

09. MECHANICAL SPECIFICATIONS

Particular specifications and Pricing Preambles for Mechanical Works

Project: **Proposed Construction of Tanzania Schools
Laboratory and WASH facilities**

Client: KOICA

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REVISION RECORD SHEET

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**PROPOSED POLICE TANZANIA SCHOOLS LABORATORY & WASH
FACILITIES**
**TECHNICAL SPECIFICATIONS FOR MECHANICAL
INSTALLATIONS**

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SECTION 1

GENERAL REQUIREMENTS

1.1 DESCRIPTION OF THE CONTRACT WORKS

The main contract works are for the proposed Laboratory and WASH facilities, Tanzania.

Drawings of the development may be inspected at the offices of the Implementing Agency provided this is done by appointment.

The services drawings are provided with the Specification - as per the Schedule of Drawings.

All subcontractors will be required to work in close liaison with the main contractor and all other subcontractors. It is essential that complete coordination is maintained at all times to enable the timely completion, within the specified contract periods, of the Works. The sub-contractors will be required to agree with the main contractor the full working programme for all elements of the contract. Certain areas are more critical to the completion than others as certain items of plant and equipment, which will be required to be installed and commissioned, may experience long delivery dates. The specialised sub-contractors must identify these areas and agree dates for completion with the main contractor and the Engineer so that no delays to the main contractor and other specialists are caused.

2 SCOPE OF THE WORKS

The works to be carried out under this section of the contract shall include the following principal items. These items, together with other contract requirements, have been further expanded under later sections of the Specification.

- Sanitary fittings
- Plumbing and Drainage
- Pipework and associated fittings;
- All other items may be necessary and required to complete the installation.

The subcontractor shall supply all labour, materials, plant, equipment and components necessary and execute the services installations described above and set out in this section of the Specifications, Bills of Quantities and the accompanying Drawings and in accordance with the general specifications herewith.

3. EXTENT OF SUBCONTRACT

The subcontractor shall include, in addition to all items scheduled above, for the design, manufacture, inspection and testing, packing for shipment, insurance, shipping, customs, dues, duties, taxes, delivery to site, unloading and all other charges, complete erection, tests on completion, setting to work, finishing, painting and maintenance for a period of twelve calendar months, all to the satisfaction of the Architect and the Engineer, of the items of Plant and Equipment described or

implied within this Specification and shown on the relevant Drawings.

The proposed installations within the new facilities are required to be complete in all respects as specified herein, and shall include all items of equipment, materials, accessories, fittings, supports, etc. necessary whether such items are specifically referred to in the contract or not. The subcontractor shall be deemed to have included in his tender price for all items necessary such that the installations are complete in all respects and left in a satisfactory working order.

The subcontractor shall provide fully detailed drawings of the entire installation together with layouts of all civil and building works, scaffolding etc. required to assist in erection and/or accommodate/house the plant and equipment, these layout drawings and details being related to the existing layouts as may be necessary. The drawings shall be submitted for approval within three weeks of the award of the subcontract such that the Architect and Engineer can be made aware of all requirements. It shall be fully the responsibility of the subcontractor to liaise with the main Contractor to ensure all civil and builder's works required for this subcontract are prepared and/or provided to suit the programme of this contract. No claims will be entertained.

All modifications to existing layouts and all proposed new layouts and structures shall be subject to the full approval of the Architect, Engineer and the Employer.

4 SUBCONTRACT PERIOD AND PROGRAMME

The subcontractor shall provide within, the stipulated period after the acceptance of his Tender, a complete programme for the execution of this contract. This programme shall indicate the expected dates of the commencement and completion of the following specialist contract works:-

- (i) Submission of Working Drawings for approval;
- (ii) Inspection and testing by the Engineer;
- (iii) Shipment from country of supply;
- (iv) Delivery to Site;
- (v) Erection on Site, details for all activities;
- (vi) Tests on Completion. Operations shall be commenced when instructed and shall be carried forward to completion with the greatest possible expediency, to the satisfaction of the Architect, and Engineer, in accordance with the Programme. The subcontractor's programme shall be agreed with the main contractor, as the subcontractor shall adhere fully to the requirements and timing of the agreed main contractor's programme.

5 DRAWINGS ACCOMPANYING THE TENDER DOCUMENTS

Drawings accompanying this Specification indicate generally the arrangement of the installations and are for assistance in tendering.

The position of equipment and apparatus shown thereon are approximate only, the exact positions, together with the actual runs of ductwork, trunking and conduit etc., will be agreed with the Architect, the Engineer and the Employer before commencement of work.

It shall be deemed that the prices entered by the subcontractor include for the repositioning, of the various services, to meet the above requirements. No claims will be entertained.

The subcontractor shall satisfy himself as to correctness of all Drawings and measurements particularly the dimensions of the works already constructed on site. If the subcontractor finds any discrepancy in the Drawings or between the Drawings and the Specification or between the constructed works and the Drawings he shall immediately refer the same to the Architect and the Engineer who will decide which shall be followed.

Figured dimensions shall be taken in preference to the scale mentioned on or attached to any Drawings.

Details shown on Drawings shall be read in conjunction with items in the Specification. Copies of all Drawings and of the Specification will be furnished free of cost to the subcontractor for his own use.

The Architect will furnish to the subcontractor within a reasonable time after the receipt by the Architect of a written request for the same, any details which, in the opinion of the Architect are necessary for the execution of any part of the work such request to be made only within a reasonable time before it is necessary to execute such work in order to fulfil the contract. One copy of the Drawings, details and Specification shall be kept on the site until the completion of the subcontract and the Architect shall at all reasonable times have access to the same. All copies of Drawings and details shall be returned by the subcontractor to the Architect on the completion of the Contract.

Additional Drawings will be issued by the Engineer to suit the design requirements of the works, these Drawings being issued either during or after the tender period as may be required or necessary. These drawings will supplement the details contained within the Specification and Bills of Quantities and the tenderer shall be deemed to have taken these into account in his pricing. Where the subcontractor can demonstrate that the Drawings relate to new or additional items these new or additional items shall be priced to approval and shall be in accordance with the subcontract rates and prices.


6 SUBCONTRACT WORKING DRAWINGS

The subcontractor shall prepare fully detailed Working Drawings for all items of plant, equipment and accessories required for installation under this section of the contract. Two copies of each Drawing shall be forwarded to the Engineer for approval and or comments. One copy will be returned stamped "approved" or "not approved". Where Drawings require further information and/or modifications to meet the comments made by the Engineer they shall be resubmitted, again in duplicate, for approval.

When Drawings have been approved two further copies shall be forwarded to the Engineer, together with copies to the Architect, site and the Employer.

Drawings, and, where relevant, calculations in respect of the following shall be prepared by the subcontractor and submitted to the Engineer for his approval commencing within ten (10) days from acceptance of the tender.

- (a) Details of the pipework runs;
- (d) Schematic arrangement details of pipework etc;
- (e) Pipework support, fixings and hangers;
- (f) General arrangements details of pipework etc

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- (g) Details of plant layout;
 - (h) Details of all pumping plants, incl. motors, couplings, fans, etc;
 - (i) Controls, control panel details and wiring diagrams;
 - (j) Pump performance curves;
 - (k) Layouts of all pipework runs, chases, holes, trenches and all other services throughout the whole of the installation.

All drawings shall be to scale and fully detailed and all-important dimensions shall be given and the material of which each part is to be constructed shall be indicated.

During progress of the building works, the subcontractor shall make all necessary checks on site to make certain the various Services can be installed as specified and shown on the approved Drawings. Where such works cannot be so installed, this must be immediately brought to the notice of the Architect and Engineer prior to the progress of such works.

The Engineer, in conjunction with the Architect and the Employer, will check and return the Drawings submitted for approval within a reasonable period, not exceeding fourteen (14) days from receipt.

The layouts of plant and equipment are for general guidance only. The subcontractor shall assess the requirements immediately and prepare a plant layout for approval, the required liaison being maintained with other specialists, subcontractors and main contractor such that an agreed layout is submitted for approval.

7 RECORD DRAWINGS

As soon as the works are complete and all tests have been satisfactorily carried out, the subcontractor shall hand to the Architect/Engineer two sets of Record Drawings, together with one set of negatives of these record drawings, showing the works as finally installed. These drawings shall be prepared on approved transparent plastic material in black ink or as approved by the Architect/Engineer. The certificate, of making good defects, will not be issued until this condition has been complied with. Record Drawings are in addition to detailed Working Drawings and shall show all cable routes, circuits, trunking, conduits, plant, trenches, ductwork and ducts etc., together with the entire plumbing & fire protection installation, as finally installed.

The Architect will provide the subcontractor with a set of Contract Drawings (in addition to the two sets provided for the subcontractor's site and office use), which shall be maintained by the subcontractor's representative on site and which shall be used for recording contract variations as they occur. This set of Drawings shall be available for the Architect's inspection on site, and shall be kept up to date.

The cost of the preparation and submission of the above Contract and Record Drawings shall be deemed to be included within the subcontractor's prices.

8 MAINTENANCE MANUALS

At the start of the defects liability period, the subcontractor shall hand over to the Architect/Engineer four full sets of maintenance and operations manuals for the plant and equipment as installed. These manuals shall be fully illustrated and written in English.

BUILDER'S WORK AND CIVIL WORKS

All Builder's Work and Civil Works incidental to this section of the contract such as the cutting of holes in walls and floors, the provision of foundations for plant and machinery, the building in of lifting beams, breaking into the existing plant rooms and duct systems, changes in levels the protection of existing structures, painting and the reinstatement of the plant rooms and associated areas to their original standard etc shall be the responsibility of the main contractor. The subcontractor shall however be fully responsible for the preparation of all such details that relate to this subcontract works, the details being subject to approval by the Architect and Engineer prior to submission to the main Contractor for action. Other items such as the fixing of brackets, cable and ductwork ducts and trenching, making good etc shall be carried out by the subcontractor to suit the installation of all the services.

It is the subcontractor's sole responsibility to ensure that all holes and chases etc are in the required position and that any additional ducts, holes and chases necessary for the erection of the installations in situ concrete walls, floor slabs etc., are included in the early stages of construction as appropriate.

The subcontractor shall furnish the Architect, the Engineer and the Main Contractor with all information as to where foundations, brackets and fixings are required and shall ensure that such work is done in accordance with such information.

The subcontractor shall include in his tender for all supports, fixings, the plugging of all walls, ceilings and floors to facilitate the fixing of the pipework, accessories, and all other portions of the plumbing, drainage and fire fighting installations. Any purpose-made fixing brackets shall also be provided and installed by the subcontractor, including escutcheon plates and the like.

The subcontractor is to set out at the earliest opportunity the position of all holes necessary for the passage of ducts, pipework and conduits or otherwise required in connection with his work, and should additional holes or openings be required due to failure of the subcontractor to fulfil the conditions of this clause, then he must arrange for the main Contractor to make such openings, etc at his own expense.

The subcontractor is not to arrange for the cutting of any holes or openings unless specifically authorised to do so and should he do so without approval, he will become liable for any damage to the building or fittings.

The subcontractor shall supply and install approved pipework support brackets and hangers. It shall be deemed that the prices entered include any special requirements and that the subcontractor has visited the site during the tender period to ascertain all details.

The subcontractor shall pay particular attention to the fixing and alignment of items. All items shall be installed square, true and perpendicular to floors i.e. as shown on Drawings and as may be required at site to the Engineers approval and to suit the existing and new services.

10 GUARANTEE

Unless otherwise indicated in this specification, the subcontractor shall guarantee all work for a period of six months after acceptance by the Architect. In the event of a defect arising within the contract

defects liability period which, in the opinion of the Architect, is due to faulty workmanship or materials, the subcontractor shall, at his own expense, make good such defects where instructed to do so, to the satisfaction of the Architect.

11 SETTING TO WORK

The subcontractor shall instruct the Employer's Maintenance Engineer or his representative on the operation and maintenance of the various components forming the plumbing, drainage and fire fighting installations and shall provide such drawings, diagrams and manuals to ensure the Maintenance Engineer or his representative is completely conversant with such installations.

The subcontractor shall ensure that the Services Installations are left in complete safe working order and operating to the satisfaction of the Architect and the Engineer.

12 REGULATIONS AND STANDARDS

The installations must be carried out strictly in accordance with the following documents:

Mechanical Installations

- (i) UNOPS Design Manual;
- (ii) Relevant British Standard Specifications and Codes of Practice published by the British Standard Institution (hereinafter referred to as B.S. and C.P. respectively);
- (iii) Water Supply and Sewerage Authorities Regulations;
- (iv) Any other duly constituted authorities regulations having jurisdiction over the works;
- (v) The Specification and accompanying documentation and Drawings;
- (vi) The Working Drawings, produced by the subcontractor and approved by the Architect/Engineer;
- (vii) The Loss Prevention Council Regulations. The subcontractor shall undertake all modifications demanded by the authorities in order to comply with the regulations, and produce all certificates, if any, for the authorities without extra charge.

13 QUALITY OF MATERIALS

All materials, fittings and accessories are to be new and in accordance with the requirements of the current rules and regulations where such exist, and with the relevant British Standard Specification.

Uniformity of type and manufacture of fittings or accessories is to be preserved as far as practicable throughout the whole work.

Wherever in this specification the practice is adopted of specifying a particular item as 'similar' to that listed in a particular firm's catalogue, it is to be clearly understood that this is to indicate the type and quality of the equipment required. No attempt is being made to give preference to the equipment supplied by the firm whose catalogue is quoted.

Where particular manufacturers only are specified herein no alternative makes will be considered without good reasons.

All materials shall be good quality, suitable for the purpose specified, and to the approval of the Architect and the Engineer.

14 WORKMANSHIP

The subcontractor shall take into consideration, when pricing his tender, that there will be other subcontractors working. Any disruptions to the existing services must therefore be kept to an absolute minimum, and in this respect the subcontractor shall include in his prices for carrying out works outside normal operating hours as may be directed by the Architect or the Engineer. No claim will be entertained where abnormal working hours are required to meet this requirement and completion of the works within the specified contract period.

The subcontractor shall be fully responsible for the coordination of all services, both new and existing, and in this respect he shall ascertain that the installation of the services will not foul other new or existing services. In all cases services through ducts etc. must be readily accessible for maintenance.

The subcontractor shall be deemed to have included in his tender prices for locating switches, terminal points, ductwork, outlets and fixtures in positions and/or locations at least one metre, both horizontally and vertically from those positions indicated on the contract drawings.

Within these limits no variations in the subcontract sum will be made unless the work has already been executed in accordance with previously approved Working Drawings.

All trade work shall be carried out by tradesmen fully competent and qualified in their respective trades, and the entire installation shall be performed in a neat and workmanlike manner.

The subcontractor shall take every precaution to avoid damage to all existing property including roads, paved walkways, grassed areas, landscaping, cables, drains and other services, and he will be held responsible for and shall make good all such damage arising at his own expense to the satisfaction of the Architect.

The subcontractor will be responsible for the exact runs and placing of pipework, conduit, boxes, ductwork and accessories that are to be cast in concrete ceilings, floors, walls, columns and beams, and for the proper fixing of the pipework and accessories to the shuttering and the steel reinforcement work.

Where ductwork is to be concealed, the pipes etc shall be in an exact position relative to the finished plaster or such other finishes as may be applied to enable adequate cover to be applied.

Where services are run above the false ceilings the subcontractor shall ensure that access to all services is readily available such that future maintenance can be carried out without difficulty. Full details shall be included on the Working Drawings such that the Architect and the Engineer can give consideration to the subcontractor's proposals.

LAYING OUT OF WORK

The subcontractor will be responsible for laying out his work and shall obtain all necessary information as may be required to carry out the work, and such information shall be obtained sufficiently in advance to avoid any possibility of delay to the works as a whole.

The subcontractor shall be fully responsible and shall inform himself of the details of all work being carried out by the various trades on Site, particularly where such trades may interfere one with the other, or where coordination is necessary. No claims for extra costs will be met arising from omissions, oversights, or neglect in this regard.

