CHAPTER 5: Equipment, standards and tenders for supply

With the completion of the design, a detailed list of all the equipment needed (bill of quantities) for the installation of the system must be prepared with full descriptions, standards and specifications for every item. The preparation of this list is of great importance. In addition to the quantities, it is imperative to determine and specify:

- size and name (2 inches ball valve, 50 mm pipe, etc.);
- kind of material (brass, uPVC, etc.);
- pressure rating (PN 16 bars, 6 bars, etc.);
- type of joints (screw, solvent welded, etc.);
- standards complied with (ISO 161, 3606, BS 21, ISO 7, etc.).

Three different lists may be prepared: one for the mains, submains and manifolds with the hydrants; one for the laterals with the emitters; and one for the head control. Sizes will have already been decided on during the design stage.

WORKING PRESSURE OF THE EQUIPMENT

A closed pipe pressurized system installation consists of pipes of different working pressures according to the location. The main pipelines are subjected to higher pressures than the submains, manifolds and laterals, therefore the main lines should be stronger than the other pipelines. The working pressure of the pipes to be installed should always be higher than the system's operating pressure. For example, in a micro-jet (minisprinkler) installation the approximate operating pressure is 2.3–2.5 bars in the laterals, 2.5–2.7 bars in the manifolds and 2.7–3.0 bars in the mains. A pipe working pressure of 4.0 bars seems to meet the requirements of the system. However, although the low to medium pressure systems are not subjected to the very high pressures created by water hammer, it is advisable to use 6.0 bar pipes for the main line and 4.0 bars for the other pipelines.

MAIN, SUBMAIN AND MANIFOLD PIPELINES, AND HYDRANTS

The most widely used kinds of pipes for these lines are rigid PVC, HDPE, LDPE and quick coupling light steel or aluminium. The following must be determined:

- total length and pieces of the pipelines (about 5 percent should be added to the total);
- quantities of pipe connector fittings (bends, tees, end plugs, reducers, etc.) of the same type of connection to be used with the above pipes;
- number of bends, tee outlets and clamp saddles, which have two different types of connections, e.g. tee 90 mm *x* 90 mm *x* 2 inches (internal threaded), bend 110 mm *x* 3 inches (flanged);
- quantity of adaptors (starters). These fittings have one end threaded or flanged and the other end arranged in the same type of connection as the pipes. They are used at the starting point of the pipelines and at any other point where valves are fitted;
- number of shut-off and air valves on the distribution network. The air valves are fitted on riser pipes connected with clamp saddles on the mains;
- quantities of the riser pipes for the hydrants, if the mains are buried, and of the shut-off valves or the special hydrant valves. If the mains are not buried, then the fittings for connecting clamp saddles with the shut-off valves must be determined. The number of these fittings is equal to the number of the hydrants.

LATERALS

Quick coupling and LDPE pipes are used as surface laterals in the majority of the systems. The following must be determined:

- total length of pipes required;
- quantities of adaptors, tees, bends, end plugs and line filters;
- total number of emitters and their connector fittings if any, e.g. minisprinkler complete with plunger, connecting flexible tube and plastic wedge, or specify in terms of set, e.g. minisprinkler complete set.

HEAD CONTROL

All the components of the head control of the system must be determined, i.e. shut-off valves, check valve, air valve, fertilizer injector, filters, pressure regulators, etc. In addition, all the auxiliary fittings must be included, such as the pipe pieces, hoses and fittings needed to assemble the unit, and the pressure gauges and other small devices required.

PUMPING UNIT

A full and detailed description of the pumping unit must be given, including the following:

- the average break horsepower (BHP) calculated of the driving force and the type (engine or motor);
- the kind of pump (centrifugal single or multi-stage, turbine, electrosubmersible), the inlet and outlet diameter, and the type and number of stages;
- the capacity and output of the pumping unit, i.e. the water delivery versus the dynamic head.

STANDARDS

Standards are consensus documents developed by task groups and technical committees to specify mechanical, functional and other requirements of irrigation equipment (workmanship, materials, dimensions, pressures, test methods, supply and delivery conditions). The continuing development of new standards follows the accelerated pace of the technological development in the field of pressurized irrigation techniques. However, some old standards may be used as an indication of the basic needs. All pipes, pipe fittings and other irrigation equipment are manufactured according to various standards applied in the countries of origin. These standards, although equivalent to each other, vary in terms of the dimensioning, the class rating, the safety factor and the nomenclature. Much technical engineering effort has been devoted by the International Standards Organization (ISO) to the establishing of international standards and specifications so that all national and regional standards are in broad conformity.

