity in the supply of drips should be with a range of self-regulation pressures between 0.8 – 3.50 atm.

- Driper Φ16-20, with radical repellent, with self-adjusting drips

  Linear PE, with built-in long-distance dripers with maze and self-regulating chamber with silicone membrane. The uniformity in the delivery of the dripers should have a range of self-regulation pressures between 0.8 – 3.50 atm.

- Driper Φ16-20 with radical repellent, self-adjustable drips and anti-drain system.

  Linear PE, with built-in long-distance dripers with maze and self-regulating chamber with silicone membrane. There should be uniformity in the supply of injectors.

  The working pressure shall be between 0.8 and 3.50 atm. They should also be suitable for underground installation, with an integrated or external system to prevent radicals from entering it with a root repellent (integrated or special filter with a root repellent or external root repellent injector etc.).

- Driper Φ16-20 with radical repellent, with non-self-adjustable injectors.

It presents the same characteristics as the previous one, but with long-distance injectors that are not self-adjustable.

4.9.3 Launchers – Components

The mounting grid of the launchers shall be at least 10 % smaller than the radius of launching at the selected pressures and settings, and up to 50 % in wind-stricken areas.

All launchers should be of the same manufacturer. Launchers controlled by the same valve shall be of the same type.

The launchers shall be selected in such a way that their supplies are proportional to the surface area of the wetting surface (depending on the arc and the radius) and that the rain provided (mm/h) is less than the filterivity of the ground.

The pressures on the launchers shall be within the limits specified in the Study and in any case the operating pressure limits given by the manufacturer.

The pressure variation in the launchers shall not be greater than ±10 % of that selected in the Working Pressure Study. The selected working pressure shall be within the limits of the operating pressures given by the manufacturer, reduced by 20 %.

a. Self-lifting launchers (Pop Up), rotary, garnet type.

   They are made of ABS material or equivalent. They have a strong steel, stainless steel retractive spring and seal ring that is activated by pressure. They have internal cleaning filter under the lifting body or nozzle.

b. Pop Up of static type.

   They shall have an entrance of ½“BSP to the base of the nozzle and an additional ½” BSP input to the side of the body for launchers with a length of more than 20 cm. The operating pressure is between 1.4-2.8 atm. The nozzles are integrated or added to a fixed or adjustable sector and contain an anti-drip valve (antidrain). More specifically:

   i. Fixed sector nozzles

      They shall have a complete range of compatible nozzles with launch areas of 90°, 180°, 270° and 360° (should, regardless of the launch sector, give the same rain height) and if required to the project and nozzles of special shapes (square, ES, CS, SS, etc.) or another variety of compatible nozzles with various rays and launch areas, with characteristic colours, to meet the corresponding needs.

   ii. Adjustable sector nozzles.

      They shall be provided with a complete set of compatible nozzles covering launch distances of at least 2 m or less, if required by the morphology of irrigation areas, up to a minimum of 5 m.

      The launch sector shall be capable of being adjusted from 0° to 360°, with proportional adjustment of the flow rate, so that the rain height (amount of water per unit of irrigated surface) is stable.

   iii. Radial jet nozzles

      It shall be of adjustable arc, radial wetting of a radius of 4.5 – 9 m, having a rotation mechanism and having the following characteristics:

- at a pressure of 3 atm the flow rate at 180° be approximately 180 lt/h,
- for a launch radius of 9 m at 3 atm the flow rate at 180° shall be approximately 450 lt/h.

They will have an internal filter at the base of the nozzle, with easy access for cleaning. It is necessary to have a radius reduction screw of up to at least 25 % with a corresponding reduction in the flow rate (proportional wetting), and they will have a colour code for easy identification.

c. Pop Up launchers, short and medium distances.

- Radius 5-9 m, input ½'' BSP: Capable of adjusting the launch radius 5 – 9 m
- Radius 7-14 m, input ¾'' BSP: Capable of adjusting the launch radius 7 – 14 m
- Radius 12-18 m, 1'' BSP input: Capable of adjusting the launch radius 12 – 18 m
- Radius 15-22 m, 1'' BSP input: Capable of adjusting the launch radius 15 – 22 m

They are water lubricants or oil oils, operate with an anti-drip valve (antidrain) and anti-vandal protection ratchet and have the ability to "memory" the adjustment.

The lifting body shall be plastic or stainless steel and a height of at least 10 cm or more, if required. They shall contain at least 4 alternative nozzles or combinations of nozzles with different facilities, whether or not incorporated, to adapt the provisions to the sector and the launch radius to provide uniform wetting.

d. Self-elevating (Pop Up) launchers geared, long distances.

- Radius 18-28 m, 1½''BSP input: With 1½"BSP" input to the launcher base and an additional 1½" BSP input on the side of the body. Capable of adjusting the jet radius of 18-28 m and a lifting body of 7.5 m or more.
- Radius 24-30 m, 1½''BSP input: With 1½"BSP" input to the launcher base and an additional 1½" BSP input on the side of the body. Capable of adjusting the jet radius of 24-30 m and a lifting body of 10 m or more.
- Radius 28-33 m, 1½''BSP input: Capable of adjusting the launch radius 28-33 m.

They are hydro lubricants, with adjustable or fixed jet sector, whether or not integrated with an electrovalve and pressure regulator. They shall contain at least 4 alternative nozzles or combinations of nozzles with different facilities, whether or not incorporated, to adapt the provisions to the sector and the launch radius to provide uniform wetting.

Depending on the requirements of the study, they may carry, built-in or additives, plastic cover or covers made of synthetic lawn or cup for the development of natural turf.

e. Self-elevating (Pop Up) long-range impact launchers

The shell is made of ABS material or equivalent. The lifting piston can be plastic or brass. They have a strong stainless steel retractive spring. They have adjustable launch sector and integrated or non-electric valve and pressure regulator.