The subcontractor shall arrange for the supply, in advance of the delivery of the equipment, of all necessary foundation bolts, templates, nuts, plates, sleeves, anchorage, etc., as required and as may be directed by the Engineer or the Architect.

16 ERECTION AND CHECKING OF WORK

The subcontractor shall provide, and be solely responsible for, all skilled and unskilled labour, tools, lifting tackle and other equipment required for transport to the site, the handling and transport about the site and the erection of the plant and equipment.

As each part of the Works is erected, it shall be subject to approval by the Engineer.

All parts shall pass such tests on the site as required by the Architect and Engineer to prove compliance with the contract irrespective of any tests which may already have been carried out at the Manufacturer's Works. In particular all electrical pressure tests made at the Manufacturer's Works shall be repeated at voltages approved by the Engineer.

The subcontractor shall supply and install all supports, fixings, brackets and similar items as may be necessary for the completion of the installation of the services as specified and as shown on the Drawings.

17 PERFORMANCE AND ACCEPTANCE TESTS ON SITE

The subcontractor shall give the Engineer, in writing, at least five days notice of the date after which he will be ready to make the specified tests on completion of installation. Unless otherwise agreed, the tests shall take place within seven days after the said date on such day or days as the Engineer shall in writing notify the subcontractor. The tests shall be carried out under normal working conditions to the satisfaction of the Engineer and shall extend over such continuous periods as he may direct.

All skilled labour, supervision, apparatus, fuel for tests and instruments required for carrying out the tests efficiently will be the responsibility and at the expense of the subcontractor. The accuracy of the instruments shall be demonstrated if required.

If any part of the plant or equipment fails to pass the specified tests, further tests of the said part shall,

if required by the Engineer, be repeated. The subcontractor shall, without delay, put in hand such modifications as are necessary to meet the requirements as described in the Contract and any expense which the Employer may have incurred by reason of such further tests shall be deducted from the subcontract price.

Each completed system within the installation shall be tested as a whole under operating conditions to ensure that each component functions correctly in conjunction with the rest of the system.

18 TEST RECORDS

The subcontractor shall make all necessary records of the tests carried out and when the tests have been successfully completed he shall provide the Architect and the Engineer with test records and reports in a form to be agreed.

The mechanical services will be deemed to be complete when the following obligations have been fulfilled by the subcontractor:

- (a) The satisfactory completion of the Performance and Acceptance Tests on Site;
- (b) Test records and reports have been received;
- (c) The handing over of two preliminary sets of Record Drawings. The supply of these preliminary Record Drawings shall not relieve the subcontractor of his obligations to supply Record Drawings in accordance with the requirements of the Specification;
- (d) The issue of an acceptance certificate from the relevant insurance company for the mechanical ventilation installations.

19 DUST, INSECT AND VERMIN PROOFING

All equipment that is affected by ingress of dust shall be effectively dust-proofed and also vermin proofed where no protection is afforded in its normal manufactured form. All materials used shall be in general resistant to attack by insects, microbiological life or other local fauna and such materials shall be to the approval of the Architect and the Engineer.

20 PAINTING AND FINISHING

All mechanical and electrical equipment installed under this subcontract shall be painted or otherwise finished to approval in accordance with B.S. Code for Standard Colours including all pipework and ductwork, etc. Such finish shall be entirely compatible with the conditions of heat, humidity, exposure to the weather, and other relevant factors arising from the materials, location and condition of operation of the equipment.

The Architect may request examples of paint finishes, the cost of which shall be deemed to have been included within the tendered prices for all works.

All final painting of equipment, fixtures, and accessories shall be carried out by the subcontractor,

except where it is the usual practice of the manufacturer of items of plant, equipment, and switchgear etc to apply a high standard of protective finishing paintwork in the shop before despatch.

This will be acceptable provided any damage to paintwork that occurs before the plant is taken over is made good by the subcontractor at his own costs.

The interiors of electrical switchboards, control panels, and similar items, where supplied by the subcontractor shall be finished in approved enamel and shall comply with the appropriate B.S. for enamel finish. The exteriors of such panels and enclosures shall be of British Standard Specification colour as specified by the Architect.

21 LABELS

All items of plant, valves, tee's etc shall be neatly and clearly labelled externally with identification marks corresponding with those on Drawings or in Specifications. Final details shall be agreed on site.

Identification labels shall be of laminated plastic material engraved, black on white, with no less than 6mm "Lino" style letters and shall be fixed on or adjacent to all items by means of at least two brass screws or to approval.

All main switches, circuit breakers, isolators, valves, motors, switchfuse, consumer's service units, and distribution boards etc shall be neatly and clearly labelled externally with identification marks corresponding with those on Drawings or in Specifications. Final details shall be agreed.

All labels/plates shall be in English.

22 SPARE PARTS AND SPECIAL TOOLS

The subcontractor shall submit his recommended list of spares covering a period of two years for all plant and auxiliary equipment supplied under this subcontract. This list shall be priced individually, but not carried forward to the Bills of Quantities where provisional sums have been included for the purchase of spare parts. Before a TakingOver Certificate is issued a full set of spares as agreed shall be handed over to the Engineer.

Complete sets of any special tools, necessary for the operation, maintenance and dismantling of various sections of the plant and equipment shall be provided in a strong box or boxes each fitted with a suitable padlock and two keys. Such tools shall not be used by the subcontractor during the erection of the plant or equipment. The cost of these tools shall not be carried forward to the Bills of Quantities where a provisional sum has been included for the purchase of these special tools.

23 SPECIALIST MANUFACTURERS AND SUBCONTRACTORS

Where specialists are not nominated by the Employer, the subcontractor shall appoint specialist manufacturers and contractors for any sections of the Works described herein in which he is not himself an experienced, recognised and approved operator.

The Tenderer shall, on submission of his Tender, indicate the names of all proposed specialist manufacturers and contractors, together with the precise sections of the Works for which each will be

responsible. The subcontractor may be required to seek alternative manufacturers or contractors or to accept specialists nominated by the Employer, it shall be deemed that the prices entered include for this requirement.

The subcontractor shall allow in his prices for phasing his work to meet the requirements of the other subcontractors and any specialists, and for varying his programme or otherwise, to comply with the erection programme of such specialist or subcontractors.

No additional costs will be allowed to the subcontractor for any disruptions to his programme, or otherwise, in his compliance with the above requirements.

24 USE OF SITE

The lands and other places outside the Site that are the property of or under the control of the Employer shall not be used except with the approval of the Architect or the Engineer.

The subcontractor shall at any time remove any vehicle, wagon, or any other obstruction within his control that may be required to be moved by the Architect/Engineer for any purpose and the subcontractor shall move such obstruction promptly on instruction being given and at his own cost, unless the Architect/Engineer shall decide otherwise.

The subcontractor shall maintain access for the inspection, operation and maintenance of any of the Employer's plant or work that lies within the Site or elsewhere. The subcontractor shall not use any portion of the Site for any purpose not connected with the Works unless the prior written permission of the Engineer has been obtained.

Except with the written permission of the Architect/Engineer, to be given when necessary for the execution of the Works, the subcontractor's employees will not be permitted to enter any of the Employer's buildings or lands or sites under the control of the Employer, other subcontractors or the Engineer. The subcontractor shall warn his employees that any man found within such buildings or sites without authority is liable to be removed from the Works.

25 POSSESSION OF SITE

It shall be deemed that the prices entered by the subcontractor for the completion of the works are inclusive of all required temporary supplies associated with retaining of essential services as may be directed by the Architect/Engineer or the Employer. All details shall be fully agreed as the works proceed to suit the operational situations as and when they arise.

26 INTERFERENCE WITH THE WORKS

The subcontractor shall not interfere in any way with any existing Works whether the property of the Employer or of a third party and whether the position of such works is indicated to the subcontractor by the Architect or the Engineer or not except where such interference is specifically described as part of the Works either in the contract or in any instruction from the Architect/Engineer.

WATER AND POWER FOR USE ON THE WORKS

Water for construction purposes and for use by the subcontractor's staff during the contract period will be the responsibility of the contractor. The contractor shall make his own arrangements for connection to the nearest suitable water supply/main and for metering the water used. In this respect the subcontractor shall liaise with main Contractor and the Employer who may be able to assist.

The subcontractor shall be responsible for the supply of all electrical power for construction purposes prior to the issue of the TakingOver Certificate.

28 SITE OFFICES, WORKSHOP AND STORAGE

A space will be provided by the Main Contractor for the subcontractor's site offices, workshops and storage. The subcontractor shall be responsible for providing all buildings, fencing, etc that he may require and on completion of the Works shall be required to remove all such buildings, fencing, etc and to restore the land to its original condition.

The subcontractor shall state, with his Tender, the areas that he requires for his site offices, workshops and storage. The areas of land available are limited and the Employer reserves the right to allocate areas of land smaller than the subcontractor may require, in which case, the subcontractor shall make such additional or alternative arrangements as may be necessary for his full requirements, all at his own cost.

29 SANITATION OF THE WORKS

The sanitation of the works shall be the responsibility of the contractor who shall arrange and maintain all required sanitation facilities to the satisfaction of the Local Authorities, Labour Department and Architect.

The sub-contractor shall warn his employees and other specialists and subcontractors that any employee found fouling the site shall be removed from the Site immediately.

In this respect, the sub-contractor shall arrange for erecting temporary toilet and ablution facilities, these facilities being connected, on a temporary basis, but to approval, into the existing foul sewage system. Full details shall be agreed. These temporary ablutions are a specific requirement of the Employer and shall therefore be provided for this duration of the contract, all items being removed at the completion of the Works and the existing system fully reinstated to its original condition.

30 PROTECTION OF WORKS

The subcontractor shall carefully protect from injury by weather all work and materials which may be affected thereby and allow in his prices for all dams, pumping, shoring, temporary drains, sumps etc, necessary for the purpose, and shall clear away and make good at his own cost to the satisfaction of the Engineer all damage caused thereby.

SUNDRIES

The necessary holding down bolts, supporting brackets and templates, guards and screens, locks, piping, conduits, lamps and other requisite sundries whether specified in detail or not shall be provided, under the contract and it shall be deemed that the subcontractor's prices, rates and the like include for all such items.

32 MAINTENANCE CONTRACT

The Employer will consider the introduction of long term maintenance contracts with specialist manufacturers and subcontractors. In this respect the subcontractor shall submit, with his tender, details of a planned maintenance contract that will take effect after the completion of the six-month maintenance period previously specified.

33 DELETION OF ITEMS FROM CONTRACT

Where Provisional Sum items have been identified within the Bills of Quantities these may be expended in whole, in part or may be totally deleted from the subcontract works.

In addition, certain items that have been designed, specified and included within the Bills of Quantities may finally be deleted from the subcontract, as the Employer has not finally decided whether they are to be provided.

It shall be deemed that the tender price entered by the subcontractor has taken into account the possible deletion of these items, and Provisional Sum items, as no claims for loss of profit or any other such claim will be entertained.

34 SCHEDULES OF TECHNICAL DATA

Where included in the Tender Documents, schedules of technical data shall be completed by all Tenderers, otherwise the Tender may not receive full consideration, and will be liable to rejection.

35 COPIES OF ORDERS

Copies of all orders for major items of plant, equipment and materials places with suppliers shall be provided in triplicate to the Engineer.

36 INSPECTION AND TESTS AT MANUFACTURER'S WORKS

The Engineer, and his duly authorised representative, shall have at all reasonable times access to the Contractor's premises to inspect and examine the materials and workmanship of the mechanical and electrical plant and equipment during its manufacture there; and if part of the plant and equipment is being manufactured on other premises, the Contractor shall obtain for the Engineer and for his duly authorised representative permission to inspect as if the plant and equipment was manufactured on the Contractor's own premises. Such inspection, examination or testing, if made, shall not relieve the

Contractor from any obligation under the Contract.

Where the plant and equipment is a composite unit of several individual pieces manufactured in different places, it shall be assembled and tested as one complete working unit, at the Maker's works, to the relevant British Standard where applicable.

SECTION 2: GENERAL MECHANICAL SPECIFICATIONS

1. General

This section specifies the general requirement for plant, equipment and materials forming part of the Contract Works and shall apply except where specifically stated elsewhere in the Specification or on the Contract Drawings.

2. Quality of Materials

All plant, equipment and materials supplied as part of the Contract Works shall be new and of first class commercial quality, shall be free from defects and imperfections and where indicated shall be of grades and classifications designated herein.

All products or materials not manufactured by the Contractor shall be products of reputable manufacturers and so far as the provisions of the Specification is concerned shall be as if they had been manufactured by the Contractor.

Materials and apparatus required for the complete installation as called for by the Specification and Contract Drawings shall be supplied by the Contractor unless mention is made otherwise.

Materials and apparatus supplied by others for installation and connection by the Contractor shall be carefully examined on receipt. Should any defects be noted, the Contractor shall immediately notify the Engineer.

Defective equipment or that is damaged in the course of installation or tests shall be replaced as required to the approval of the Engineer.

3. Regulations and Standards

The Contract Works shall comply with the current editions of the following:

- a) Regulation of the Local Authority with Jurisdiction over the Works
- b) Relevant British Standard Specifications and Codes of Practice published by the British Standard Institution
- c) Chartered Institute of Building Services Engineers (CIBSE) Design Guides
- d) UNOPS Design Manual
- e) BS EN752: Drain and sewer systems outside buildings.
- f) BS EN12056 (All Parts): Code of practice for gravity drainage systems inside

buildings.

- g) BS EN15874: Specifications for plastic piping systems for hot and cold water installations.

4. Site Supervision

The Contractor shall ensure that there is an English-speaking supervisor on the site at all times during normal working hours.

5. Testing

5.1 General

The Engineer reserves the right to inspect and test or witness all manufactured plant equipment and materials.

The right of the Engineer relating to the inspection, examination and testing of plant during manufacture shall be applicable to Insurance companies and inspection authorities so nominated by the Engineer.

The Contractor shall give two week's notice to the Engineer of his intention to carry out any inspection or tests and the Engineer or his representative shall be entitled to witness such tests and inspections.

Six copies of all test certificates and performance curves shall be submitted as soon as possible after the completion of such tests, to the Engineer for his approval.

Plant or equipment which is shipped before the relevant test certificate has been approved by the Engineer shall be shipped at the Contractor's own risk and should the test certificate not be approved new tests may be ordered by the Engineer at the Contractor's expense.

The foregoing provisions relate to tests at manufacturer's works and as appropriate to those carried out at site.

5.2 Material Tests

All material for plant and equipment to be installed under this Contract shall be tested, unless otherwise directed, in accordance with the relevant BS Specification concerned.

For materials where no BS Specification exists, tests are to be made in accordance with the best modern commercial methods to the approval of the Engineer, having regard to the particular type of the materials concerned.

The Contractor shall prepare specimens and performance tests and analyses to demonstrate

conformance of the various materials with the applicable standards.

If stock material, which has not been specially manufactured for the plant and equipment specified is used, then the Contractor shall submit satisfactory evidence to the Engineer that such materials conform to the requirements stated herein in which case tests of material may be partially or completely waived.

Certified mill test reports of plates, piping and other materials shall be deemed acceptable.

5.3 Pressure Testing

All pipework installations shall be pressure tested in accordance with the requirements of the various sections of this Specification.

The installations may be tested in sections to suit the progress of the works but all tests must be carried out before the work is buried or concealed behind building finishes. All tests must be witnessed by the Engineer or his representative and the Contractor shall give 48 hours notice to the Engineer of his intention to carry out such tests.

Any pipework that is buried or concealed before witnessed pressure tests have been carried out shall be exposed at the expense of the Contractor and the specified tests shall then be applied.

The Contractor shall prepare test certificates for signature by the Engineer and shall keep a progressive and up-to-date record of the section of the work that has been tested.

6. Colour Coding

Unless stated otherwise in the Particular Specification all pipework shall be colour coded in accordance with the latest edition of BS 1710 and to the approval of the Engineer or Architect.

7. Welding

All welding unless stated otherwise shall be arc welding.

Gas welding may be employed in certain circumstances provided that specific prior approval is obtained from the Engineer.