The general policy in many countries is to adopt gradually the European Standards (EN) and to withdraw any conflicting national standards. The EN are prepared by the Technical Committees of the European Committee for Standardization (CEN/TC) and is given the status of national standards in most for the European countries and the United Kingdom. Each EN forms part of a System Standard based on the results of the work undertaken by corresponding ISO/TC. The System Standards are consistent with general standards on function and installation and supported by separate standards on test methods to which references are made throughout the System Standards. Also EN incorporate provisions of other publications.

However, at present the variety of standards causes small farmers a great deal of confusion regarding thermoplastic irrigation equipment. In Table 5.1 below is an example of a 4 inches rigid PVC pipe, 6.0 bars, in two different national standards:

TABLE 5.1 - A 4 inches rigid PVC pipe (6.0 bars) in two different national standards

	to DIN 8062	to ASTM D2241 (SDR 4.1)
Nominal diameter	110.0 mm	4 inches
Outside diameter	110.0 mm	114.3 mm
Inside diameter	103.6 mm	108.7 mm
Wall thickness	3.2 mm	2.8 mm
Working pressure	6.0 bars	6.8 bars (100 psi)

The description of the equipment should be as clear and simple as possible. An example with the minimum specifications required for two items is as follows:

Item 1: Black LDPE pipe, PN 4.0 bars, to DIN 8072 or equivalent standards in compliance with ISO standards, supplied in coils of 200 m:
a. 32 mm DN, 1 800 m;
b. 25 mm DN, 3 200 m.

Item 2: Polypropylene connector fittings manufactured to ISO metric dimensions. Quick release, compression type and/or threaded (screw-type) ends male or female, to ISO 7 or BS 21, PN 10 bars for use with the above PE pipes:
a. 63 mm *x* 2 inches (male) adaptor, 7 pieces;
b. 63 mm *x* 2 inches (female) clamp saddle, 2 pieces;
c. 50 mm *x* 2 (male) adaptor, 2 pieces.

Should the equipment not comply with any standard, due to many reasons, a full technical description should be given of the material it is made of, the working pressure and the use. The latter is important because the fittings should be made of material recommended for use with the particular pipe.

Most of the irrigation equipment should meet the appropriate material, dimensional, and quality requirements recommended in the specifications in Table 5.2.