They shall contain at least 4 alternative nozzles or combinations of nozzles with different facilities, whether or not incorporated, to adapt the provisions to the sector and the launch radius to provide uniform wetting.

Depending on the requirements of the study, they may carry, built-in or additives, plastic cover or covers made of synthetic lawn or cup for the development of natural turf.

- Radius 14-22 m: With 1"BSP input to the launcher base and an additional 1" BSP input on the side of the body. Capable of adjusting the launch radius from 14 m up to and including 22 m
- Radius 18-30 m: With 1½"BSP" input to the launcher base and an additional 1½" BSP input on the side of the body. Capable of adjusting the launch radius from 18 m up to and including 30 m

- Radius 18-38 m: With 1½“BSP” input to the launcher base and an additional 1½" BSP input on the side of the body and an integrated or non-decoder for monocable connection. Capable of adjusting the launch radius from 18 m up to and including 38 m

- Radius 30-45 m: With 1½“BSP” input to the launcher base and an additional 1½” BSP input on the side of the body. Capable of adjusting the launch radius from 30 m up to and including 45 m

4.9.4 Launcher accessories

Triple modular arm: PVC, 1“or 1 ½” rated pressure 21 atm, with movable parts sealed by rubber seal. It is used to connect long-distance launchers, to protect the installation from possible pressures on the surface of the launchers, and to easily adjust height and horizontality.

4.10 Irrigation control apparatus

4.10.1 Electrovalves

a. Electrovalves common

They are diaphragmatic, linear or angular or a combination thereof. They have a spherical configuration with few movable parts. The body and lid are made of nylon reinforced with glass threads. Springs and all metal parts are stainless steel to prevent corrosion. Manually operated as internal relief valves, with or without manual flow control. They have the ability to repair the internal mechanism without dismantling the body from the network.

The nominal pressure is between 10-13.5 atm depending on the study, with operating pressures of at least 0.7 atm up to 10 atm and 0.7 atm up to 13.5 atm respectively (linear – angular).

Its “closure” is slow, to avoid a hydraulic shock (anti-stroke operation). The diaphragm is made of synthetic Buna N rubber, reinforced with nylon. For cross-sections of more than 2' they should have a self-cleaning filter.

b. Direct flow electrovalves

Electrovalves are diaphragm type, linear and rated pressure 10 or 12.5 atm.

They have the same technical characteristics as common electrovalves but operate at a nominal pressure of 10 or 12 atm and an operating pressure of at least 0.7-12.5 atm. For cross-sections above ¾’, they have a self-cleaning filter.

4.10.2 Electrovalve coils

- They are compact, made of anti-corrosion material. The piston (holding), springs and all metal parts are stainless steel, to avoid corrosion.

- Types of coils:

  - Common Current Programmer Inductors

    Operating voltage 24 V/AC, 50 Hz and max power 5 VA.

  - Lacing solenoid coils for battery programmers

    Operating voltage 9-18 Volt DC. Compatible with programmers. They adapt to the electrovalves directly or with a receptacle.

4.10.3 Programmes

4.10.3.1 Battery programmers

- One-stop home battery programmers

  Watertight programmers, operating on one or more single-stop batteries, whether or not incorporating a latching coil and a diaphragm type electrovalve “or 1”. Have a watering cycle of at least 1 to 7 days.

- Simple type battery programmers

  Programmers operating with one or more batteries and able to control between 2 and 12 or more electrovalves through latching at least 20 m shall have a cross-section cable of 1.5 mm^2, with at least 3 starts per 24 hours, a watering cycle of at least 1 to 7 days and a pump or master valve.

- Well battery programmers

  Watertight programmers with one or more batteries. They are placed in the shafts of the electric vans or in separate wells. Control 1 to 6 or more electrovalves through latching coils. They are programmed with a portable programming unit. They should have:

  - At least three start-ups per 24-hour period.
  - Watering cycle from at least 1 to 7 days.
  - Watering time from 1 min up to 12 hours at least.
  - Ability to operate manually without the console.
  - Pump start or master valve.
  - Ability to maintain the program for at least 3 minutes when switching the battery.
  - At least three programmes or independent program for each stop.

  The portable programming unit (console) has the ability to program an unlimited number of valves, from a distance of at least 3 m, regardless of the way of communication, the ability to review the program, independent programs for each valve, 6 repetitions per day and a watering duration of 1 min up to 24 hours.

- High-capacity battery programmers

  Programmers operating with one or more batteries and able to control between 1 and 12 electrovalves through locking coils, at a distance of at least 400 m shall include a 1.5 mm^2 cross-section cable, with at least three programmes, 8 starts per program per 24 hours, a watering cycle of 1 to 30 days, and pump or master valve selectively per program.

  There is the ability to connect to a sensor and overcircuit circuit of short-circuited coils, an indication of the state of the battery and the ability to connect to a solar collector.