Welding codes and symbols shall be to BS 499 and BS EN 13622.

For arc welding, welding, welders, welding processes procedures etc. shall be to BS EN 287 & BS EN ISO 15609. Materials for welding shall be grouped as per (published document of the BSI) PD CR 15608. Arc welded joints in steel shall comply with the guidelines in BS EN ISO 5817.

Welders where prior approval shall not be required shall comply with BS 4872.

Generally all welding shall comply with the requirements of BS EN 1011.

7.1 Welder's Qualifications

Any welder employed on this Contract shall have passed the trade tests as laid down by the Government.

The Engineer may require to see the appropriate certificate obtained by any welder and should it be proved that the welder does not have the necessary qualifications the Engineer may instruct the Contractor to replace him by a qualified welder.

SECTION 3 PARTICULAR SPECIFICATION FOR PLUMBING AND DRAINAGE INSTALLATIONS

1.1 INTRODUCTION

These specifications cover the execution of the Plumbing and Drainage installations and should be read in conjunction with other relevant specifications, drawings and contract documents issued to the Contractor in conjunction with the job.

The specifications apply to works at the above-mentioned site, description and design by and executed under the supervision of UNOPS, or any agent or representative duly appointed to do so.

1.2 INCLUDED IN THE SUB-CONTRACT

- (a) The works include, unless otherwise specified, supply, delivery, installation, testing, commissioning, cleaning-up and setting to work all the installations described in the specifications and shown on the Contract Drawings.
- (b) The provision of all labour, materials, tools, instruments, testing apparatus and scaffolding necessary to execute the work in a first class manner, even such labour, materials, instruments or apparatus that are not specifically mentioned in the project but are necessary for the satisfactory completion of the works, including such elements as:
 - Cold water supply pipework and fittings to the water storage tanks from the mains supply;
 - PE water storage tanks complete with all necessary covers, fittings, washouts, overflow pipes and supports. Also included are pipe connections, fittings, washouts and overflow piping to the ground plastic tank. The Sub-Contractor is expected to take the overflow and washout pipes to reasonable discharge points;
 - The water supply pipework to the functional points and sanitary fittings as shown on the drawings plus the necessary fixing, supporting and jointing materials from the water storage tank and the mains;

- The sanitary and operational fittings together with the fixing, supports and jointing to the supply and discharge pipes;
 - The waste and soil pipework from the sanitary and operational fittings to the first manholes, including all fixing, supports and jointing materials.
- (c) All cutting away and all making good will, if nothing else is specified, be carried out by the Main Contractor, but it will be the responsibility of the Sub-Contractor to ensure that this work is kept to a minimum. The Sub-Contractor shall also be responsible for the correct marking of all chases and holes, including the provision of all necessary details to the Main Contractor.
- (d) The Sub-Contractor shall also be responsible for ensuring that runs for floor or wall chases, holes to be cut or left, will be marked out at appropriate stage of the structural work.
- (e) The Sub-Contractor shall undertake all notifications demanded by the Authorities in order to comply with current regulations and produce all certificates, if any, from the Authorities without extra charge.
- (f) The Subcontractor shall, as part of his Tender, supply all necessary information such as manufacturer's catalogue or type numbers, brochures or copies of catalogue pages, weight, and all other relevant information that are necessary to classify the equipment tendered for.
- (g) All other materials, labour, tools, instruments, scaffolding, etc., which are necessary for final completion in a first class manner of the plants to the Engineer's satisfaction. Excluded are only materials and workmanship especially mentioned herein as "Excluded from this Sub-Contract".
- (h) The sub-contractor shall include cables, pipes, etc., from central facilities to the working area.
- (i) Provide the consulting engineer for his approval complete working and manufacturing drawings as specified.
- (j) Commissioning and testing of the plants as specified.
- (k) Supply of complete operation and maintenance manuals as specified, as well as instructions to the Client's maintenance personnel as specified.
- (l) The Sub-Contractor shall include for full maintenance during initial maintenance period as specified.

2 EXCLUDED FROM THE SUB-CONTRACT

- (a) The Main Contractor will provide central located facilities for supply of water and power during the construction period.

3 EXTENT OF THE SUB-CONTRACTOR'S DUTIES

At the commencement of the work, the Sub-Contractor shall investigate and report to the Engineer if all materials and equipment to be used in the work, and not specified as supplied by others, are available locally. If not available, the Subcontractor shall at this stage place orders for the materials in question and copy the orders to the Architect and/or the Engineer. Failure to do so shall in no way relieve the Sub-Contractor from supplying the specified materials and equipment in time.

Materials supplied by others for installation and/or connection by the Sub-Contractors shall be carefully examined before installation and connection. Any defects noted shall immediately be reported to the Engineers.

Any item or material found to be defective shall be replaced by the Sub-Contractor within seven days of his being notified and any result of defective workmanship shall be repaired including supply of new parts if necessary, immediately upon being notified.

The Sub-Contractor shall furnish at his own cost any samples of materials or workmanship required for the Sub-Contractor works, that may be called for by the Engineer for his approval. The Engineer may reject materials or workmanship not in his opinion up to the approved standard. The Sub-Contractor shall allow in his prices for such samples.

The Subcontractor shall, when authorised in writing by the Architect or the Engineer, make variations from the specifications and drawings.

The Sub-Contractor shall submit to the Architect or to the Engineer, claims for any work for which he considers demanding extra payment before the beginning of such work.

The Sub-Contractor shall be responsible for verifying all dimensions relative to his work by actual measurements taken on the site.

The Sub-contractor shall request any alteration to the building structures within 30 days of the awarding of the Sub-Contract. Only such alterations as deemed unavoidable by the Engineer will be considered.

The Sub-Contractor shall collaborate with the Engineer and the Contractor in planning the installation before work is commenced. Particular care shall be taken to ensure that there is close collaboration with the other Subcontractors when installing services.

The Engineer and Architect shall have full rights to inspect the work in progress and all materials and equipment for use in the installation prior to its erection whether these are on site or the Sub-Contractor's workshop. The Sub-Contractor shall allow for reasonable access to the work for this purpose.

Where large items of equipment are to be installed, the Subcontractor shall advise the Contractor in good time, so that access is provided for installation before work is commenced on site.

The Sub-Contractor or his responsible representative shall participate in all site meetings as and when required, in order to discuss the works, make necessary decisions, receive relevant instructions, confirm fulfillment of time schedules, etc.

4 FINISH PAINTING

When all the installations have been set work, tested and commissioned, the Subcontractor shall prime the pipework with an undercoat and paint 2 No. coats of paint in accordance with BS 1710 standard for color coding, to the satisfaction of the Engineers and the Architects.

SECTION 4: - GENERAL SPECIFICATIONS FOR PLUMBING AND DRAINAGE

1.0 MATERIALS AND STANDARDS

1.1 General

This section specifies the general requirements for plumbing and drainage forming part of the Contract Works and shall apply except where specifically stated elsewhere in the specification, bills of quantities or on the contract Drawings.

Where the standard specified has been withdrawn, superseded or made obsolete, the standard replacing it shall prevail.

1.2 Pipework and Fittings

Pipework materials to be used are as follows: -

1.2.1 Cold Water

PPR polypropylene random copolymer as specified on the drawings and bills of quantities.

1.2.6 Polypropylene Random Copolymer Pipe

Where specified, polypropylene Random pipes shall be installed.

Pipes shall be manufactured with materials to BS 4991. Dimensions, test methods, pressure ratings and physical characteristics shall comply with BS 4991. Pipework shall be installed in accordance with CP 312 and the manufacturer's instructions.

Backfilling

For the protection of the pipe, initial backfilling shall be carried out as soon as possible after laying. The initial backfill shall be fine grained material thoroughly compacted around the pipe and consolidated to a depth of 6" above the crown of the pipe and at no time shall heavy rocks, stones or

other objects be included in the balance of the backfill that might protrude the initial backfill layer and come into contact with the pipe.

Testing

Pipelines shall be tested in sections under an internal water pressure normally one and a half times the maximum allowable working pressure of the class of pipe used. Testing shall be carried out as soon as practical after laying and when the pipeline is adequately anchored. Precautions shall be taken to eliminate all air from the test section and to fill the pipe slowly to avoid risk of damage due to surge.

1.2.7 MuPVC Waste Systems

All pipes and fittings shall be manufactured in accordance with BS 5255: 1989 oStandard.

Pipe shall be supplied in plain-ended lengths.

Thickness

The Minimum acceptable wall thickness of pipe and fittings shall be as follows:

Size (in) Thickness (mm)	Size (mm)	Pipe and Fittings Wall
1¼	32	1.8
1½	40	1.9
2	50	2.0

Jointing

The method of joining to be employed shall be that of solvent welding, using the pipe and manufacturer's approved cement. Seal rings joints shall be introduced where it is necessary to accommodate thermal expansion.

Anchoring

All bends, valves and hydrant tees etc, in the line of water main shall be adequately anchored to resist thrust due to internal water pressure. A concrete block shall be cast under and around the pipe and between it and sides of the trench. Well-rammed material shall be used to support the pipe and either side of the concrete.

Workmanship

The installation method of jointing shall be solvent welding; and both jointing and fixing shall comply in all respect to the manufacturer's site-work instructions. The maximum intervals between pipe supports at 20°C shall be as follows: -

Nominal size (in)	Nominal size (mm)	Horizontal (mm)	Vertical (mm)
1¼	32	500	1200
1½	40	500	1200
2	50	900	2000
3	80	900	2000
4	100	1000	2000
6	150	1000	2000

Pipes shall be fixed in straight runs and horizontal runs and shall be laid to gradients in conformity with BS EN 12056 and in any event not less than 18mm/m unless otherwise specified.

Pipes passing through walls or floor shall be sleeved to allow unrestricted movements.

The works shall be inspected and tested during installation at any stage in accordance with BS EN 12056. All work, which will be concealed, shall be tested before it is finally enclosed and verified by the Clerk of Works.

Pipe Bed

Pipes shall uniformly be laid on a 75mm thick bed, (Sand or red soil) and not be allowed to rest on the joint or on stones etc.

Supports to Fittings

In underground installation care shall be taken to ensure that heavy components such as valves are fully supported so that the pipeline carries no weight.

Backfilling

For the protection of the pipe initial Backfilling shall be carried out as soon as possible after laying. The initial backfill shall be fine-grained material thoroughly compacted around the pipe and consolidated to depth of 6" above the crown of the pipe. At no time shall heavy rocks, stones or other objects be included in the balance of the backfill that might protrude the initial backfill and come into contact with the pipe.

Testing

Pipelines shall be tested in section under an internal water pressure normally one and a half times the maximum allowable working pressure of the class pipe used. Testing shall be carried out as soon as practicable after laying and when the pipeline is anchored precautions shall be taken to eliminate all air from the test section and the pipe slowly to avoid risk of damage due to surge.

1.2.8 A.B.S. Waste Systems

Where indicated on the Drawings and Schedules, the contractor shall supply and fix A.B.S. waste pipes and fittings.

The pipes, traps and fittings shall be in accordance with the relevant British Standards, including BS EN 274, and fixed generally in accordance with manufacturer's instructions and BS EN 12056.

Jointing of pipes shall be carried out by means of solvent welding, the manufacturer's instructions and BS EN 12056.

Jointing of pipes shall be carried out by means of solvent welding. The manufacturer's recommended method of joint preparation and fixing shall be followed.

Standard brackets, as supplied for use with this system, shall be used wherever possible. Where the building structure renders this impracticable the contractor shall provide purpose made supports, centres of which shall not exceed one metre.

Expansion joints shall be provided as indicated. Supporting brackets and pipe clips shall be fixed on each side of these joints.

1.2.9 uPVC Soil Pipes System

The contractor shall supply and fix uPVC soil pipes and fittings as indicated on the Drawings and Schedules.

Pipes and fittings shall be in accordance with relevant British Standards, including BS 4514 & BS EN 1329 and fixed to the manufacturer's instructions and BS EN 12056.

The soil system shall incorporate synthetic rubber gaskets as provided by the manufacturer whose fixing instructions shall be strictly adhered to.

Connections to WC pans shall be effected by the use of a WC connector, gasket and cover, fixed to suit pan outlet.

Suitable supporting brackets and pipe clips shall be at maximum of meter centres.

The contractor shall be responsible for the joint into the Gully Trap or Drain Trap as indicated on the drawings.

1.2.10 uPVC Square Rainwater System pipe and Gutter

Gutter(s) shall be as specified by the Architect (on drawings and/or as measured in bills of quantities).

Rainwater pipes where specified as uPVC shall be supplied in plain-ended lengths and shall comply with BS EN 12200.

The minimum acceptable wall thickness of rainwater pipes shall be 1.80mm. Pipe support brackets must be adequate to screen expansion gaps.

The grade of uPVC used for gutter (where gutters are specified as uPVC) and pipe shall have a minimum softening point of 75°C when tested by the Vicat method as described in BS EN ISO 306. The pipe and gutter shall be colour Grey, to BS 5252 or black white or rustic

1.2.11 uPVC Rainwater Fittings

All fittings shall be injection moulded and shall be compatible with pipe and gutters and shall conform to the BS EN 12200, BS EN 607 and BS EN 1462 Standard.

All rain-pipes and fittings shall be Colour Grey to British Standard 5252, or black, white or rustic.

Brackets shall be to BS EN 1462.

Gutter connecting fittings shall have integrally moulded seal retaining cavities housing a rubber seal of hollow section.

The fitting shall incorporate a gutter-retaining clip.

Gutter shall be supplied in plain-ended lengths.

Rain water pipes shall be circular in section, 65mm nominal diameter complying in all respects to BS EN 12200, BS EN 607, and BS EN 1462 or the relevant local Standards.

Rainwater pipes shall be supplied in plain-ended lengths. The minimum acceptable wall thickness of rainwater pipes shall be 1.80mm

Pipe support brackets must be adequate to screen expansion gaps.

The grade of UPVC used for gutter and pipe shall have a minimum softening point of 75°C when tested by the Vicat method as described in BS EN 306.

The pipe and gutter shall be Colour Grey, to BS 5252, or black, white or rustic.

1.2.12 uPVC Underground Drainage System

(a) Pipes and fitting

The pipes and fittings shall comply in all respects to BS EN 13598, BS EN 1401 or the relevant local Standards.

Pipes shall be supplied in plain-ended lengths.

The minimum acceptable wall thickness of pipe and fittings will be as follows:

110mm pipe	3.0mm	
160mm pipe	3.9mm	
110mm junction only	3.50mm socket	3.80mm body
All other fittings	3.20mm socket	3.40mm body
160mm all fittings	4.30mm socket	4.70mm body

The method of jointing to be employed shall be by lip seal socketed fittings. Jointing to other materials shall be made in the manner specified by the manufacturer.

The grade of UPVC used for the pipes shall have a minimum softening point of 82°C when tested by the 'Vicat' method as described in British Standard BS EN ISO 306, BS 2782.

Holderbats shall be made of Mild Steel protected from corrosion by galvanizing or such coating for optimum fit. To fit pipe supports a special purpose made PVC packing piece may be used.

The base of soil and vent stack connection to the below ground drain shall be made with a bend of minimum centre lines radius of 250mm.

Minor changes of direction where permitted shall be made with a variable bend that has a constant effective length.

(b) Excavation of Trenches

The installation method of joining shall confirm in all respects to the manufacturer's site work instruction.

Trenches shall be excavated to a sufficient depth to allow a 50mm minimum bed below the underside of the pipe. Trenches width shall be not less than the outlet diameter of the plus 300mm and not wider than necessary.

(c) Trench Invert

The base of the trench shall be such that even support is given to the pipe for its full length. Soft spots shall be removed and replaced with compacted granular material as described below. High spots and rock shall be removed to allow full 50mm-bed depth.

(d) Pipe bed

The bed shall be composed of granular material to the specification called for below and shall cover the full trench width and length and boned to gradient.

(e) Laying and jointing

Pipes and fitting shall be laid true to gradient in straight lines and joined in accordance with manufacturer's instructions. All pegs used for alignment and other purposes must be removed after use and before side filling. All joints shall be watertight complying with BS EN 752.