TABLE 5.2 - Equipment standards and specifications

Standard name:	Standard description:
ASAE EP419.1 February 2003	Evaluation of Irrigation Furrows
ASAE EP405.1 february 2003	Design and Installation of Microirrigation Systems
ANSI/ASAE S261.7 December 2001	Design and Installation of Nonreinforced Concrete Irrigation Pipe Systems
ASAE S526.2 January 2001	Soil and Water Terminology
ASAE S491 February 2003	Graphic Symbols for Pressurized Irrigation System Design
ANSI/ASAE S395 February 2003	Safety for Self-Propelled, Hose-Drag Agricultural Irrigation Systems
BSR/ASAE S577-200x	Specification for Poly (Vinyl Chloride) (PVC) Irrigation Pipe (PIP) Fittings
ANSI/ASAE S376.2 February 2004	Design, installation and Performance of Underground, Thermoplastic Irrigation Pipelines
ANSI/ASAE S436.1 December 2001	Test Procedure for Determining the Uniformity of Water Distribution of Center Pivot and Lateral Move Irrigation Machines Equipped with Spray or Sprinkler Nozzles
ANSI/ASAE S330.1 February 2003	Procedure for Sprinkler Distribution Testing for Research Purposes
ANSI/ASAE S539 February 2003	Media Filters for Irrigation - Testing and Performance Reporting
ASAE S447 February 2003	Procedure For Testing and Reporting Pressure Losses in Irrigation Valves
ANSI/ASAE S397.2 February 2003	Electrical Service and Equipment for Irrigation
ASAE EP409.1 February 2004	Safety Devices for Chemigation
ASAE S435 February 2004	Polyethylene Pipe Used for Microirrigation Laterals
ASAE S398.1 january 2001	Procedure for Sprinkler Testing and Performance Reporting
ASAE EP367.2 February 2003	Guide for Preparing Field Sprayer Calibration Procedures
ASAE S327.2 February 2003	Terminology and Definitions for Agricultural Chemical Application
ANSI/ASAE S553 march 2001	Collapsible Emitting Hose (Drip Tape) – Specifications and Performance Testing
ASAE EP369.1 December 1999	Design of Agricultural Drainage Pumping Plants
ASAE S561 February 2003	Procedure for Measuring Drift Deposits from Ground, Orchard, and Aerial Sprayers
ASAE EP400.2T February 2003	Designing and Constructing Irrigation Wells
ASAE EP285.7 January 2001	Use of SI (Metric) Units
ASAE S431.3 February 1999	Safety Signs
ANSI/ASAE S397.2 February 2003	Electrical Service and Equipment for Irrigation
ASAE S471 February 2003	Procedure for Measuring Sprayer Nozzle Wear Rate
ASAE S263	Minimum Standards for Aluminum Tubing
ISO 7714:2000	Agricultural irrigation equipment – Volumetric valves – General requirements and test methods
ISO 7749-1:1995	Agricultural irrigation equipment – Rotating sprinklers – Part 1: Design and operational requirements
ISO 8026:1995 ISO 8026:1995/Amd 1:2000	Agricultural irrigation equipment – Sprayers – General requirements and test methods
ISO/TR 8059:1986	Irrigation equipment – Automatic irrigation systems – Hydraulic control
ISO 8224-1:2003	Traveller irrigation machines – Part 1: Operational characteristics and laboratory and field test methods
ISO 8224-2: 1991	Traveller irrigation machines – Part 2: Soft wall hose and couplings – Test methods
ISO 8779:2001	Polyethylene (PE) pipes for irrigation laterals – Specifications
ISO 8796:2004	Polyethylene (PE) 32 and PE 40 pipes for irrigation laterals – Susceptibility to environmental stress-cracking induced by insert-type fittings – Test method and requirements
ISO 9261:2004	Agricultural irrigation equipment – Emitters and emitting pipe – Specification and test methods
ISO 9625:1993	Mechanical joint fittings for use with polyethylene pressure pipes for irrigation purposes

TABLE 5.2 - Equipment standards and specifications (cont'd)

Standard name:	Standard description:
ISO 9635-1:2006	Agricultural irrigation equipment – **Irrigation valves – Part 1: General requirements**
ISO 9635-2:2006	Agricultural irrigation equipment – **Irrigation valves – Part 2: Isolating valves**
ISO 9635-3:2006	Agricultural irrigation equipment – **Irrigation valves – Part 3: Check valves**
ISO 9635-4:2006	Agricultural irrigation equipment – **Irrigation valves – Part 4: Air valves**
ISO 9635-5:2006	Agricultural irrigation equipment – **Irrigation valves – Part 5: Control valves**
ISO 9644:1993 ISO 9644:1993/Amd 1:1998	Agricultural irrigation equipment – Pressure losses in irrigation valves – Test method
ISO 9911:2006	Agricultural irrigation equipment – Manually operated small plastics valves
ISO 9912-1:2004	Agricultural irrigation equipment – **Filters for micro-irrigation – Part 1: Terms, definitions and classification**
ISO 9912-2:1992	Agricultural irrigation equipment – **Filters – Part 2: Strainer-type filters**
ISO 9912-3:1992	Agricultural irrigation equipment – **Filters – Part 3: Automatic self-cleaning strainer-type filters**
ISO 10522:1993	Agricultural irrigation equipment – Direct-acting pressure-regulating valves
ISO 11545:2001	Agricultural irrigation equipment – Centre-pivot and moving lateral irrigation machines with sprayer or sprinkler nozzles – Determination of uniformity of water distribution
ISO 11678:1996	Agricultural irrigation equipment – Aluminium irrigation tubes
ISO 11738:2000	Agricultural irrigation equipment – Control heads
ISO 12347:1995	Agricultural irrigation – Wiring and equipment for electrically driven or controlled irrigation machines
ISO 13457:2000	Agricultural irrigation equipment – Water-driven chemical injector pumps
ISO 13460:1998	Agricultural irrigation equipment – Plastics saddles for polyethylene pressure pipes
ISO 15081:2005	Agricultural irrigation equipment – **Graphical symbols for pressurized irrigation systems**
ISO 15873:2002	Irrigation equipment – Differential pressure Venturi-type liquid additive injectors
ISO 15886-1:2004	Agricultural irrigation equipment – **Sprinklers – Part 1: Definitions of terms and classification**
ISO 15886-3:2004	Agricultural irrigation equipment – **Sprinklers – Part 3:Characterization of distribution and test methods**
ISO 16149:2006	Agricultural irrigation equipment – **PVC above-ground low-pressure pipe for surface irrigation – Specifications and test methods**
ISO 4065	Thermoplastics pipes – Universal wall thickness table
ISO 7-1:1994	Pipe threads where pressure-tight joints are made on the threads – **Part 1: Dimensions, tolerances and designation**
ISO 7-2:2000	Pipe threads where pressure-tight joints are made on the threads – **Part 2: Verification by means of limit gauges**
ISO 49:1994/Cor 1:1997	Malleable cast iron fittings threaded to ISO 7-1
ISO 4422-1:1996	Pipes and fittings made of unplasticised poly(vinyl chloride) (PVC-U) for water supply – Specifications – Part 1: General
ISO 4422-2:1996	Pipes and fittings made of unplasticised poly(vinyl chloride) (PVC-U) for water supply – Specifications - Part 2: Pipes (with or without integral sockets)
ISO 4422-3:1996	Pipes and fittings made of unplasticised poly(vinyl chloride) (PVC-U)
ISO 4422-4:1997	Pipes and fittings made of unplasticised poly(vinyl chloride) (PVC-U) for water supply – Specifications - Part 4: Valves and ancillary equipment
ISO 4422-5:1997	Pipes and fittings made of unplasticised poly(vinyl chloride) (PVC-U) for water supply – Specifications - Part 5: Fitness for purpose of the system for water supply – Specifications - Part 3: Fittings and joints
ASTM D1785-06	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