4.10.3.2 Current programmers

Electronic or hybrid programmers with electromechanical programming characteristics, in a plastic or metallic (outdoor mounting) lock box, with integrated transformer and:

- Weekly scheduling or selection of days in a skip days from at least 1 to 15 days
- Button “On – Off” to isolate the programmer when required.
- Ability to start manually (manual) or irrigation cycle (semi-auto)
- Ability to start pump or central valve (master valve)
- Terminal with easy connection of cables

- Input 230 V/AC (50 Hz) and output 24 V/AC

a) Domestic Current Programmers

They should have:

- At least three independent programs for all electrovalves
- At least three start-ups per day per program
- Output at least 0,5 A per stop and 1.0 A total output
- Circuit for 9 V rechargeable battery to maintain the program in case of power failure and backup SOS program. The backup program operates each program for 10 min daily after reset, in case of prolonged power failure and battery depletion.

b) Professional Current Programmers

They should have:

- At least four independent programs for all electrovalves
- At least four start-ups per day per program
- Output at least 0,5 A per stop and 1.2 A total output
- Adjustable pump/central valve control per program
- Ability to change the operating times of the programs
- Uninterrupted circuit (maintenance of the program in case of battery-free power failure)
- Time delay between stops
- Ability to undo irrigation via sensor

c) Professional power programmers (16 to 42 stops)

They should have:

- At least four independent programs for all electrovalves
- At least twelve start-ups per day per program
- Output not less than 1.2 A per stop and 1,5 A total exit
- Adjustable pump/central valve control per program
- Possibility of a percentage change in the years of the programs
- Uninterrupted circuit (maintenance of the program in case of battery-free power failure)
- Time delay between stops
- Possibility of circular programs
- Ability to start, pause or undo irrigation through a suitable sensor.

4.10.4 Programmer accessories

a) Mono-cable operation unit (signal codec)

Mechanism for encoding the output signal from an Irrigation Electronic Programmer to convert a multi-cable programmer into a monocable. It should have 8 outputs, extending to 48 via expansion boards and capable of simultaneous operation of up to four electric vans.

b) Operation unit extension tile for monocable electrovan connection (signal codec), 8 exits

c) Electric van signal decoder for monocable electric van or pump connection.

Compatible with the above mentioned signal encoder, installed in the valve shaft and connected to its coil.

d Seatless, mono-cable signal decoder.

Compatible with the above mentioned signal encoder, installed in the valve shaft and connected to its coil.

4.11 Plastic wells

Round or rectangular (column cone or hollow pyramid type) plastic wells for underground installation of electric vans or other appliances and easy access to them. They should be made of high density polyethylene foam (HDPE) or polypropylene and with a green cap.

The wells should be of standard dimensions as provided for in the design and according to the manufacturer's tables.

4.12 JIVV-U cables (former NYY)

The programmer's connecting cables to the electrovalves shall be JIVV-U (former NYY), flower, 3 kV test voltage, rated voltage 0.6/1.0 kV and based on ELOT Standard 843.

The passage pipes shall be copper, monoclonal or polyclonal (depending on their cross-section) and shall be insulated by thermoplastic polyvinyl chloride (PVC). The inner liner of the cable should be made of rubber or PVC tape. The outer lining is also made of PVC. The operating temperature is set between 70–90 °C and the maximum short-circuit temperature of 160 °C (on 60 sec).

The minimum diameter of the cables should be calculated according to their length and the characteristics of the programmers, but may not be less than 1.5 mm^2.

An unconnected spare conductor shall be provided for every maximum of five valves, from the programmer to each well. At least one spare conductor per cable shall be provided on a monocable connection.

5 Methodology for carrying out the works

5.1 General

The installation of the irrigation system is implemented by the Contractor in accordance with the provisions of the Study and the contractual issues.

Prior to the commencement of the works, the Contractor shall inspect at the site of the project the installations, the abstraction sources, the power supply, the existence of underground networks, the configuration of the soil, etc. and shall submit any observations to the Competent Authority on any difficulties in the implementation of the Study.

With the approval of the Competent Authority and securing the necessary permits, proceeds to the construction and conducts the necessary tests for the proper functioning of the network.

In order to carry out the temporary partial or total temporary acceptance of the works, he is obliged to submit the construction plans (as built) to the competent authority.

5.2 Preliminary work

5.2.1 Network study

A prerequisite due to the technical scope of the work is the existence of a Final Study or Implementation Study. The study shall include the technical specifications of the materials and equipment required for the

installation of the network, as well as all the necessary drawings showing the abstraction sources, the locations and cross-sections of all pipelines, the location of the central irrigation control system, the irrigation control devices, the NMPs, etc. as well as the maximum and minimum operating pressures of the dispensers (spunners, dripers) by groups (irrigation line, irrigated part or area or entire irrigated area), depending on the type of irrigation and the conditions.

If there is no definitive irrigation plan or final installation plan for the tertiary irrigation network, the Contractor is obliged to draw it up in accordance with the provisions of this Technical Specification and submit it to the Competent Authority for approval.

For large green works (e.g. integrated into road or rail projects) the drafting of the general plans of the tertiary irrigation plant network can also be done in sections. In any case, however, the relevant plans should be drawn up in good time to avoid delays in the timetable for the installation of the Network or planting operations.

5.2.2 Research on existing facilities

The Contractor is obliged to take the necessary protection measures for all existing facilities attached to the project. More specifically:

- All underground installations shall be marked before digging or piling.
- Measures shall be taken to avoid damage or destruction of neighbouring, underground or above-ground facilities and structures.
- The roads, the sidewalks and the various spaces are kept clean and free from rubbish and the drains are open for the free run-off of water.
- The cooperation of local government, businesses and O.K.O. is ensured to provide the required services and information at the site of the project.
- Close communication with the supervisor during construction is maintained for on-site instructions and information.

5.2.3 Inspection of installation area network

Before starting installation work, the Contractor should inspect the project area, carefully check all levels and verify all dimensions and factors relevant to the installation work to ensure that the work progresses smoothly and safely.

Changes or modifications to the plan to adapt to the actual circumstances shall be made after approval by the Competent Authority. When an already installed network is renewed, repaired or extended, or the primary and secondary network is already built by another contractor (e.g. in road construction), the Contractor and the Competent Authority should check the existing system before any work begins.