Pipe barrels shall be in continuous contact with the trench bed when laid.

(f) Side Filling

The side filling of pipes shall be composed of hard granular material, which shall be to the requirements below.

Side fillings must be placed equally on both sides of the pipe and compacted, so as to buttress the pipes against the trench walls. Side filling shall continue up to pipe crown level as a minimum and above this level if required by the Engineer.

(g) Backfilling

The first 300mm of backfill above crown level shall be taken from selected trench spoil all passing 25mm sieve. It shall be placed in two 150mm layers each firmly tramped. Above the 300mm level mechanical fillings and compaction may be used.

Where cover is less than 450mm the pipe shall be covered with 75mm of selected material laid to support a concrete tile or slab indicating the presence of a service.

(h) Granular Material for Bed and Side Fill

The material may be composed of crushed stone, clinker, quarry scalping, ballast, gravel, shingle or all-in aggregate to British Standard BS EN 12620.

All material for bed and site fill shall be hard and granular passing 20mm sieve and shall contain not more than 5 per cent fines passing 3mm sieve.

The material shall have a compaction factor of 0.3 or less.

1.2.13 Valves

a) Draw-off Taps and Stop Valves (Up to 50mm Nominal Bore)

Draw-off taps and valves up to 50mm nominal bore, unless otherwise stated or specified for attachment or connection to sanitary fitting shall be manufactured in accordance with the requirements of BS 1010.

b) Gate Valves

All gate valves 80mm nominal bore and above, other than those required for fitting to buried water mains shall be of Cast Iron construction, in accordance with the requirements of BS EN 1171.

All gate valves required for fitting to buried water mains shall be of Cast Iron construction in accordance with the requirements of BS 5163.

All gate valves up to and including 65mm nominal bore shall be of Bronze construction in accordance with the requirements of BS EN 12288.

The pressure classification of all valves shall depend upon the pressure conditions pertaining to the site of works.

c) Globe Valves

All globe valves up to and including 65mm nominal bore shall be of Bronze construction in accordance with the requirements of BS 5154 and BS EN 12288:2003.

The pressure classification of all globe valves shall depend upon the pressure conditions pertaining to the site of works.

d) Check or Non-Return Valves

All check or non-return valves 80mm nominal bore and above shall be of the swing check type of Cast Iron construction in accordance with the requirement of BS EN 12334:2001.

The pressure classification of all globe valves shall depend upon the pressure conditions pertaining to the Site of works.

e) Float operated Valves

All float operated valves for use in connection with hot and cold water services shall be of the Portsmouth type in accordance with the requirements of B.S.1212, constructed from Bronze or other corrosion resistant materials. These valves fall into three pressure classifications as follows: -

- | | | | |
|-------|-----------------|---|--------------------|
| (i) | Low pressure | - | 3.58 bars maximum |
| (ii) | Medium pressure | - | 7.72 bars maximum |
| (iii) | High pressure | - | 12.62 bars maximum |

The pressure classification required for each ball valve will be designated in the description of its associated equipment contained in section C of the Specification.

(f) Manually Operated Mixing Valves

Mixing valves for shower fittings and other appliances being provided under the contractor Works shall be manufactured in accordance with the requirements of BS EN 1287:1999 from Bronze or other corrosion resistant materials.

1.2.14 Waste Fitment Traps

a) Standard and Deep Seal P & S Traps

Where standard or deep seal traps are specified they shall be manufactured in suitable non-ferrous materials in accordance with the full requirements of BS EN 274.

In certain circumstances, Cast Iron traps may be required for cast iron baths and in these instances bath traps shall be provided which are manufactured in accordance with the full requirements of BS 1291.

b) Anti-Syphon Traps

Where Anti-Syphon traps are specified, these shall be similar or equal to the range of traps manufactured by Geberit Limited, New Hythe Business Park, Aylesford, Kent, England.

The trade name for traps manufactured by this company is 'Terrain'.

1.2.15 Pipe Supports

a) General

This sub-clause deals with pipe supports securing pipes to the structure of buildings for above ground

application.

The variety and type of support shall be kept to a minimum and their design shall be such as to facilitate quick and secure fixings to metal, concrete, masonry or wood.

Consideration shall be given, when designing supports, to the maintenance of desired pipe falls and the restraining of pipe movements to a longitudinal axial direction only.

The contractor shall supply and install all steelwork forming part of the pipe support assemblies and shall be responsible for making good damage to builders work associated with the pipe support installation.

The contractor shall submit all his proposals for pipe supports to the Engineer for approval before any erection works commence.

b) Steel and Copper Pipes and Tubes

Pipe runs shall be secured by clips connected to pipe hangers, wall brackets, or trapeze type supports. 'U' bolts shall not be used as a substitute for pipe clips without the prior approval of the Engineer.

An approximate guide to the maximum permissible supports spacing in metres for Steel and Copper pipe and tube is given in the following table for horizontal runs.

Size Nominal Bore	Copper Tube To BS EN 1057:1996	Steel Tube To BS 1387
15mm	1.25m	2.0m
20mm	2.0m	2.5m
25mm	2.0m	2.5m
32mm	2.5m	3.0m
40mm	2.5m	3.0m
50mm	2.5m	3.0m
65mm	3.0m	3.5m
80mm	3.0m	3.5m
100mm	3.0m	4.0m
125mm	3.0m	4.5m
150mm	3.5m	4.5m

The support spacing for vertical runs shall not exceed one and a half times the distances given for horizontal runs.

b) Expansion Joints and Anchors

Where practicable, cold pipework systems shall be arranged with sufficient bends and changes of direction to absorb pipe expansion providing that the pipe stresses are contained within the working limits prescribed in the relevant BS specification.

Where piping anchors are supplied, they shall be fixed to the main structure only.

Details of all anchor design proposals shall be submitted to the Engineer for approval before erection commences.

The contractor when arranging his piping shall ensure that no expansion movements are transmitted directly to connections and flanges on pumps or other items of plant.

The contractor shall supply flexible joints to prevent vibrations and other movements being transmitted from pumps to piping systems or vice versa.

1.2.16 Sanitary Appliances

All sanitary appliances supplied and installed as part of the contract works shall comply with the general requirements of BS 6465 and the particular requirements of the latest BS Specifications.

1.2.17 Pipe Sleeves

Main runs of pipework are to be fitted with sleeves where they pass through walls and floors. Generally the sleeves shall be of PVC except where they pass through the structure, where they shall be of mild steel. The sleeves shall have 6mm – 12mm clearances all around the pipe or for insulated pipework all around the installation. The sleeve will then be packed with slag wool or similar material.

2.0 Installation

2.1 General

Installation of all pipework, valves, fittings and equipment shall be carried out under adequate supervision from skilled staff to the relevant codes and standards as specified herein. The contractor shall be responsible to the Main Contractor for ensuring that all builders' work associated with his piping installation is carried out in a satisfactory manner to the approval of the Engineer.

2.2 Above Ground Installation

a) Water Services

Before any joint is made, the pipes shall be hung in their supports and adjusted to ensure that the joining faces are parallel and any falls which shall be required are achieved without springing the pipe.

Where falls are not shown on the Contract Drawings or stated elsewhere in the Specification, pipework shall be installed parallel to the lines of the buildings and as close to the walls, ceilings, columns, etc., as is practicable.

All water systems shall be provided with sufficient drain points and automatic air vents to enable them to function correctly. Valves and other user equipment shall be installed with adequate access for operation and maintenance. Where valves and other operational equipment are unavoidably installed beyond normal reach or in such position as to be difficult to reach from a small stepladder, extension spindles with floor or wall pedestals shall be provided.

Screwed piping shall be installed with sufficient number of unions to facilitate easy removal of valves and fittings and to enable alterations of pipework to be carried out without the need to cut the pipe.

Full allowances shall be made for the expansion and contraction of pipework, precautions being taken to ensure that any force produced by the pipe movements are not transmitted to valves, equipment or plant.

All screwed joints to piping and fittings shall be made with P.T.F.E. tape.

The test pressure shall be maintained by the pump for about one hour and if there is any leakage, it shall be measured by the quantity of water pumped into the main in that time. A general leakage of 4.5 litres per 25mm of diameter, per 1.6 kilometres per 24 hours per 30 metres head, may be considered reasonable but any visible individual leak shall be repaired.

b) Sanitary Services

Soil, waste and vent pipe system shall be installed in accordance with the best standard of modern practice as described in BS EN 12056 – 2:2000 to the approval of the Engineer.

The contractor shall be responsible for ensuring that all ground waste fittings are discharged to a gully trap before passing to the sewer via a manhole.

The contractor shall provide all necessary rodding and inspection facilities within the draining system in positions where easy accessibility is available.

Where a branch requires rodding facilities in a position to which normal access is unobtainable, then that branch shall be extended so as to provide a suitable purpose made rodding eye in the nearest adjacent wall or floor to which easy access is available.

The vent stacks shall terminate above roof level and where the stack passes through the roof, a weather skirt shall be provided. The contractor shall be responsible for sealing the roof after installation of the stacks.

The open end of each stack shall be fitted with a plastic coated or galvanized steel wire guard.

Access for rodding and testing shall be provided at the foot of each stack.

c) Sanitary Appliances

All sanitary appliances associated with the contract works shall be installed in accordance with the best standard of modern practice as described in BS 6465 to the approval of the Engineer.

2.3 Underground Installation

a) General

All underground water and drainage service installations shall be carried out in accordance with the best standard of modern practice as described in BS EN 752 and BS 6700 respectively and the following clause.

b) Sequence of Operation for Underground Service Installation

(i) Setting Out

As described in BS EN 752

(ii) Breaking Up Surface (If in Roads)

As described in BS EN 752

(iii) Excavation and Timbering

As described in BS EN 752 and 503 and the following:-

Excavation shall be made to such depths and dimensions as may be required by the Engineer to obtain prior fall and firm foundations. No permanent constructions shall be commenced on any bottom until the excavation has been examined and approved by the Engineer.

Should the Contractor in error or without the instructions of the Engineer make any excavation below the required level of the pipe or bed, as the case may be, then he shall be required to refill such

excavation to the correct levels with concrete 1: 4 : 8 to 38mm maximum aggregate size.

The Contractor's prices shall be included for excavating in all materials met with, for trimming bottoms to the necessary falls and for any extra excavation required for planking, strutting and working space.

The Contractor shall keep the whole of the trenches or other excavations free from water and shall execute such works and install such pumps as may be necessary to keep the excavation dry at all times.

No sub-soil water shall discharge into the sewage system without written permission of the Engineer.

(iv) Laying of Concrete Beds or other Supports for Pipes

As described in BS EN 752 and the following:-

All drains below buildings and roads shall be encased in concrete 150mm thick.

Concrete beds and supports shall be concrete 1:3:6 to 25mm maximum aggregate size.

(v) Pipe Laying and Jointing

Drain pipes shall be laid and jointed as described under BS EN 752.

Water pipes shall be laid and jointed as described under BS EN 752

(vi) Manholes

(a) General

All manholes provided under the Contract works shall be constructed of approved materials and in an approved manner.

All manholes shall be watertight and if constructed of brickwork, solid block work or stone work, they shall be rendered internally with a cement mortar of at least 12mm thickness and finished with a smooth surface.

The sides of all channels in every manhole shall be brought up vertically to a height of not less than the diameter of the drain and shall be benched in good concrete from the top of the channels at an surface with a coat of 1:1 cement mortar.

In all other respects, manholes shall be constructed in accordance with BS EN 752.

(b) Rectangular and Square Manholes

Rectangular and square straight through manholes shall be constructed from brickwork, solid block work, stone and concrete

(c) Steps Iron and Covers

Access shaft to manhole of depth greater than 760mm shall be provided with approved steps iron at suitable intervals. Every manhole or manhole access shaft shall be fitted with a removable airtight cast iron cover to adequate size and strength, fixed in a manner that prevents surface water gaining into the system.

Cast manhole covers and frames shall be manufactured in accordance with the requirements of BS EN 124:1994 and shall generally be classified into the following categories:

Heavy Duty :For Carriageway

Medium Duty :For Footpaths

Light Duty :For domestic premises or other places where they do not have to carry wheeled traffic

(d) Back Drop Connections

Where the level of the branch drain entering the manhole is higher than can be suitably accommodated by the normal type benching, then the branch drain shall be connected to the manhole by means of a back drop Connection.

(e) Channels

Where the branch channel connects to the main channel in the manhole, the invert of the branch channel shall be a minimum of 38mm higher than the main channel.

(f) Testing of Pipelines

After pipelines are connected up and joints have been sealed, the pipeline shall be tested before pipes are, if required haunched or surrounded in concrete

Methods of testing and inspection shall be in accordance with the Specification.

(g) Concrete Bedding Hunching and Surround

Concrete 3 bedding, hunching and surrounding shall be provided as necessary or where called for by the Engineer in accordance with the requirements laid down in BS EN 752.

(h) Backfilling

Backfilling of trenches, headings and around manholes shall be carried out in accordance with the methods described in BS BS EN 752.

(i) Reinstatement of Surface

Following the final Backfilling of all trenches, headings and manhole surrounds, the surface of the excavated areas shall be fully reinstated to the approval of the Engineer.

Where excavations have been carried out in public highways or other areas are not forming part of the site, the contractor shall be deemed to have allowed in his price for all charges associated with the temporary and final reinstatement requirements of the local or highway Authority concerned.

No Claims for extra in this respect will be accepted.

(j) Sewer Connection

Sewer contractor shall pay all charges associated with the connection by the local Authority of the drainage to the main sewer, including necessary reinstatements

(k) Invert Levels

Where indicated on drawings, invert levels are to be used as a guide only. The contractor shall ascertain the depth, position and suitability of the sewer and stormwater connection points prior to the commencement of any work (pipe laying & excavation) and ensure that the sanitary drainage and stormwater can gravitate to the relevant connection points. The Engineer shall be advised immediately should any adjustment be required to execute the work.

No claims for redundant work will be considered due to failure to comply with this requirement.

3.0 Testing and Inspection**3.1 Site Tests – Pipework Systems****a) Above Ground Internal Water Services Installation**

All water service pipe systems installed above ground shall be tested hydraulically for a period of one hour to not less than one and half times to design working pressure.

If preferred, the contractor may test the pipelines in sections. Any such section found to be satisfactory need not be the subject of a further test when the system has been completed, unless specifically requested by the Engineer.

During the test, each branch and joint shall be examined carefully for leaks and any defects revealed shall be made good by the contractor and the section re-tested.

The contractor shall take all necessary precautions to prevent damage occurring to special valves and fittings during the tests. Any item damaged shall be repaired or replaced at the contractor's expenses.

b) Underground Water Mains

After laying, jointing and anchoring, the main shall be slowly and carefully charged with water, so that all air is expelled and allowed to stand full for three days before testing under pressure.

A long main shall be tested in sections as the work of laying proceeds and all joints shall be exposed for inspection during the testing.

The open end of the main may be temporarily used for testing under moderate pressure by fitting a water pipe expanding plug, of which several types are available. The end of the main and the plug should be secured by struts or otherwise, to resist the end thrust of the water pressure in the main.

If the section of main terminates with a sluice valve, the wedge of the valve shall not be used to retain the water, instead the valve shall be fitted temporarily with a blank flange, or if a socket valve with a plug and the wedge shall be placed in the open position while testing. The Contractor shall provide suitable end supports to withstand the end thrust of the water pressure in the main.

c) Above Ground Soil Waste and Ventilation System

All soil, waste and ventilating pipe systems forming part of the above ground installation, shall be given appropriate test procedures as described in BS EN 12056 – 2:2000.

Smoke tests on above ground soil, waste and ventilating pipe system shall not be permitted.

Pressure tests shall be carried out before any work which is to be concealed is finally enclosed.

In all respects, tests shall comply with the requirements of BS EN 12056 – 2:2000.

d) Underground Drainage System

A site test shall be carried out on all drainage pipes before concrete hunching or surrounds are applied. These tests shall be carried out preferably from manhole to manhole.