TABLE 5.2 - Equipment standards and specifications (cont'd)

Standard name:	Standard description:
ASTM D2241-05	Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2447-03	Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
ASTM D2464-99	Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2466-02	Standard Specification for (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D2467-02	Standard Specification for (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2609-02	Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe
ASTM D2683-98	Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D2683-04	Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D3139-98(2005)	Standard Specification for joints for Plastic Pressure Pipes Using Flexible Elastometric Seals
ASTM D3261-03	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
BS 21:1985	Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions) (equivalent to ISO 7-2:1982)
BS 3867:1987	Method of specifying outside diameters and pressure ratings for pipe of thermoplastics materials (inch series) (equivalent to ISO 161-2:1977)
BS 4346 (Part 1–3)	Joints and fittings for use with unplasticized PVC pressure pipes
BS 143 and 1256:2000	Threaded pipe fittings in malleable cast iron and cast copper alloy
DIN 2440/41/42	Steel tubes (Medium-Weight) suitable for screwing
DIN 2999 (1–6)	Pipe threads for tubes and fittings
DIN 8062 (1988)	Unplasticised polyvinyl chloride (PVC-U, PVC-HI) pipes – Dimensions
DIN 8072 (1987)	Pipes of low-density PE (low-density polyethylene) – Dimensions
DIN 8074 (1999)	High-density polyethylene (PE-HD) pipes – Dimensions
DIN 8075 (1999)	High-density polyethylene (PE-HD) pipes – Testing
DIN 8161 (1994)	Unplasticised polyvinyl chloride pipes – General quality requirements and testing
EN 2452-2	Plastic piping systems for water supply - Unplasticized Poly(vinil chloride) (PVC-U) – Part 2: Pipes
EN 12201-2	Plastic piping system for water supply – Polyethylene (PE) – Part 2: Pipes

Note:

ASAE: The Society for Engineering in Agriculture, Food, and Biological Systems (former American Society of Agricultural Engineers).
ANSI: American National Standards Institute.
ASTM: American Society for Testing Material.
BS: British Standards.
DIN: Deutsches Institut für Normung (German standards).
ISO: International Standards Organization.
EN: European Standard.

TENDERS

The purchasing of irrigation equipment or execution of services, such as the installation, operation and maintenance of irrigation networks and or pumps, should be subject to public tender.