It is also necessary to identify the necessary measures to proceed without disrupting other activities and to protect existing facilities in and around the project.

5.2.4 Engravings

Before the start of the work, the position of the transmission lines as well as the various pile control devices or special indicative position flags shall be marked, in accordance with the designs of the Study.

The drawings of irrigation plant systems are diagrammatic and in many cases it is not apparent the exact location of existing or installing pipes, valves, programmers, etc.

Pipes of irrigation plant networks and cables should not run under pavements, corridors, pavements, park squares, etc. but beside these structures and below ground level.

The grooves in which underground piping and wiring networks are placed should be engraved near curbs, walls, fences or sidewalk edges. Pipes which appear parallel to the drawings can be placed in the same groove, at the same depth but at least 5 cm apart. For the safety of the network the cables (if provided for in

the Study) should be mounted at a distance of 10 cm from the irrigation lines, and every 20 – 30 m wells should be arranged for the inspection and repair of the faults.

The locations of Irrigation Control Devices, ICW, Launchers, etc. after they have been finalised and the necessary tests should be accurately reflected in the drawings.

Replacements or changes to the plans may be proposed and submitted for approval at this stage, with a view to adapting to existing conditions and achieving full coverage of the irrigated area. No replacement or change to the system as planned can be made without prior approval by the Competent Authority.

5.3 Transport, storage and management of materials

Pipes and other materials should be transported in accordance with the manufacturer's instructions and treated in the various operations in such a way as to ensure their installation without damage, abrasions, etc. Special care should be taken to ensure that polyethylene (PE) tubes do not break when they unfold.

PVC pipes during transport shall be protected from impact and stored in such a way that they are in contact throughout their length, in layers up to 1.5 m high and protected from sunlight.

The ends of the pipes should be closed with watertight closures so that the inside is clean from foreign materials and kept clean throughout the installation. When work is not in progress, the open ends of pipes or fittings or devices should be hermetically closed so that water, soil, insects or other materials cannot enter.

Before installation, the pipes are necessarily checked for any defects. Materials which are found to be defective or damaged before, during or after installation are required to be replaced.

Pipe incisions should be vertical, clean and made with appropriate tools skillfully, without causing damage. Plastic pipes are cut vertically and crabs, chips, etc. should be cleaned and removed.

Sensing tape shall be mounted (if applicable) on all non-metallic piping.

5.4 Construction of a primary irrigation network

It is always placed underground.

In small networks, where there are no special requirements and the transport of water takes place in the green area, the primary network (aquarium), which concerns the transport lines from the water abstraction to the central head and from it to the irrigation control heads (with pipes of cross section ≤ 40 mm and pressure 6 or 10 atm) may be constructed in accordance with what is stated for the transport lines of the tertiary network.

Materials suitable for forming the tubes of the primary network within the planting areas shall be the soil extracted at the opening of the groove, free from stones, roots, wood, garbage or other materials with a diameter of more than 2.5 cm or sand or other aggregates depending on the type of tubes and the manufacturer's instructions. The minimum depth for placing primary network lines shall be 60 cm.

5.5 Construction of a secondary irrigation network

5.5.1 Irrigation control

Irrigation control may be carried out:

- With hand-operated valves, mounted in an EMP (above or underground).
- With irrigation programmers.
- With Programmable Telecontrol/Remote Control System (SCADA).

5.5.2 Wells

The heads are placed in wells, which should be plastic or concrete.

- Plastics wells

  They are mainly placed in phytotechnics. Each head can be placed in more than one plastic well if the dimensions are larger than the standard well.

  The dimensions of the plastic wells (and their fitting) should be such that the appliances contained (vanes, reducers, ventilation valves, etc.) are at least 7-8 cm away from the nearest walls of the wells and in any case do not impede their handling and repair. Wells shall be centred on the heads and shall not prevent the on-site repair of electric vans. The upper surface of the wells shall be up to 2 cm above the ground surface.

  The installation work of the plastic wells includes opening the burrow (at least 50 % long and wide and 15 cm in depth greater than the dimensions of the well), forming the openings and exits for the passage of the pipes, placing a layer of gravel on the bottom of the pit for draining and supporting the well, and stabilising and aligning it.

  Also, after the connection of the pipes and cables, the passage openings are covered with plastic sheets, so as not to enter the well and fill the gaps around the well with the excavation soil.

- Concrete wells

  They are made in cases where increased resistance is required.

  The inner dimensions of concrete wells (length, width) should be at least 30 cm larger than the dimensions of the head (including the entrance and exit connectors) in order to be easily connected, and the depth necessarily being at least 40 cm.

  They are made in situ or may be prefabricated, and the type of concrete should be B16/20 with double reinforcement of B500C mesh. They shall be fitted with a galvanised iron cover made of a sheet metal or cast iron cover, on a corresponding galvanised iron or cast iron frame, and shall be fitted with a safety lock.

  When construction of concrete wells it is necessary to anticipate and build:

  - The openings by position and cross section for the passage of pipes.

  - The drainage opening of the well at the bottom, in combination with the layer of gravel bearing the well.

5.5.3 Irrigation control heads

In order to simplify the construction and easier detection and handling, the electro valves (or manual, in the case of a manual system) should be placed in groups in Irrigation Control Heads.

The heads shall be placed in the design position underground in wells outside the road deck. They are placed horizontally, so as to be easy to access, and rest on tacks made of wood, polystyrene, bricks or gravel, at the same depth as the tertiary Network.

Equipment in addition to valves may include filters, pressure reducers, ventilation valves, etc. depending on the conditions. The location and layout of the various devices shall be as indicated in the drawings of the study.