Short branch drains connected to a main drain between manholes shall be tested as one system with the main drain. In long branches a testing junction shall be inserted next to the junction with the main drain and the branch tested separately. After the test has been passed, the testing junction shall be effectively sealed.

Water tests shall be carried out in accordance with the methods described under BS EN 752 and the test pressure shall not be less than 1,520mm head at the highest point in the pipe section and not more than 10,360 head at any point in the section.

The test pressure shall be maintained for a period of one hour during which time the pipe and joints shall be inspected for sweating and leakage. Any leak discovered during the tests shall be made good by the Contractor and the section re-tested.

In addition to pressure tests, drain pipe runs shall also be tested for straightness where applicable. This test shall be carried out in accordance with one of the two methods described in BS EN 752.

Testing of manholes shall be carried out in accordance with the methods described under BS EN 752.

(e) Above Ground Soil Waste and Ventilation System

All soil waste and ventilating pipe systems forming part of the above ground installation, shall be given appropriate test procedures as described in BS 12056.

Smoke tests on above ground soil, waste and ventilation pipe system shall not be permitted.

Pressure tests shall be carried out before any work, which is to be concealed, is finally enclosed.

In all other respects, tests shall comply with the requirements of BS 12056 –2:2000.

3.2 Site Test – Performance

Following satisfactory pressure tests on the pipework system, operational tests shall be carried out in accordance with the relevant BS on the systems as a whole to establish that special valves, gauges, control, fittings, equipment and plant are functioning correctly to the satisfaction of the Engineer.

All hot water pipework shall be installed with pre-formed fibreglass lagging to a thickness of 25mm where the pipe runs above a false ceiling or in areas where the ambient temperature is higher than normal with the result that pipe “sweating”, due to condensation will cause nuisance.

All lagged pipes which run in a visible position after erection shall be given a canvas cover and prepared for painting as follows:

- i) Apply a coating of suitable filler until the canvas weave disappears and allows it to dry.
- ii) Apply two coats of an approved paint and finish in suitable gloss enamel to colour approved by the Engineer.

All lagging for cold and hot water pipes erected in crawl ways, ducts and above false ceiling which, after erection are not visible from the corridors of rooms, shall be covered with a reinforced aluminium foil finish banded in colours to be approved by the Engineer.

In all respects, unless otherwise stated, the hot and cold water installation shall be carried out in accordance with the best standard of modern practice as described in CP 342 and BS 6700 respectively to the approval of the Engineer.

The test pressure shall be applied by means of a manually operated test pump or, in the case of long main or mains of large diameter, by a power driven test pump which shall not be left unattended. In either case precautions shall be taken to ensure that the required pressure is not exceeded.

Pressure gauges should be recalibrated before the tests.

The contractor shall be deemed to have included in his price for all test pumps, and other equipment required under this specification.

The test pressure shall be one and a half times the maximum working pressure except where a pipe is

manufactured from a material for which the relevant BS specification designates a maximum test pressure.

4.0 Sterilization of Hot and Cold Water Systems

All underground and above ground water distribution systems cisterns, tanks, pumps etc shall be thoroughly sterilized and flushed out after the completion of all tests and before being fully commissioned for handover.

The sterilization procedures shall be carried out by the contractor in accordance with the requirements of BS 6700:1997 and to the approval of the Engineer.

5.0 Water Mains

5.1 Piping

All piping shall be plain ended and suitable for use with flexible mechanical couplings (e.g. Viking Johnson, Dresser or Gibault). Steel pipes shall comply with BS 534 or BS EN 10224:2002. Galvanised steel pipes for distribution system shall comply with BS Galvanized steel pipes for distribution system shall comply with BS 1387-1967 medium tubes and be supplied with flanges on pipes 75mm diameter and over.

All pipes less than 75mm diameter shall be screwed and socketed, unless otherwise stated.

5.2 U.P.V.C Pipes

UPVC piping shall be in accordance with BS 3505: 1986.

The maximum sustained working pressure to which the pipes and fittings will be subjected is based on water at a temperature of 20°C.

The Contractor shall submit full details of the colour of the pipe he intends to supply. The Colour of the pipe shall be such as to meet the requirements of 'material' and 'opacity' in BS 3505 or BS EN 1452.

The pipes up to and including 50mm diameter shall be of solvent weld type. The pipe shall be supplied with interchangeable sockets pre-formed at the factory and of such internal diameter that it takes the plain end of the pipe with same nominal diameter.

The joints shall sustain the end thrust to which the pipe shall be submitted. The contractor shall supply sufficient quality of the cleaner and adhesive which shall be required to make the joints with the pipes.

The pipes of 75mm diameter and over shall consist of a grooved socket at one end of the pipe. The socket shall be designed to give a clearance fit on the outside diameter of the parent pipe. The sealing medium that shall seat in the groove shall be a rubber ring.

If the formation of the socket and groove results in the thinning of the original wall thickness of the

pipe, it shall be compensated for by shrinking the outside of the socket area as by reinforcing sleeve of the same material as the pipe.

The socket and groove shall incorporate no sharp angles where the stress points are created.

The socket and groove shall incorporate no sharp angles where the stress points are created.

The joint shall take 10% deformation of the spigot at the point where the stress points where it enters the socket without leakage from the pipe when subjected to the test pressure specified for the pipe.

Thermal expansion of the pipe shall be accommodated in the joint. The joint shall be capable of lined deflection up to 30°C.

The sealing ring shall supply be of the first grade natural rubber and the physical properties of the mix shall meet the requirement of BS 7874:1998, BS EN 681 or BS EN 682.

The contractor shall supply sufficient quantity of any lubricant or other material that shall be needed to make the joint, which shall be assembled by hand.

The fittings shall have the same type of joint and or the pipes to be used. The contractor shall submit full lists of the materials, dimensions and test pressures of the fittings offered.

Precautions shall be taken to avoid damage of the pipes and fittings.

In handling and storing the pipes and fittings, every care shall be taken to avoid distortion, flattening, scoring or other damage. The pipes and fittings shall not be allowed to drop or strike objects. Pipe lifting and lowering shall be carried out by approved equipment only. Special care shall be taken in transit, handling and storage to avoid any damage to the ends.

All jointing of pipes and fittings shall be carried strictly in accordance with the manufacturer's instructions.

5.3 Manufacturer's Instructions

The contractor shall be responsible for obtaining copies of any manufacturer's instructions for pipe joining and shall familiarize himself and his employees with these instructions.

All necessary tools and equipment required for laying, jointing and testing of pipes and joints shall be provided by the contractor at no extra cost.

5.4 Fittings and Specials for Galvanized Steel Pipes

All specials shall be of such dimensions as will meet with piping supplied. Screw down stop valves shall comply with BS 1010. Specials shall comply with BS EN 10241:2000.

5.5 Flanged Adaptors and Flanges

Flanged adaptors shall be piece suitable for connecting a flanged sluice valve to the type of piping supplied. All flanged or special shall conform to BS 10 part 1 and shall be drill to Table 'C' and

machined across the faces. The flanged adaptors shall comply with BS 78 and BS 3961. All PVC flanged shall be supplied with metal backing rings jointing of flanges shall be carried out using the joint rings, bolts and washers as necessary.

5.6 Tees

The spigot ends of all tees shall be suitable for connection to the pipework supplied using the aforementioned flexible mechanical joints and branches shall be flanges drilled to BS 10 table 'C'.

5.7 Hydrants

Hydrants shall comprise a 75mm sluice valve and a 75mm Duckfoot bend with gunmetal screw connection to detailed drawings. These specials shall comply with the requirements of BS 750.

5.8 Gate Valves

All gate valves 80mm nominal bore and above, other than those required for fitting to buried water mains shall be of cast iron construction, in accordance with the requirements of BS 3464.

All gate valves required for fitting to buried water mains shall be of cast iron construction in accordance with the requirements of BS 5163.

All gate valves up to and including 65mm nominal bore shall be of bronze construction in accordance with the requirements of BS 5154:1991 and/or BS EN 12288:2003.

The pressure classification of all valves shall depend upon the pressure conditions pertaining to the site of works.

5.9 Air Valves

Air valves shall be of cast iron conforming to BS EN 1561:1997. They shall not be suitable for working pressure nor less than that specified for the class of pipe to which they are connected.

5.10 Ball Float Valves

Ball float valves shall be to BS 1212 parts 1 and 2 shall be suitable for working pressure not less than the working pressure for the class of pipe specified for connection to the ball float valve.

5.11 Non-Return Valves

Non-return valves shall be of cast iron with flanges and shall conform to BS EN 12334:2001.

5.12 Stop Cocks

Stopcock up to 50mm diameter shall be brass and shall conform to BS 1010.

5.13 Rubber and Insertion Jointing

Rubber and insertion jointing for flange jointed shall comply with BS 7874:1998, BS EN 681, BS EN 682 and no jointing rings shall be used in the contract, which have not been supplied by manufacturers approved by the Engineer.

5.14 Bituminous paints

All bituminous or tar paints for protection of buried steel bolts, pipes specials etc. shall be the best of their respective kinds manufactured by approved makers.

5.15 Steel Pipe and Fittings for Rising Main

All piping shall be plain ended and suitable for use with flexible mechanical couplings (e.g. Viking Johnson, dresser). The grade of steel used shall comply with the requirements of BS EN 10216 – 1:2002, BS EN 10217 – 1:2002. Pipes shall be welded or seamless and shall conform to BS 534: 1990 and/or BS EN 10224:2002 or an equivalent acceptable standard.

All pipes shall be externally and internally protected with bitumen in accordance with BS 534: 1990 and/or BS EN 10224:2002.

The external protection shall be reinforced with oven glass, cloth glass, tissue wrapping or by other approved material.

The ends of all bitumen lined pipes, fittings and specials shall be closed by means of discs or other suitable covers firmly held in place.

5.16 Draw-Off Taps, Stops Valves for Water Services

Fittings for mains of size 50mm or under shall comply with BS 1010. Samples must be submitted to the Engineer for approval prior to installation of fittings.

5.17 Storage of Plants and Material

The contractor shall, at his own expenses, make arrangements for dumps along the route of the pipe line for storage of pipes, his plant and materials to suit his own convenience, but such arrangements shall be subjected to the Engineer's approval.

5.18 Loading, Handling and Conveying of Pipes

The contractor shall before commencing to lay the pipes, valves or other materials examine them and ascertain that they are in perfectly sound condition and he shall be responsible for any laying. The stocking of pipes and specials on site, loading and unloading etc. shall be carried out to the satisfaction of the Engineer.

5.19 Interferences with Fences, Drains, Pipes, Property etc.

The contractor shall ensure the proper reinstatement of fences, drains, telephone lines, electricity supply authority Cables etc where affected by his work. All service shall be adequately protected and

propped to the satisfaction of the Engineer. The contractor shall be liable for any damage caused to the service due to his failure to provide adequate protection.

5.20 Method of Excavation

- a) The Contractor shall excavate the pipe trenches in the line and to the depths indicated by the Engineer. Except where otherwise indicated on the Drawings or indicated by the Engineer, it is intended that the trench shall be excavated to such a depth as will allow for a minimum cover of 5000mm over top of the barrel of the pipe when laid plus or minus a tolerance of 75mm either way. All trenches shall be excavated in open cuttings.
- b) Where the trenches passes through grassland, arable land or garden, whether enclosed or otherwise, the turf, if any shall be pared off and stalked, and the productive soil shall be carefully removed for a width of 600mm greater than the nominated trench width or equal to the overall width of track of the excavating machine, whichever is greater, and laid aside to be subsequently used in reinstating the surface of the ground after the trench has been refilled.
- c) The bottom of the trench shall be property trimmed off, and all low places or irregularities shall be where rock or large stones are encountered, they shall be cut down to a depth of at least 75mm below the level at which the bottoms of the barrel of the pipes are to be laid, and covered to a like depth with materials, so as to form a fine and even bed for the pipe.
- d) Joints holes shall be excavated to suit minimum dimension as to allow the joints to be well and properly jointed.
- e) The pipe trench shall be kept clear of water at all times.
- f) The contractor shall whenever necessary by means of timbering, or otherwise support the sides of the trench so as to make them thoroughly secure, and afford adequate support to adjoining roads, lands, buildings and property during the whole time the trench remains open and shall remove such timbering or other work shall be deemed to be included in the rate for excavation. In case the Contractor is instructed by the Engineer to leave any portion of such timber in position, he will be paid for it accordingly.
- g) The cleared width inside the timbering in the case of single pipes shall be at least 320mm in excess of the external diameter of the pipe be laid, in order to allow it to be freely lowered into position, in the trench without damage to the external protection.
- h) Where more than one pipe is to be laid parallel, then the clear width inside the timbering shall be at least 520mm in excess of the combined external diameters of the pipes.
- i) Should the excavations be taken out to a greater depth than is specified the bottom shall be made good to the correct level with mix 1:3:6 concrete or other materials approved by the Engineer. No payment shall be made for any other excavation carried out by the contractor and the coat of filling up to required levels.
- j) If a mechanical excavator is used by the contractor, he shall indemnify the employer against all claims for damages that in the opinion of the Engineer, may be caused by the use of this

plant. When a mechanical excavator is used the bottom 230mm of excavation shall be got out by hand to ensure an even bed for the pipes.

5.21 Main Laying

Mains shall be laid in straight lines and/or smooth curves as indicated on the drawings. The vertical profile of the pipes shall be to even gradients. Any pipes not so laid shall be removed if so directed by the Engineer, and re-laid in proper manner at the contractor's expense.

In laying the pipes and specials, care shall be taken not to damage the protective linings and the pipes shall be handled with tackle as directed by the Engineer.

The pipes and specials shall be slug and sounded with hammer for flaws before they are lowered into trench. After the pipes or specials have been checked they shall be cleaned internally and carefully lowered into trench and set to proper gradient and line so that is a continuous rise from each washout to air valve.

5.22 Temporary Bench Marks and Sight Rails.

The contractor shall fix rails for use with bonding rods at intervals of not more than 65 meters and temporary Bench mark related to the survey of the country's Datum shall be provided at intervals as directed by the Engineer.

5.23 Curves and Bends

Large diameter curves of main shall wherever possible be formed by giving a set not exceeding 30 to each joint, bends being used only where large diameter curves are not possible.

5.24 Cutting of Pipes

The contractor shall, subject to approval of the Engineer, cut pipes to such lengths as directed. Pipes should be cut off clean and square while the axis cuts should be made with an approved cutter from rotary cutting machine, engineer may approve cutting by oxy acetylene cutters.

5.25 Flanged Joints

In laying pipes and specials with flanged joints, flanges shall be brought together and bolted with the faces absolutely parallel. A rubber jointing ring 3mm thick shall be used in each flange joint and one washer with each bolt. The ring shall be a strip ring lying within the bolt circle and full flange width ring.

The bolts shall be tightened up gradually and equally in customary manner in order to distribute the stress evenly over the flange.

5.26 Surface Boxes

Sluice valves, air valves and fire hydrants shall be covered with surface boxes in accordance with details as shown on the Drawings. In roads and footpaths the boxes shall be laid flush with the surface.

5.27 Fixing of Valves, Air Valves and Washouts Pipes

The contractor shall fix the sluice valves, air valves, washout pipes complete with iron casing for spindles and surface boxes in accordance with and in position shown on the drawings. As far as possible the cutting of pipes for this should be avoided.

5.28 Support and Anchor Blocks

Concrete mix 1:3:6 shall be placed around and against bends and other specials in trenches.

5.29 Colour Coding

All underground pipes are to be wrapped with adhesive plastic tape at each meter in colours blue for drinking water and green for untreated water. All pipework above ground and valves in valve chambers and pits are to be painted in similar colours.