For equipment and services up to a value of US$500, the purchase can be effected through 'quotations', i.e. written quotations may be asked from a representative number (2–3) of suppliers. Where the value of the equipment exceeds a certain amount, e.g. US$600, their purchase should be affected through tender. This is done in accordance with the 'stores regulations' applied in the project or the country concerned.

Wide publicity should be given to every 'notice inviting tenders' (invitation for tenders). This must include the name of the buyer, a brief description of the items for which tenders are invited, the address for delivery of equipment, and the closing date and time of the tenders. Moreover, it should include a statement that the buyer is not bound to accept the lowest or any other tender, and also state to whom the bidders must apply for full particulars.

In the case of 'local tenders' for the purchase of relatively limited quantities, the tender document that must be available and given to prospective bidders on request should include only the general conditions of the tender and the technical specifications of goods. It is important that all required conditions be clearly stated in detail in the tender document, including the time and method of delivery, i.e. FOB (Free on board), CIF (Cost insurance and freight), ex-stock; method of payment, i.e. letter of credit, cash against documents, payment on delivery, etc.; and other related information. For tenders over US$3 000, bidders should furnish a bank guarantee or cheque equal to 10 percent of the value of the tender price. An example of this kind of tender is given below

In the case of 'international bids', the contract documents must include, in detail, the following:

- invitation for bids (as described above);
- instructions to bidders (source of funds, eligible bidders, goods and services, cost, content of bidding documents, preparation and submission of bids, opening and evaluation, award of contract, etc.);
- general conditions of contract (definitions, country of origin and standards, performance, security, inspection and tests, insurance, transportation, warranty, payment, amendments, delays, force majeure, etc.);
- special conditions;
- technical specifications (general, materials and workmanship, schedules of requirements/bill of quantities [Table 5.3], and particular technical requirements/specifications [Table 5.4]);
- bid form and price schedules;
- contract form, bid security and performance security.

EXAMPLE

Tenders for the supply of irrigation equipment

Tenders are hereby invited for the supply of irrigation equipment required for a private farm in the Project area, as per attached quantities, description and specification.

General conditions of tenders

1. **Price:** Bidders to quote prices per unit and total, CIF nearest port, Republic of …, full liner terms, including bank charges on the attached price schedules. Prices to be firm for at least 90 calendar days from the closing date of tender.

2. **Delivery:** Date of delivery in the project site should not exceed 60 days from the time of awarding the tender.

3. The tenders should be sealed and addressed to the General Manager, Irrigation Project, P.O. Box 5564. Tenders should be marked 'TENDER FOR THE SUPPLY OF IRRIGATION EQUIPMENT FOR PRIVATE FARM' on the envelope and should reach Project main offices not later than 31 December 2007.

4. The bidder shall be prepared to accept the prices tendered by him. The tender shall become binding and be carried into effect upon being accepted by the Project. Should the bidder delay execution of the tender or refuse to execute the tender, the bidder shall be liable for any expenses incurred by the Project.

5. **Payment:** The Project shall make all necessary arrangements towards the opening of the letter of credit in US dollars for goods to be supplied in its name and on behalf of the supplier within seven days after receiving the import licence. The Project shall make a first payment of 50 percent of the value of the tender upon submission of all the necessary shipping documents. Such documents shall reach the Project at least one month before the scheduled date of arrival of goods into the port of entry. A second payment of 50 percent of the value of contract shall be paid to the supplier after receipt of goods at Project's store and issuing certificate of acceptance in accordance with the technical specifications.

6. Insurance to cover all the risks for the CIF value, plus 10 percent from warehouse up to the Project's stores.

7. Bidders to quote the country of origin. It is imperative to quote for the items according to the specifications and standards as per the attached list. Otherwise, full details are required.