Unless otherwise provided in the Study, the following are recommended for pipeline and device connections:

The various devices shall be connected to collectors made of iron pipes and shall be capable of disassembling them by split steel fittings. For entry sections, output less than 1½'', the collectors may be made with iron galvanised hydraulic components.

It is generally not permitted to build collectors or connect to any kind of plastic components, except for plastic racks on the pipe connections of the tertiary network after isolation devices.

The connection to the power pipes by PE (Primary Network) is made by means of rudders and iron components (tau, corners, tubular, etc.), or male tau racks or saddles of a reinforced type with screws and not with common saddles.

The connection (water abstraction) to a Primary Network from PVC or iron tubes is made with special cast iron pieces, and other iron galvanised fittings and tubes.

At the entrance of the irrigation control head, a divided steel rack should be inserted inside the well.

In case the static and/or dynamic pressure in the head position is greater than 6 atm, a piezocretic valve shall be provided before the inlet collector.

5.5.4 Programmes

Programmersion to well programmers, are always placed in enclosed areas, in other electrical installations or watertight boxes with a security lock (pillar).

Programmers are selected with the minimum capabilities that can meet the specific needs of the project, with an additional backup program and one reserve stop per 8 stops

It is necessary to have in the programmer's space a diagram indicating the correspondence and programming of the controlled valves.

5.5.5 Cables

The irrigation control cables are placed either in cable passage pipes (roads, large gardening works) or in the soil inside the pipe trenches and at the same depth as them (in smaller gardening projects). In the case where the cables in the "same channel" are tied to each other every five metres, at distances every 5 m.

A bare brass cable is placed in the passage pipes, with its ends clearly protruding into the control shafts, so that it can be used for future placement of new cables (with traction).

Connections between cables can only be made in junction boxes, electric van wells or control devices and never between valves or valves and programmers. At all connections (final or electric vans) a minimum length of 50 cm additional conductor should be left to facilitate control or future connections.

Cable connections, other than those in the programmer's box, are made with special cable connectors, containing silicone grease for sealing or insulation of cables with vulcanising tape.

5.6 Construction of a tertiary irrigation network

5.6.1 General

In all areas to be planted, the installation of the tertiary irrigation plant network takes place before or at the same time as the plantings, unless there are special restrictions, which make modern construction impossible (the competent authority should verify). The works are completed in separate sections (area controlled by an irrigation control valve).

The tertiary network begins after the collectors of the ICW.

All installation and connection operations should be carried out with care to prevent the entry of soil or other materials into the pipes or apparatus and to cause blockages. Special care should also be taken to ensure that when work is not in progress, the open ends of the pipes or fittings or devices are hermetically closed.

5.6.2 Excavation of trenches

These are the excavations in the plant soil at the site of the project for the underground installation of pipes and cables.

For the installation of underground irrigation networks (with drips or self-lifting launchers) for turf irrigation, all transport lines and irrigation lines shall be located underground. In the case of the installation of surface networks for irrigation of plants or lawns, only transport lines shall be installed underground, either along their entire length or in those parts not connected to the irrigation lines.

The opening of trenches near already installed trees should be avoided. If this is not possible, manual tunnels shall be opened under large roots (δ > 5 cm). Near plants with a root diameter of less than 5 cm can also be used machinery with shackles, which should have well sharpened knives, to make smooth incisions on the roots.

Grooves with exposed roots should be refilled within 24 hours after excavation. Large roots are wrapped in burlap or other material to protect them from mechanical damage or dehydration.

Stones and materials unsuitable for casing should be removed during excavation from the soil of the excavation and up to 10 cm below the bottom of the groove.

The width of the groove depends on the number of conductors and their cross-sections. The ducts shall be positioned with a gap of 5 cm between them. It also takes into account the space required for the various connection tasks to be carried out.

The grooves should be straight, curved smoothly and have vertical sides. They should also have a smooth bottom, appropriately adapted to the pipes, so that they can be mounted throughout their length.

For excavations in areas where turf will be installed, the surface soil up to 15 cm deep is placed separately from the deeper soil and should be removed as a surface layer when refilling, debris, aggregates or inappropriate soil.

Where an irrigation network is installed on an already installed lawn, the manufacturer should remove the grass above the points necessary to excavate and reposition it after completion of the installation of the network in this section. The repositioning of the removed lawn should be done within 48 hours of its extraction.

For reasons of economy in construction, it is possible (if provided for in the contract) not to open a groove in draft irrigation plant on an already installed lawn and the network can be placed underground, opening a crack in the lawn and soil with a floor at the appropriate depth. After mounting the network is followed by closing the opening, compressing the soil with the feet, right and left of the slit.

5.6.3 Readings

For the passage of pipes or cables under roads, corridors, pavings or other structures, passages are constructed from hard PVC sewer pipe, encased in concrete for small constructions.

Depending on the needs, the crossings can be single double, triple, etc. The same passage pipe may pass more than one tertiary network pipe or cables.

The diameter of each passing tube shall be at least 1.5 times the diameter of the pipe passing through it.

No curves greater than 11° are allowed at crossings. It is repeated that when the pipes pass through the passages their limbs should be closed.

5.6.4 Installation of pipelines

This includes the installation of transport ducts within the “passage works” in the trench and superficially in the sections connected to the irrigation lines, the connection with the waiting in the collectors of the ICW and the closure of the openings of the ICW and “passage works” in order to protect them from the soil. Also, the installation of irrigation lines (on the slopes are placed approximately parallel to the contours, upstream of the planting lines) and their connection to the transport pipelines. Finally, the installation and connection of the dispensers (injectors, launchers) is included.

For the installation of underground irrigation networks (with drips or self-lifting launchers) for turf irrigation, all transport lines and irrigation lines shall be located underground.