5.30 Lettering

The lettering for sluice valves, fire hydrants, air valve and washout abbreviated SV FH and WO respectively shall be in accordance with the detail shown on the Drawings colour as detailed hereafter: -

Untreated water:	White lettering on green background
Drinking water:	White on blue background
Fire Hydrant:	White lettering on yellow background

5.31 Testing

- a) The test pressure shall be one and a half the maximum working pressure except where a pipe is manufactured from a material for which the relevant BS specification designates a maximum test pressure should not exceed 120,180 and 240 meters/head for clause B, C, or D pipes, respectively. The pump shall maintain the test pressure for about one hour and if there is any leakage it shall be measured by the quantity of water pumped into the main that time.
- b) When a section of the mains has been jointed, the ends shall be closed with caps, plugs or flanges, which must be strongly strutted against a solid backfilled rammed as hereinafter and as shown on the Drawing, for its whole length so as to cover the mains to a depth of not less than 500mm, except at the joint holes which shall be kept clear of all backfiring, if necessary by the use of timbering, so that each joint is left fully exposed for inspection. No backfilling will be permitted before testing of each section. As long a section of main as possible shall be tested at one time subject to the maximum length of open trench approved by Engineer or permitted by the Highway

Authority, and the test shall be carried out within 12 working days of the completion of such sections of mains.

Where a main is laid across a road or in such a position as to interfere seriously with the normal use of the road, the contractor may, with the consent of the Engineer and at his own risk, fill in such joint holes as may be necessary.

He shall at his own expense, re-excavate any or all joint holes necessary to locate a leak and carry out repair work should the results of his hydraulic test prove unsatisfactory.

The section shall then be filled with mains water, great care being taken to drive out all air through air valves, ferrules or otherwise to the approval of the Engineer.

- c) After the section to be tested has been charged and all air liberated it shall stand underrated moderate pressure for several days' final airing. The leakage from the mains and connections from each section tested shall not exceed 4 litres per 25mm diameter of main, per 2Km. Length each 24 hours, every 30 meters head of pressure, and any visible individual shall be repaired.

To determine the rate of leakage, the contractor shall furnish a suitable hydraulic test pump, pressure gauge, connection and water meter or other appliance, for measuring the amount of water pumped.

If the leakage were at a greater rate than that specified, the contractor should re-excavate the trench where necessary and shall remake the joints and replace defective work until the leakage shall be reduced to the allowable amount.

- d) The employer shall charge the contractor the cost of any coupling required to join up tested lengths of main if, in the Engineer's opinion, greater lengths could reasonably have been tested or if failure under test requires the pipe to be cut, or other methods of laying should have been adopted. The contractor shall supply water used by the contractor in testing the main. The contractor shall carry out all work, which may be necessary for making temporary connections to the existing mains to obtain water for testing at his own expense.
- e) In carrying out the test for water tightness only the Engineer shall authorize the operation of all valves, but the contractor shall provide all the necessary labour to assists in the opening and closing of the valves to the Engineer's instructions and he shall allow in his price for all his expenses in connection with testing on completion.

The Engineer shall be the sole judge of water tightness.

5.32 Cleansing and Sterilizing the Main

When a pipeline is complete and where applicable, has successfully passed the test it shall be thoroughly washed out using, if possible, an open end. Thereafter it shall be sterilized by being filled

with a suitable solution containing not less than 20p.p.m. of free available chlorine or such other Sterilizing agent as the Engineer shall approve. After standing for 24 hours the main shall again be washed out and refilled with mains water prior to the taking of Bacteriological samples.

The contractor shall provide all necessary stop-ends fittings and chemicals for this work.

Emptying and washing out of the pipes shall be done in such a manner as not to damage the trench or cause due flooding of vicinity, and the contractor shall supply and use such piping, specials and/or hose as may be necessary to facilitate the flow of water to the nearest drain or watercourse. Water used for washing out and sterilizing will be supplied by the employer.

Before any section of the mains is put into use, bacteriological samples will be taken by the Engineer's representatives and only on the receipt of a satisfactory certificate from the medical Research Laboratory of the Employer will the main or section of main be permitted to be put into supply and be considered as having been substantially completed.

Any expenditure involved in Providing facilities or materials for taking of samples shall be included in the contractor's tendered rates and Engineer will specify and shall be sole judge as to the number of sample required and points at which they are to be taken.

The cost of the Bacteriological Examination will be borne by the employer but if the sample and samples are not satisfactory the cost of any subsequent analyses will be borne by the contractor.

5.33 Clearance of Site

The contractor shall remove all surplus pipes, special and other fittings from the site as directed by the Engineer. The site of works shall be leveled and all surplus excavation, debris, cut trees or bushes shall be carted to the approved tip sites.

5.34 Existing Installations

a) Cold Water

Where pipes for cold water are to be connected up to existing installations, the condition of the existing installation is to be reported to the Engineer in order to establish if part of the existing installation is to be replaced.

b) Sanitary Fittings

Where existing sanitary fittings are to be removed or replaced, the fittings are to be removed with utmost care and fittings and taps to be handed over to the client.

c) Sealing off Existing Drains and Manholes

Existing foul, surface water and subsoil drains exposed during progress of work are to be recorded and reported for investigation by the Architects. Where not required to be removed, seal off with concrete or grout solid as directed. Seal off connection to manholes, demolish wall to 50mm below surrounding ground level and fill remainder of manhole with consolidated approved rubber and cover

to level of surrounding ground as directed.

6.0 Cold Water Storage Tanks

Cold-water storage tanks shall include the ball valves and connectors for inlet, supply, washout, and overflow and may also include in his pricing the price of the overflow and amount pipes to a place to be indicated by the Engineer. He shall also include the washout valve.

1. PIPEWORK AND FITTINGS

Pipework shall be PP-R 80 to PN 20 as per specification. Fittings, with the exception of interconnections between solar panels, shall be galvanised mild steel fittings manufactured in accordance with B.S. 21 unless otherwise stated. All connections to items of plant and equipment shall be made with union connectors. Interconnections between solar panels shall be made using manufacturer-supplied special connectors.

All pipe supports shall be in accordance with B.S. 39744 at centres not exceeding those given in the following table: -

Pipework Nominal Bore (mm)	Intervals for Horizontal Runs (mm)	Intervals for Vertical Runs (mm)
13	1.4	2.0
19	1.4	2.0
25	1.7	2.4
32	1.7	2.4
38	2.0	2.8
51	2.0	2.8
63	2.0	2.8
76	2.4	3.4

2. VALVES AND COCKS

Valves shall be all gun metal with union connections similar or equal to those manufactured by Yorkshire Imperial Metals Ltd. Isolating valves shall be in accordance with B.S. 1952 with non-rising spindle as type 610 but with union connectors with the exception of the valves on the cold feed which shall have a lock-shield as type 610LS. Regulating valves shall be type 608.

Draincocks shall be type 526GM. Automatic air vents shall be of bronze construction similar or equal to Fig. 425 as manufactured by Hattersley (Ormskirk) Ltd.

3. PIPE INSULATION

Hot water pipework and fittings shall be insulated with 30mm thick Thermotec 4-Zero fire retardant closed cell polyethylene foam with factory applied weather resistant aluminium foil

4. INSTALLATION

Installation shall be carried out strictly to the manufacturer's printed instructions.

The installation shall be well coordinated to ensure clearance from other services, compliance with structural requirements, and for the location of items such as holes through ceiling, wall, roof, floor, etc, and access panels.

The sub-contractor shall install any necessary supports / props to ensure that the orientation of the solar panels is within 10°-25° to the horizontal, or as recommended by the particular manufacturer.

The systems shall be combined to form a well coordinated, complete and fully operational system. The contractor shall ensure that the pressure losses within the solar water heating system are minimal, so as to achieve a final pressure of not less than 0.2 bar at the outlet of the highest hot water discharge point in the bathrooms (approximately 2400mm from FFL).

In addition to the automatic safety devices mentioned elsewhere, all plants shall be equipped with all normal safety facilities for protection against personal hazard and damage to the plant and as required by any authorities having jurisdiction over the work. These shall include guards, housing, shrouds and railings, as applicable to all working parts or otherwise hazardous locations, interlocks, electrical overloads, warning notices and similar provisions.

5. SETTING TO WORK, TESTING & COMMISSIONING

After successful completion of the installation, the sub-contractor shall set the systems to the design requirements.

The sub-contractor shall be responsible for carrying out such tests as are required to prove compliance of the installation with the specified performance requirements. The procedure for each performance test, all results, data, graphs and instrument readings obtained during such tests shall be lodged with the Engineer prior to practical completion.

In general, the operation of each piece of equipment, individually and each completed service as a whole shall be tested and correctly adjusted to obtain the required satisfactory performance.

The entire exercise shall be carried out to the entire satisfaction of the Engineer.

6. WARRANTY

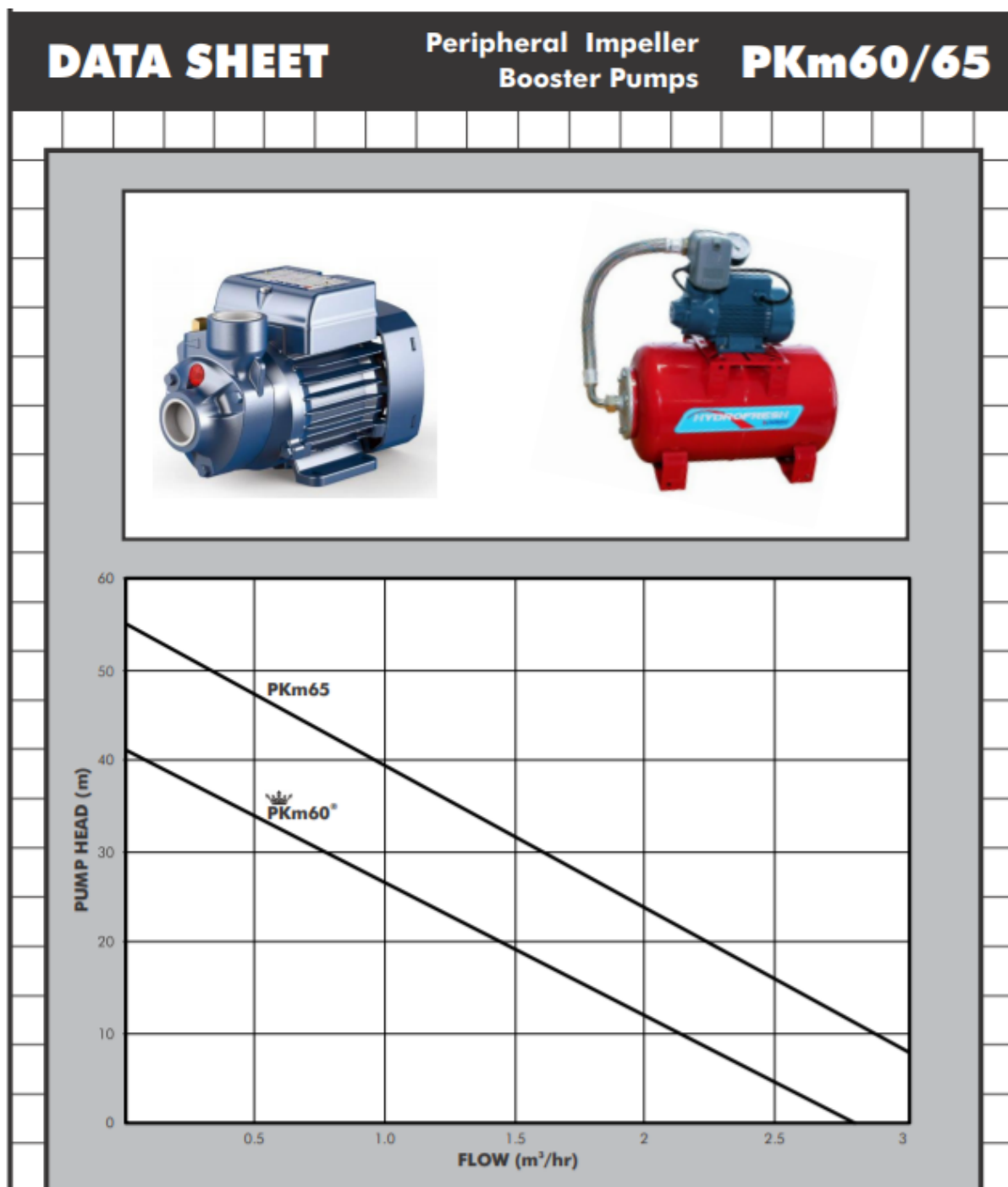
After testing and commissioning, a warranty of a minimum of 5 years shall be provided on equipment and workmanship.

SECTION 5:- PARTICULAR SPECIFICATIONS FOR AIR CONDITIONING

Specification			Unit	S4-Q12JA3QB			S4-Q18KL3QD			S4-Q24K23QD		
Capacity	Cooling	Min ~ Rated ~ Max	kW	0.59	3.517	3.99	0.95	5.275	5.84	1.03	6.448	7.18
			Btu/h	2,000	12,000	13,600	3,250	18,000	19,910	3,500	22,000	24,500
Power Input	Cooling	Min ~ Rated ~ Max	W	200	1,095	1,250	300	1,640	1,850	240	1,880	2,400
Running Current	Cooling	Min ~ Rated ~ Max	A	1.10	5.80	6.20	1.90	7.60	8.90	1.40	8.20	10.50
EER			W/W	3.21			3.22			3.43		
			(Btu/h)/W	10.96			10.98			11.70		
Power Supply			Ø, V, Hz	1/220-240/50			1/220-240/50			1/220-240/50		
Air Flow Rate	Indoor	Cooling, Max / H / M / L	m³/min	13.0 / 10.0 / 6.6 / 4.2			18.0 / 12.7 / 10.2 / 8.4			20.0 / 15.0 / 13.5 / 10.5		
			CFM	459 / 353 / 233 / 148			617.8 / 448.3 / 360.1 / 296.5			706.2 / 529.7 / 476.7 / 370.8		
	Outdoor	Max	m³/min	28.0			38.0			49.0		
			CFM	989			1342			1730		
Sound Pressure Level	Indoor	Cooling, H / M / L / SL	dB(A)	40 / 34 / 26 / 20			45 / 40 / 37 / 32			46 / 40 / 36 / 31		
	Outdoor	Cooling, Rated	dB(A)	50			54			55		
Refrigerant		Type	-	R410A			R410A			R410A		
Compressor		Type	-	Twin Rotary			Twin Rotary			Twin Rotary		
Fan(Indoor)	Type		-	Cross Flow Fan			Cross Flow Fan			Cross Flow Fan		
	Motor Output		W	30			30			58		
Fan(Outdoor)	Type		-	Propeller Fan			Propeller Fan			Propeller Fan		
	Motor Output		W	28			43			85		
Piping	Size	Liquid	mm	ø 6.35			ø 6.35			ø 6.35		
		Gas	mm	ø 9.52			ø 12.7			ø 15.88		
Drain Hose Size			O.D, I.D	21.5, 16.0			21.5, 16.0			21.5, 16.0		
Dimensions (W × H × D)	Indoor	Net	mm	837	308	189	998	345	210	998	345	210
	Outdoor	Net	mm	717	483	230	770	545	288	870	650	330
Net Weight	Indoor	Net	kg	8.50			11.0			11.9		
	Outdoor	Net	kg	24.0			32.8			42.0		
Operation Range		Cooling	°C DB	18 ~ 48			18 ~ 48			18 ~ 48		
Piping Length		Min / Standard / Max	m	3	7.5	15	3	7.5	20	3	7.5	20
Max. Elevation Difference			m	10			15			15		
Energy Label Grade		Cooling	-	1 Star			1 Star			2 Star		
Circuit Breaker			A	15			15			20		

SECTION 6:- PARTICULAR SPECIFICATIONS FOR WATER PUMPS

PKm60 datasheet TO PUMP POTENTIALLY UNCLEAN WATER FROM THE 10,000 LITRE GROUND MOUNTED WATER TANK TO THE TOILETS



PUMPS

The Pedrollo PKm is a robust, reliable and economical pump used principally for water transfer in domestic and small scale water transfer applications. The pump body is made from cast iron with a brass insert set into the front housing for improved starting performance and protection from jamming. The impeller is made from brass.