8. Bidders should provide a guarantee of excellent workmanship and against faulty material of not less than 12 months.

9. Selected candidates should confirm by fax without delay their receipt of the invitation to tender.

10. Tenders shall not be considered unless all the above conditions have been strictly observed.

11. Tenders to be submitted in duplicate.

12. The Project does not bind itself to accept the lowest or any tender.

TABLE 5.3 - Bill of quantities

Item	Description	Unit	Quantity	Rate (US$)	Amount (US$)
1.	HDPE pipe ø 75 mm	m	300		
2.	HDPE pipe ø 63 mm	m	650		
3.	HDPE pipe ø 50 mm	m	100		
4.	LDPE pipe ø 25 mm	m	3 600		
5.	LDPE pipe ø 16 mm	m	1 400		
6.	Clamp saddle ø 75 mm x 2 in (F)	pcs	8		
7.	Clamp saddle ø 63 mm x ¾ in (F)	pcs	70		
8.	Clamp saddle ø 50 mm x ¾ in (F)	pcs	10		
9.	Adaptor (starter) ø 75 mm x 3 in (M)	pcs	1		
10.	Adaptor (starter) ø 63 mm x 2 in (M)	pcs	7		
11.	Adaptor (starter) ø 50 mm x 2 in (M)	pcs	1		
12.	Adaptor (starter) ø 25 mm x ¾ in (M)	pcs	240		
13.	Adaptor (starter) ø 16 mm x ¾ in (M)	pcs	150		
14.	Coupling ø 75 mm	pcs	2		
15.	Coupling ø 63 mm	pcs	4		
16.	Coupling ø 50 mm	pcs	1		
17.	Coupling ø 25 mm	pcs	30		
18.	Coupling ø 16 mm	pcs	10		
19.	Tee ø 50 x 50 x 50 mm	pcs	1		
20.	Tee ø 25 x 25 x 25 mm	pcs	10		
21.	Tee ø 25 mm x ¾ in (M)	pcs	10		
22.	Tee ø 25 mm x ½ in (F)	pcs	150		
23.	Cross ø 2″	pcs	1		
24.	Nipple hexagon ø 2 in	pcs	8		
25.	Nipple hexagon ø ¾ in	pcs	80		
26.	End plug ø 75 mm	pcs	1		
27.	End plug ø 63 mm	pcs	10		
28.	End plug ø 50 mm	pcs	1		
29.	Ball valve ø 2 in	pcs	8		
30.	Ball valve ø ¾ in	pcs	80		
31.	Filter strainer ø 3 in	pcs	1		
32.	Dripper emitter 24 litres/h	pcs	5 000		
33.	Sprinkler pop-up full circle	pcs	4		
34.	Air valve ¾ in	pcs	2		
35.	Valve box	pcs	8		
36.	Excavation of trench and backfill	m	1 050		

TABLE 5.4 - Equipment specification

Item number	Equipment specification
1,2,3	Black HDPE pipes, PN 6.0 bars, in accordance with CYS104: Part 1: 1985 (Cyprus Standard) or equivalent other national standards in compliance with ISO. Supplied in 100 and 60 m rolls.
4,5	Black LDPE pipes, PN 4.0 bars, in accordance with CYS106: Part 1, Part 2: 1985 or equivalent other national standards in compliance with ISO. Supplied in 200 m rolls.
6-28	Polypropylene connector fittings for use with PE Pipes to CYS and ISO dimensions, quick release compression type and/or screw ends to BS 21, or ISO 7, PN 10 bars.
29,30	Ball valves, quarter-turn, on-off operation, made of brass, PN 16 bars to BS 5154, threaded to BS 21, or ISO 7.
31	Filter (strainer), screen type, or grooved disks, 120 mesh/130 micron, epoxy coated metal body, or other high quality material, PN 10, complete with pressure inspection valves, wash-out drain valve, threaded connection to BS 21.
32	On-line, point-source dripper emitters, turbulence flow made of high quality plastic material, 24 litres/h discharge, 1.0 bar operating pressure, cv < 7%, filtration requirements 120 mesh/130 micron.
33	Pop-up sprinkler rotary gear driven full circle, 0.7–0.8 m^3/h discharge at 2–2.5 bars operating pressure, radius 7 m, interchangeable nozzle, c/with small strainer, drain mechanism and plastic cover, threaded (F) connection ¾ inch to BS 21.
35	Valve boxes, made of reinforced plastic or any other material, with cutout openings for pipe on opposite sides of the open bottom, c/with tight-fitting lids or covers on the top. Approximate dimensions: 33 cm *x* 45 cm (base) x 30 cm height.
36	The trench should be as uniform and level as possible, free of large stones and any other sharp-edged materials. Where required it must be filled with embedment material such as grained soil or sand to a depth of 10 cm. Trench dimensions should be 60 cm minimum depth for the 75 mm pipe and 50 cm for the 63 and 50 mm pipes, and 35 cm minimum width in all cases.