In the installation of surface networks for irrigation of plants, only transport lines shall be installed underground. In road and rail works only those parts of transport pipelines which are not connected to the irrigation lines are located underground.

The minimum depth for the installation of irrigation lines of underground networks with self-lifting launchers depends on their type and length, but in no case may it be less than 30 cm.

The depth for the installation of irrigation lines of underground networks with drips is 5 – 7 cm (underground irrigation of islet turf, etc.). Their equal abstinence is determined in the study according to the supply of the injectors and the composition of the soil.

In no case may plants or burrows be planted in the groove with pipes and at a distance of at least 30 – 80 cm behind the launcher line (depending on the size and shape of the plants in full growth) in order not to prevent the spraying of water at the boundaries of the turf. Injecting irrigation lines in gradient soils shall be located parallel to red, or on the contours and upstream of the planting lines, and if the inclinations are above 1:3, on the upper edge of the irrigation basins.

The irrigation lines and the transfer lines (surface) on the slopes are mounted with B500C iron bars, diameter Φ8 and approximately 0.40 m in length, curved at the top, in the shape of a hook to be nailed to the ground every 5 m and at a depth of about 0.25 m. The transfer lines shall be wired over the piles. In gardening works special plastic piles with hook are used.

The drip ducts – particularly in gardening works – should be as straight, parallel as possible and not crossed, so that they can be repositioned in the same position with the drips in the basin of each plant.

Shrub trees should be planted with dripping drips in order not to deviate (the drips) from the plant basin.

In dense plantings (annual, soil cover, etc.) dredgers with integrated injectors are used. A grid shall be formed with lines placed in parallel, as far as possible in straight lines, on one or two planting lines depending on the size and distances of planting.

The free ends of irrigation and transport lines should be closed immediately after installation with plastic stoppers or binoculars.

5.6.5 Tertiary network connections

The connections of PE pipes in the wells and branches of the tertiary network for diameters D > Φ20 shall be made with plastic racks, tau-rockers, connectors and other plastic components (not saddles).

Pipe connections with diameters D ≤ Φ20 in larger diameter pipes shall be made by saddles and rudders, and pipes with diameter D ≤ Φ20 with tau-fitting.

Under no circumstances “plugs” or prickly parts should not be used instead of fittings, except in the cases mentioned below (see Pop Up connection)

In PE pipes permanently under pressure (upstream from flow stoppers), screwed fittings and in no case locks which over time (due to pressure) expand and show leaks shall be used.

Hydraulic metal fittings (crosses, taus, corners, etc.) are always galvanised.

The connection of microtubes (PE tubes with cross section D ≤ Φ8) and micro-launchers is always made with special accessories for microtubes, such as shots, taus, nipples, etc.

All connecting components (plastics and metals) of the irrigation network use hemp and teflon tapes. Where there are female threads of devices and accessories made of plastic enter only teflon.

The connections of self-lifting launchers up to ¾'' (BSP) in the irrigation lines are made with saddles and breasts, or split breasts, or plug and PE fittings.

The connections of the 1"and 1 1/2" self-lifting launchers are made by heavy-duty saddles or pumps and interspersed breasts (triple articulated arms), of corresponding cross section.

5.6.6 Mounting injectors

The injectors shall operate at a pressure range from 0.6 to 4 atm and be a flow rate of 2 – 4 l/h. The injectors are always placed directly on the cross-sectional irrigation lines Φ 16 or Φ20, nails, in a hole opened with sprouts of similar diameter and in any case in the basin of the plant, except in cases of irrigation of plants in pots where microtube Φ6 is inserted and fixed with a special plastic pile.

On slope seedlings and bushes of all kinds, it is necessary to place an injector on each plant, near its trunk.

In trees with a ball or pot diameter up to 24 cm two injectors shall be placed at a distance of approximately 0.20 m to 0.30 m to the right and left of its trunk.

In trees with a larger diameter, the number of injectors depends on the size of the tree and the microclimatic conditions.

5.6.7 Placing of self-lifting launchers

The launchers shall be mounted in place and with the nozzle provided for in the Study for uniform soil wetting.

If the launchers are positioned next to a hedge, they should be at least 30 – 80 cm from the planting line (depending on the size and shape of the plants) in order not to prevent irrigation at the boundaries of the turf.

No plants may be found in the launch field of each launcher and within 1.5 – 2.5 m of it, which may prevent the spraying of the water. In such a case, the Competent Authority may request the designer or the contractor to partially redesign the planting as regards the locations of those plants.

When installing the launchers, all measures shall be taken to protect them from soil or other materials that may cause blockages or problems at their setting points. One way is to cover them when mounting and backfilling them with protective covers, which are removed after all network and lawn installation works have ended.

The positions of the launchers shall be marked with stakes or special indicative position flags, up to and including after the end of the installation works of the turf, so as not to cause damage in the performance of the work that is necessary to follow.

The launchers shall be placed perpendicular to the ground surface and in depth so that their upper surface is at the final height of the ground up to 1 cm above it.

The impactors shall be encased with gravel, at a depth of 10 – 15 cm from the surface of the ground up to 10 – 15 cm below their lower end, in a pit 30 – 50 cm in diameter in order to ensure good drainage. The other ejectors are backfilled with the excavated soil.

5.6.8 Installation of ventilation valves

Ventilation valves are placed on all transport lines of the tertiary network at its highest points, according to the study.

Especially in transport works, kinetic ventilation valves (cast iron, brass or plastic), with a nominal diameter of 1΄ in wells, for the ventilation of parts of the irrigation network on the trenches slopes should be placed at the upper points of the transport ducts.