The pumps have been remodelled and re-engineered offering the following benefits;

- Quiet operation due to the anti vibration system between shaft and impeller
- More compact
- More efficient motor with low energy consumption and lower operating temperature
- Special paint which gives improved resistance against environmental corrosion
- Extended life

Pumps can be installed for manual or automatic control using either the recommended 'Pedrollo Easysmall' controller or a pressure tank and switch. Also available is the integral 'Hydrofresh' version (PKm60) only which combines a 24L horizontal diaphragm tank, pressure switch and gauge with pressure settings of 1.4 bar for pump start and 2.8 bar for pump stop.

MOTOR

Pumps are close coupled to a TEFC brushless induction motor designed for continuous operation. A thermal relay is provided in the windings to protect against electrical and mechanical overload and the pump can be connected directly to the mains power supply through a 10amp fuse or MCB.

Enclosure Class: PKm60®:IPX4
PKm65: IP44

Voltage: 1x240V

Insulation Class: F

Speed: 2900rpm

OPERATING CONDITIONS

Pumped Liquid: Thin, clean, chemically non aggressive liquids without abrasive particles or fibres.

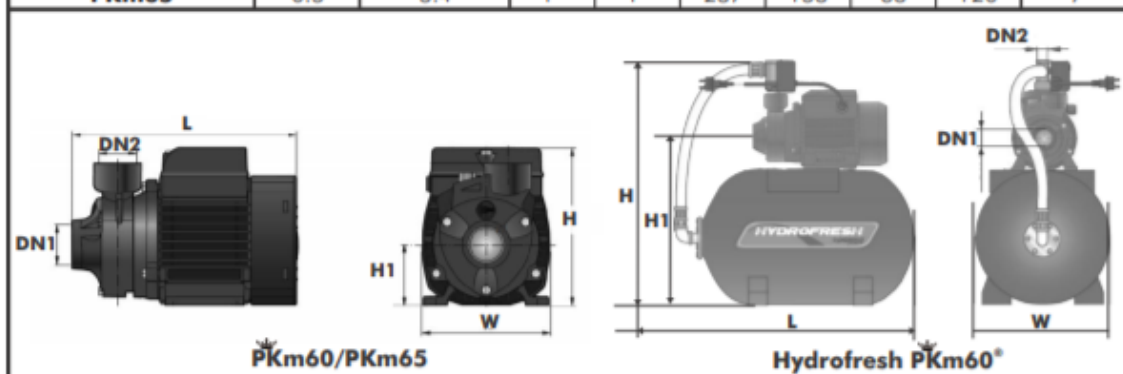
Max. Fluid Temperature: +60°C

Max. Ambient Temperature: +40°C

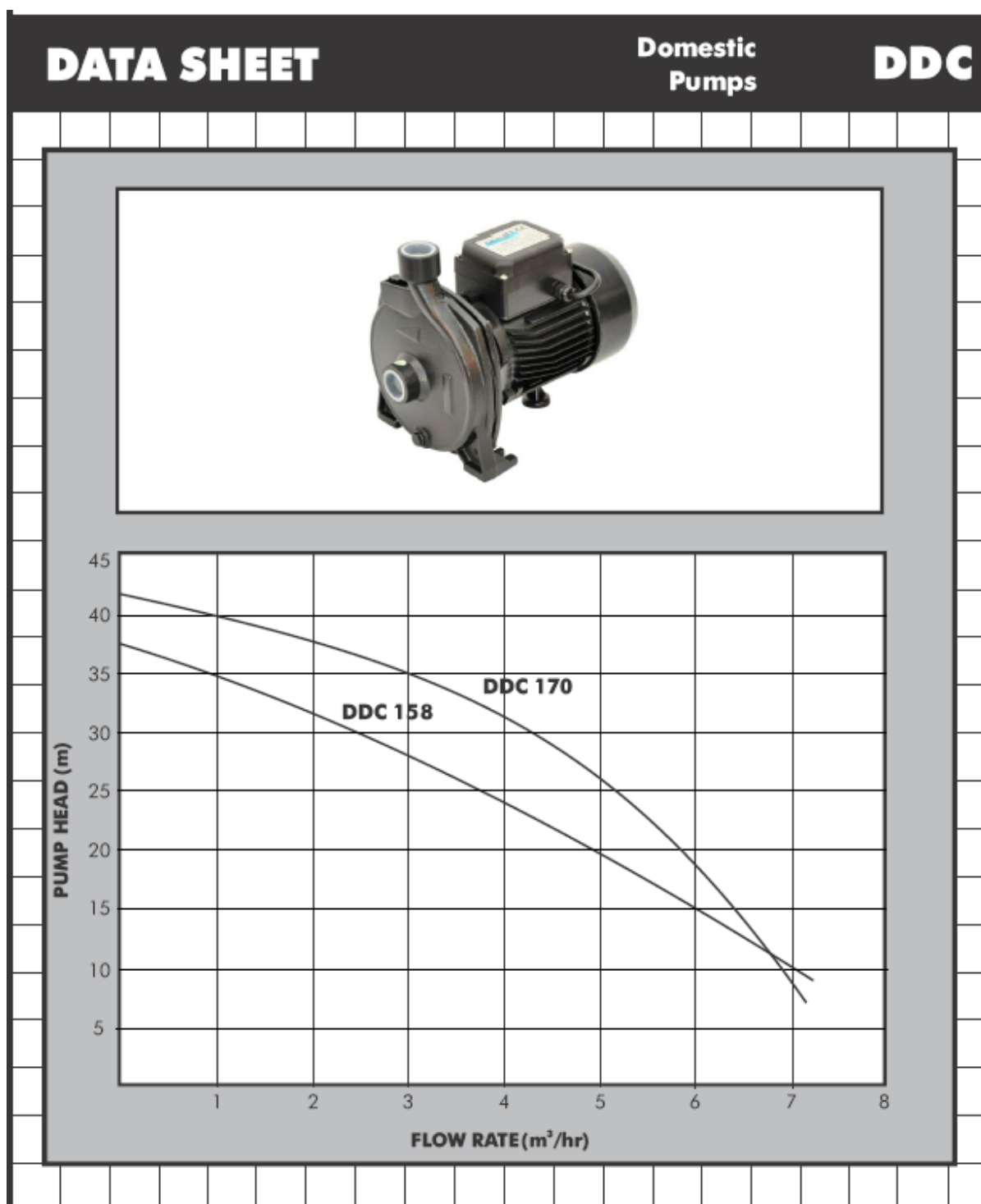
Max. Suction Lift: 7m (at sea level)

PUMP DATA

Model	Power (kW)	Max. Operating Current (A)	DN1 (")	DN2 (")	Dimensions (mm)				Weight (kg)
					L	H	H1	W	
PKm60®	0.37	2.4	1	1	208	145	56	118	5
Hydrofresh PKm60®	0.37	2.4	1	1	535	500	346	255	14
PKm65	0.5	3.4	1	1	237	153	63	120	7



DDC 158 datasheet TO PUMP CLEAN MUNICIPAL WATER TO THE ELEVATED 10,000 LITRE WATER TANK FOR USE IN THE LABORATORIES



PUMPS

The Dayliff DDC centrifugal non self priming closed impeller pump is specially designed for all small scale domestic and commercial water supply uses and is particularly suited for water boosting and transfer applications. The pump body is cast iron and the impeller stainless steel.

MOTORS

Pumps are close coupled to reliable TEFC electric motors designed for continuous operation and are provided with a thermal cutout to protect against electrical overload. They can be connected directly to the mains power supply through a 10A fuse or MCB.

Enclosure Class: IP44

Insulation Class: F

Speed: 2900rpm

Voltage: 1x240V

OPERATING CONDITIONS

Pumped Liquid: Thin, clean, chemically non-aggressive liquids without solid particles or fibres

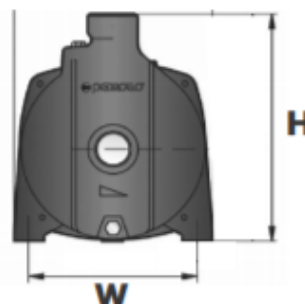
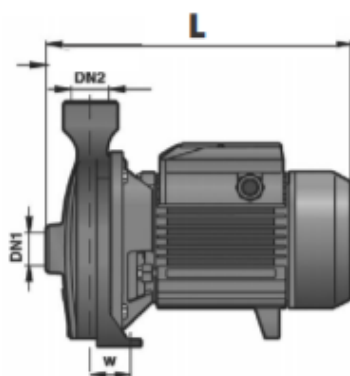
Max. Fluid Temperature: +60°C

Max. Ambient Temperature: +40°C

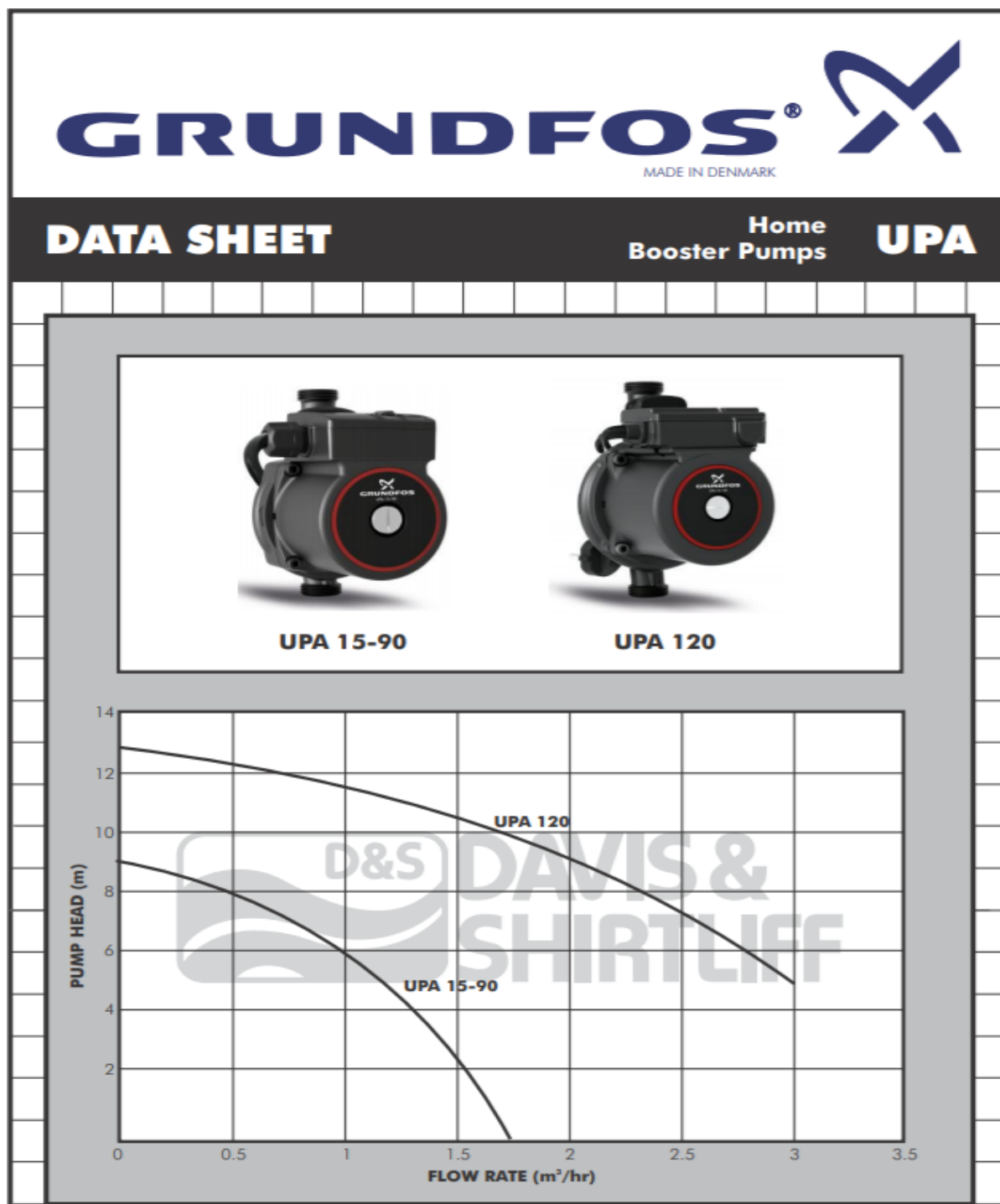
Max. Suction Lift: 7m at sea level

PUMP DATA

Model	Power		Dimensions (mm)					Weight (kg)
	kW	Current (A)	L	W	H	DN1(")	DN2(")	
DDC 158	0.75	5.2	305	190	260	1	1	13.8
DDC 170	1.1	7	346	230	293	1.5	1.5	21



GRUNDFOS UPA 120 datasheet TO WATER FROM THE LOFT TANKS ON TOP OF THE TOILETS TO THE WASH HAND BASINS



PUMP

The Grundfos UPA mini circulator pumps are designed for pressure boosting of domestic potable and hot water supplies with particular applications for showers, taps and water feeds to appliances. Pumps incorporate a flow switch for automatic on demand operation. They are for use in open systems and the option of manual or auto operation can be selected.

Pump construction is stainless steel encapsulated rotor, rotor can and bearing plate, polycarbonate impeller and cast iron pump housing. Pumps are supplied with a female threaded BSP union connection set.

MOTOR

The integral 2-pole asynchronous squirrel-cage motor includes a built-in thermal switch which monitors winding temperature and cuts off the power supply in the event of overload. No remote overload protection is required, though the pump must be connected to a suitably rated MCB or fuse.

Power Supply: 1x240V
UPA 120-F

Enclosure Class: IP42

Insulation Class: UPA15-90-H

OPERATING CONDITIONS

Pumped liquid: Thin, clean, chemically non-aggressive liquids without solids, fibres or mineral oils.

Fluid Temperature Range: +2°C to +70°C.