At the embankment sites, if no ventilation valves of the tertiary network have been constructed within the ICW, ventilation valves shall be placed in a VVW, on the bases of the road works or at the end of the railway deck.

Spherical isolation valves 1’ shall be installed before the valves.

Aeration valves should be placed in PVV wells of suitable dimensions (at least 30x30x30 cm), 10 cm thick concrete B15 with reinforcement of B500C mesh and a cover with a safety lock.

Small brass or plastic ventilation valves with a diameter of ¾“” shall be placed in the transport ducts on smaller slopes – up to 7.5 m high and with a cross section of trenches and embankments (on the embankments inside the ICW) – small brass or plastic ventilation valves with a diameter of ¾′ are placed on an upright tubular 30 cm long.

Surface driper ducts do not need ventilation valves. In underground drip systems, when no drip with run-off deterrence device is used, ventilation valves should be installed in groups of irrigation lines.

5.6.9 Pressure Reducer Installation

Pressure reducers or pressure reduction valves with a glycerin manometer Φ63 shall be of the type described in the Study and in drawings and with a nominal pressure of at least 10 atm. They shall be of the same cross-section as the line on which they are placed.

When installing all pressure adjustment valves shall be closed.

At the first start of the network, each pressure reduction valve shall be adjusted to the pressures specified in the Study. After completion of the installation, the Contractor should check and record the pressures displayed on each pressure reducer. If any indication of pressure is outside the limits of the recommended pressures, adjustment and re-checking should be performed again.

5.7 Flushing of the network

Once the network connection works have been completed and before the underground part of it has been grounded, the entire network or its independent part should be adequately flushed and then checked for leaks under pressure.

First the main aqueduct is cleaned, sequentially opening the valves of the evacuation wells starting from the pumping station.

In every independent part of the irrigation network and before it enters operation, the free ends of the pipes (which are not covered) are opened and the pipes are washed away, so that all solid bodies that may exist in them are removed.

The free ends of the pipes are permanently closed while rinsing continues. The flow of water during rinsing from each open end or discharge hydrant shall last at least 5 – 10 min depending on the length of each line.

This work should be done on every part of the network, after any repair or extension.

5.8 Backfilling

No backfilling on the tertiary network is permitted before a sealing check has been carried out and permission has been given by the competent authority.

Refilling cannot be carried out while the pipes are in a state of expansion due to high temperature or pressure. The pipes can be cooled by draining water for a few minutes before the backfilling or the backfilling can be carried out in the morning before the temperatures rise.

The re-filling of the trenches and other excavations is carried out with the excavation soil, free of stones, roots, wood, trash or other materials with a diameter of more than 2.5 cm. There shall be a layer of soil at least 30 cm above the aggregates or concrete formwork in the plant or lawn areas.

The launchers are first coated and aligned with the ground surface, perpendicular to it and then the entire network. The soil is compressed with the feet to such an extent that it does not “sit” later after irrigation and the surface is levelled, and if there is time it is advisable to do two irrigations before the final surface formation.

5.9 Cleaning of premises

After completion of the installation and related works, good cleaning of the premises should be carried out and all the rubble and excess materials resulting from the work should be removed.

5.10 Maintenance of irrigation plant networks

The Contractor is responsible for the maintenance and repair of damage for the entire irrigation network (drilling, central head of aqueduct, Irrigation control wells, irrigation control system, tertiary network, etc.) and for the whole year from its installation to the receipt of the project.

The Contractor is obliged to maintain the network in excellent condition and to repair any damage (injector blockages, leaks, etc.) throughout the duration of the contract until the final receipt of the project.

The Contractor is responsible for the installation of the network until its temporary partial or total receipt. The control and inspection for the proper operation of the network is a separate subject and should be included in the maintenance work until the final receipt of the project.

During the operation of the network it is necessary to continuously clean the filters, control the settings of pressures, arcs and beams of the launchers, the proper operation of the various appliances and machinery, leaks, seals, injector blockages etc. and their immediate restoration.

In addition, at least three times in each growing season - at the beginning, in the middle and at the end of the irrigation season - general maintenance of the network must be carried out, readjustments, cleaning or replacement of all drippers that show problems, restoration of the support of the pipes and finally general flushing of the network, as already described.

Maintenance of pumping and other machinery is required to be done continuously according to the manufacturer’s instructions

At the end of the irrigation period, measures shall also be taken to protect the installations during the winter dead season, in accordance with the instructions of the manufacturer of each appliance. Filters and network, if not used in parallel for other purposes (e.g. firefighting), should be emptied from the accumulated water.

6 Quality control requirements upon receipt

Necessary conditions for the receipt of the installation of an irrigation plant network are the verification of its compliance with the provisions of the Study and the terms of the present, as well as its successful response to the waterproofing tests and its testing operation.

6.1 Network tightness control

The watertightness test of the primary and secondary network, in the parts of the network up to and including the electric vans, is recommended to last from one to 24 hours depending on the network. No leakage shall occur during the examination of the pipeline.

In smaller PE networks (pressures up to 5 atm, cross sections up to and including Φ40 and a total length of primary network up to 300 m), a visual check of watertightness at a pressure of 1 atm greater than the prescribed static pressure for at least one hour may be performed.

In the tertiary network, which usually cannot be applied static pressures, the leakproofness test is carried out during the test operation before the trenches are backfilled. At the same time there is also a first adjustment of the arcs and sectors of the launchers after their rough support in a vertical position.

Broken or defective parts, appliances or tubes during pressure control shall be replaced by the Contractor with no additional remuneration and the part shall be re-checked until satisfactory results are obtained.

When welded plastic pipes are connected the sealing check should be done 24 hours after they are carried out. This time should be increased to 48 hours when cold.

6.2 Test operation

After completion of the installation works and in the case of turf before sowing, the irrigation plant network, or any independent part thereof, should be adjusted and operated to verify whether the irrigation is complete and universal, and its operation meets the specifications and needs of the plants.

The test operation of the network should be carried out by the Contractor in the presence of a representative of the Competent Authority to check that all installations (electric and plumbing) are operating in accordance with the Study and the provisions of this Law.

As a first step the operational tests should be carried out at a standstill (electrovalve) and the various settings (pressures, arcs and launch beams of the launchers, etc.), the correct operation of the various devices and the uniformity in the delivery of the drips or the rain height of the launchers should be checked.

In the second stage the tests should be carried out per programmer or control centre and with at least two repetitions of the irrigation programme. The duration of each test irrigation is determined by the competent authority according to the extent of each irrigated section. If problems occur, they should be restored by the Contractor and the test operation repeated until the results meet the requirements of the Study.

The test operation of grass irrigation plant networks should be carried out before any turf installation work begins.

7 Method of measurement

The works for the construction of irrigation networks and the installation of all kinds of appliances and components shall be measured analytically by component, device and accessory (tubes, network control and safety devices, distributors, launchers, injectors, dripers, steel racks, etc.), on the basis of the categorisation provided for in the Contractual Issues of the Project.

Sections of pipes constructed with tube cross-sections larger than those specified in the Study shall be measured according to the diameters provided for in the Study.

The above measured units include:

- The employment of the required staff and the provision of the necessary equipment and means to carry out the work in accordance with the terms of this Technical Specification.

- The supply, transport on site and construction site storage of all required materials, components and consumables.
- Deterioration and impairment of materials
- Collection of waste of any kind resulting from the execution of the works and their transport for final disposal.
- Carrying out the required tests and checks according to this Technical Specification, as well as taking corrective measures (work and materials), if non-conformities are detected, during tests and checks.

Annex A
(Informative**)**

Health, safety and environmental protection conditions

A.1 General

During the execution of the works, the applicable provisions on Occupational Health and Safety Measures shall be met and employees shall be equipped with the necessary Personal Protective Equipment (PPE), as appropriate, which should comply with the provisions of Regulation (EU) 2016/425.

The provisions laid down in the approved Health and Safety Plan (HSP)/Health and Safety File (HSF) of the work, according to Ministerial Decisions ΓΓΔΕ/ΔΙΠΑΔ/οικ/889 (ΦΕΚ/16 Β'/14-01-2003) and ΓΓΔΕ/ΔΙΠΑΔ/οικ/177 (ΦΕΚ/266 Β'/14-01-2001) shall also be strictly met.

References to specific requirements per specific work are indicative.

A.2 Health and safety measures

In any case, the provisions of the project's Safety and Health Plan (SAP) shall be implemented.

The following minimum requirements are also indicated:

Compliance with Directive 92/57/EEC "On the implementation of minimum safety and health requirements at temporary or mobile constructions sites" (as transposed into Greek legislation by Presidential Decree 305/96), as well as compliance with the Greek legislation on health and safety issues (Presidential Decree 17/96 and 159/99, etc.) is mandatory.

In the event of work being carried out under road traffic, full site marking is required.

It is also mandatory to use personal protective equipment when carrying out the work.

The mechanical equipment must be adequately maintained in accordance with the instructions of the manufacturing plants and operated only by trained operators/drivers, holders of the licences provided for by the applicable provisions by type of machinery/vehicle.

Mechanical equipment should be inspected by contractor's technicians to verify that braking systems, tyres, headlamps, etc. systems directly related to safety function satisfactorily.

The following are mentioned as potential risks during the execution of the works:

- At transport, storage and installation of pipes and other accessories
- When using equipment and means for cutting, forming and welding pipes (tools, machines and machinery) for network configuration (positioning, connections, testing, etc.).
- When performing pressure tests
- While performing live work and tests

A.3 Measures to protect the environment

The Contractor should respect environmental conditions and restrictions.

It is pointed out that special care is required, when the water extraction is done from a public network, to avoid its contamination from the return of water from the irrigation network with fertilizers, pesticides, or various pollutants.

Bibliography

[1] The No. 14097/757/4-12-2012 Decision of the State Secretary for Development, Competitiveness, Infrastructure, Transport and Networks *"Control of technical specifications for plastic pipes and fittings for the transport of drinking water, sewage and underfloor heating" (Β' 3346).*

[2] The Decision ref. no. 114233/7-9-2019 of the State Secretary for Development and Investment *"Amendment to No. 14097/757/4-12-2012 of the Deputy Minister for Development, Competitiveness, Infrastructure, Transport and Networks on checking technical specifications for plastic pipes and their components for the transport of drinking water, sewerage and underfloor heating (Β΄ 3346)" (Β΄ 4278*).

[3] Presidential Decree 396/94*, Minimum safety and health requirements for the use by workers of personal protective equipment at work, in compliance with Directive 89/656/EEC*

[4] Directive 92/57/EU*, Minimum requirements for health and safety of permanent and mobile work sites – Minimum health and safety requirements for temporary and mobile work sites.*

[5] Joint Ministerial Decision 36259/2010*, Measures, conditions and programme for the alternative management of waste from excavation, construction and demolition (AEKK) – Government Gazette, 1312B / 24-08-2010 (B' 1312)*

[6] OMOE-SEEO (version 2010*), Road Projects Guidelines: Specifications and instructions for the marking of works carried out on roads*

[7] Regulation (EU) 2016/425 *of the European Parliament and of the Council of 9 March 2016 on personal protective equipment and repealing Council Directive 89/686/EEC.*