Max. Ambient Temperature: 40°C

Max. Operating Pressure: 6 Bar

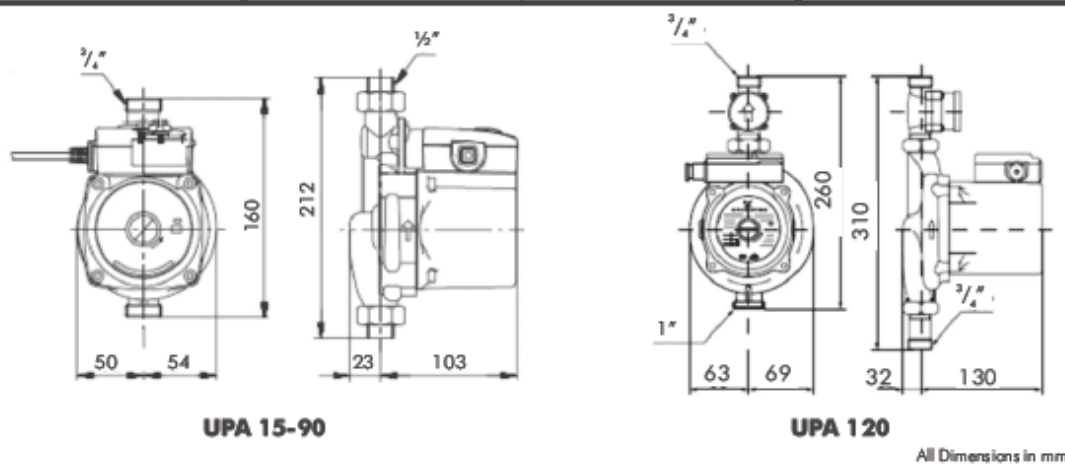
Min. Inlet Pressure: 0.2 Bar

Max. Relative Humidity: 95%

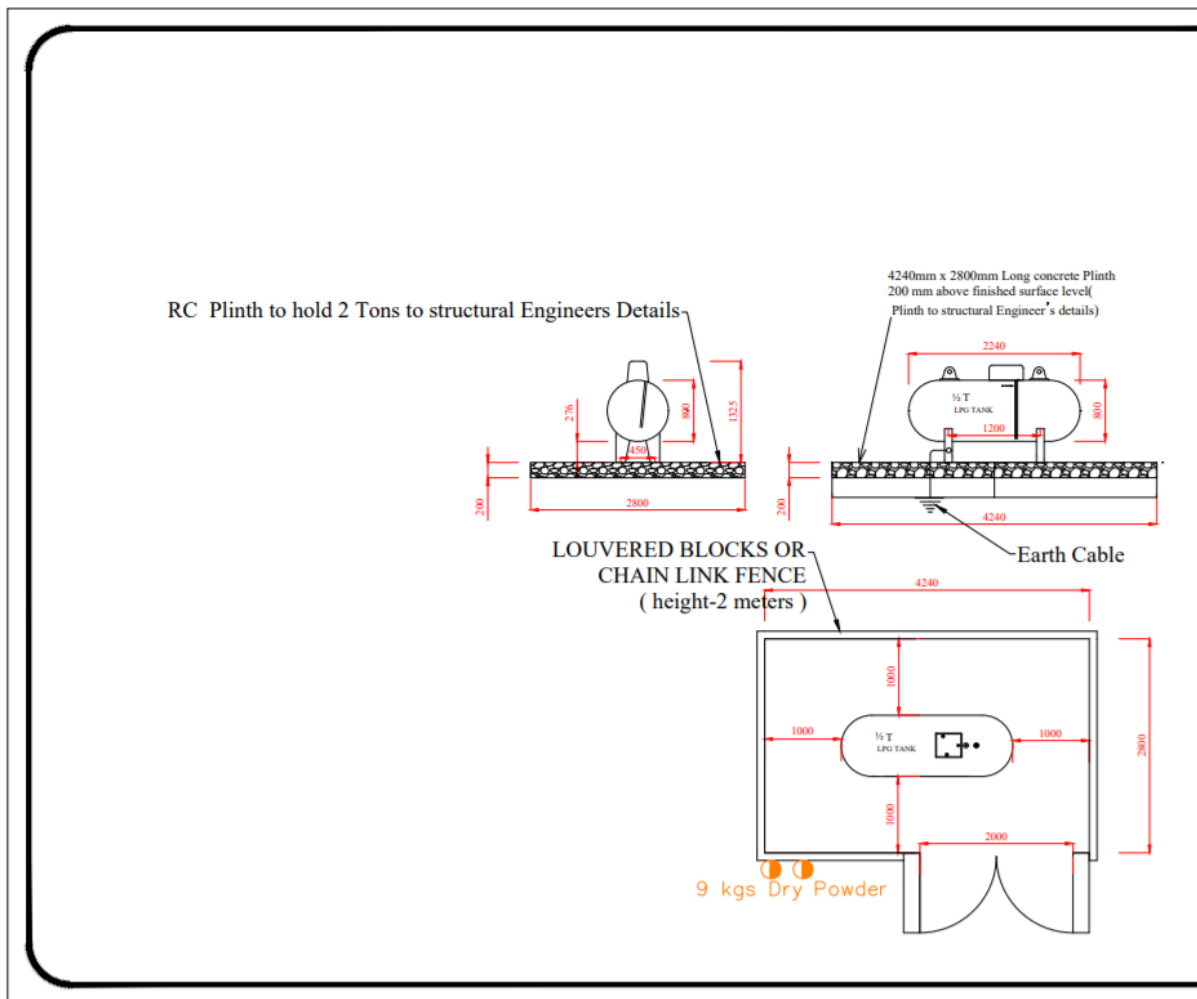
Installation: Pumps must be installed with the pump shaft horizontal.

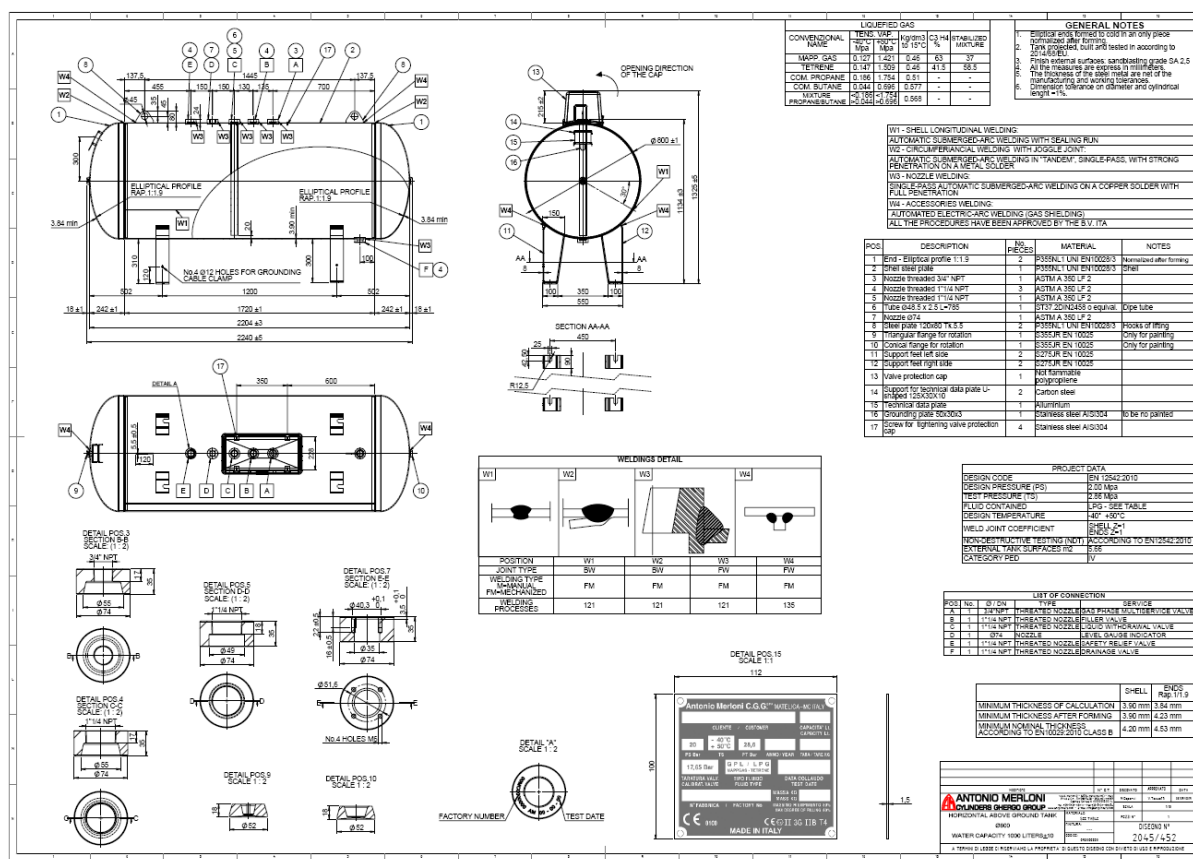
ELECTRICAL DATA

Model	Motor		Weight (kg)
	Power P ₁ (W)	Max. Current (A)	
UPA 15-90	120	0.48	2.5
UPA 120	250	1.14	5



SECTION 7:- PARTICULAR SPECIFICATIONS FOR LPG SYSTEM





Compact First Stage Regulators LV3403TR

Ideal for use as a first stage regulator on any domestic size ASME or DOT container in propane gas installations requiring up to 1,500,000 BTU's per hour. The regulator is factory set to reduce container pressure to an intermediate pressure of approximately 10 PSIG.



LV3403TR

Ordering Information

Part Number	Inlet Connection	Outlet Connection	Orifice Size	Factory Delivery Pressure	Bonnet Vent Position	Vapor Capacity BTU/hr Propane*
LV3403TR	1/4" F.NPT	1/2" F.NPT	1/4"	10 PSIG	Over Outlet	1,500,000
LV3403TRV9	1/4" F.NPT	1/2" F.NPT	1/4"	10 PSIG	9:00	1,500,000

* Maximum flow based on inlet pressure 20 PSIG higher than the regulator setting and delivery pressure 20% lower than the regulator setting and delivery pressure 20% lower than the setting.

High Pressure First Stage Regulators LV4403SR and TR Series

Provides accurate first stage regulation in two-stage bulk tank systems. Reduce tank pressure to an intermediate pressure of 5 to 10 PSIG. Also used to supply high pressure burners for applications like industrial furnaces or boilers. Also incorporated in multiple cylinder installations.



LV4403 Series

Ordering Information

Part Number	Inlet Connection	Outlet Connection	Orifice Size	Factory Delivery Pressure	Adjustment Range* (PSIG)	Integral Relief Included	Vapor Capacity BTU/hr Propane**
LV4403SR4	1/2" F. NPT	1/2" F. NPT	1/4"	5	1-5	Yes	2,500,000
LV4403TR4	1/2" F. NPT	1/2" F. NPT	1/4"	10	5-10		
LV4403SR9	1/2" F. NPT	1/2" F. NPT	1/4"	5	1-5		
LV4403TR9	1/2" F. NPT	1/2" F. NPT	1/4"	10	5-10		
LV4403SR96	1/2" F. NPT	1/2" F. NPT	1/4"	5	1-5		
LV4403TR96	1/2" F. NPT	1/2" F. NPT	1/4"	10	5-10		

* When used for final stage pressure control, must either incorporate integral relief valve or separate relief valve should be specified in accordance with NFPA Pamphlet 58.

** Maximum flow based on inlet pressure 20 PSIG higher than the regulator setting and delivery pressure 20% lower than the setting.

Low Pressure Second Stage Regulators LV4403B Series

Designed to reduce first stage pressure of 5 to 20 PSIG down to burner pressure, normally 11" w.c. Ideal for medium commercial installations, multiple cylinder installations and normal domestic loads.



LV4403B Series

Ordering Information

Part Number	Inlet Connection	Outlet Connection	Orifice Size	Factory Delivery Pressure	Adjustment Range	Bonnet Vent Position	Vapor Capacity BTU/hr. Propane**
LV4403B4	1/2" F. NPT	1/2"	#28 Drill	11" w.c. at 10 PSIG Inlet	9" to 13" w.c.	Over Inlet	935,000
LV4403B46	1/2" F. NPT	1/2"					
LV4403B46R*	1/2" F. NPT	1/2"					
LV4403B66	1/2" F. NPT	1/2"					
LV4403B66R*	1/2" F. NPT	1/2"					

* Backmount design

** Maximum flow based on 10 PSIG inlet and 9" w.c. delivery pressure.

RILEVAZIONE GAS CENTRALI TERMICHE
COMMERCIAL GAS DETECTION
Centraii per 3 zone con sensori remoti
3 zones central unit for remote sensors

CTP 21

La centrale è adatta fino a 3 sensori di rilevamento gas. Essi sono da collegarsi esternamente nella posizione più adeguata.

- Indicazione a barra di LED della misura di gas presente sul frontale
- 3 relè di attuazione allarme e guasto.
- Funzione TEST
- Funzione RESET
- N° 1 ingresso AUX per le elettrovalvole con sensore magnetico

The central panels are equipped with three led bars that indicate the reached gas concentration. The green led indicates fresh air; the first and second red leds indicate pollution and the third and fourth red leds indicate the switching on of the alarm relay. The yellow led indicate an anomaly of the system and it operate on the fault relay.

Modello Type	Sensori Sensors	Uscite Output	Portata Capacity	Sensori (max 3) Sensors (max 3)
CTP 21	Metano - Metano GPL - LPG	N° 3 relè - N° 3 relays 230V 3A SPDT	230Vacc 3A SPDT	SE 192KM SE 192KG SE 193KM SE 193KG


CTP 23

La centrale è adatta a fino a 3 sensori di rilevamento gas. Essi sono da collegarsi esternamente nella posizione più adeguata. Il Display permette la visualizzazione della misura di tutti i sensori collegati contemporaneamente.

- Indicazione a Display della misura
- Funzione TEST e RESET
- N° 1 ingresso AUX per la elettrovalvole con sensore magnetico

The central panel is equipped with graphic backlighted DISPLAY that indicate the reached gas concentration. It is equipped with n° 3 inputs for sensors and n° 3 relays output for alarm and fault with alarm memory. Alarm levels are programmable via DIP-switch. TEST and RESET functions.

Modello Type	Sensori Sensors	Uscite Output	Portata Capacity	Sensori (max 3) Sensors (max 3)
CTP 23	Metano - Metano GPL - LPG	N° 3 relè - N° 3 relays 230V 3A SPDT	230Vacc 3A SPDT	ST 441KM ST 441KG SE 193KM SE 193KG


CE IP65

Alimentazione: 110/230Vacc 50-60Hz 12Vacc - Installazione: Fisso

Power supply: 110/230Vacc 50-60Hz 12Vacc - Installation: fixed

Absorbimento: 10 VA

Absorption: 10 VA

Soglia di allarme: 10% LEL - 20% LEL - Campo di misura: 0-20% LEL

Alarm level: 10% LEL - 20% LEL - Measuring range: 0-20% LEL

N° 3 relè a sicurezza positiva con memoria di allarme in comune per tutti i sensori

N° 3 safety positive relay with alarm memory for all sensors

Indicazione a barra di led della concentrazione di gas; 1 per ogni sensor

A led bar indicate the reached gas concentration; 1 for each sensor


CE IP65

Alimentazione: 110/230Vacc 50-60Hz - 24Vacc - Installazione: Fisso

Power supply: 110/230Vacc 50-60Hz - 24Vacc - Installation: fixed

Absorbimento: 15 VA

Absorption: 15 VA

Soglia di allarme: 10% LEL - 20% LEL - Campo di misura: 0-20% LEL

Alarm level: 10% LEL - 20% LEL - Measuring range: 0-20% LEL

N° 3 relè a sicurezza positiva con memoria di allarme in comune per tutti i sensori

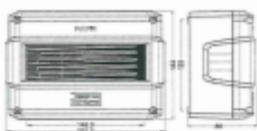
N° 3 safety positive relay with alarm memory for all sensors

Indicazione a display della misura

Backlighted DISPLAY that indicate the reached gas concentration

RILEVAZIONE GAS CENTRALI TERMICHE

COMMERCIAL GAS DETECTION

Sirena
Siren


CE IP43

Alimentazione: 230Vca 50-60Hz - 12Vdc

Power supply: 230Vca 50-60Hz - 12Vdc

Assorbimento: 9VA - 230V / 5W - 12Vdc

Absorption: 9VA - 230V / 5W - 12Vdc

Intensità sonora: 115db

Sound intensity: 115db

Installazione: A parete

Installation: Wall

A richiesta: SE301B con alimentazione 24Vdc - 5W

On request: SE301B with power supply 24Vdc - 5W


SE301A
SE301B

Sirena piezoelettrica con segnalazione a luce rossa intermittente

Piezoelectric modulated siren with flashing red light indication.


Alimentatori auxiliari PS
Auxiliary power supply PS

CE IP40

Alimentazione: 230Vca 50-60Hz

Power supply: 230Vca 50-60Hz

Batteria Pb standard: 12Vdc, 7.2Ah

Standard battery Pb: 12Vdc, 7.2Ah

Custodia: Metallica

Housing: Metallic

Installazione: A parete

Installation: Wall



PS

Alimentatore con batteria in parallelo che rimane sempre sotto carica e interviene nel caso di caduta dell'alimentazione della rete.

It consists of a power supply unit with a continuous on-charge battery which activates only in case of a current failure.

Modello Type	Dimensione Size	Corrente erogata Current	Batteria Pb Pb Battery
PS 175	285x220x95	1.2 A	7 Ah
PS 180	285x220x95	2.5 A	7 Ah
PS 195	455x260x220	6 A	18 Ah

RILEVAZIONE GAS CENTRALI TERMICHE

COMMERCIAL GAS DETECTION

Rilevatori per centrali termiche

Detector for commercial applications


ST 441

Sensore catalitico in due versioni, per metano (SE192KM) e per GPL (SE192KG). Completamente insensibile a temperatura ed umidità, con elemento sensibile di livello professionale. Ideale per installazioni in centrale termica o piccole e medie attività.

- Alimentato direttamente dalla centrale
- Collegabile alle centrali: CTM31-CTM21-CTM11-CTP21-CTP31-CTP23

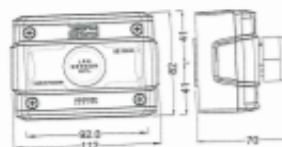
Catalytic sensor to detect methane or LPG.

It can be connected to central units.

CTM31-CTM21-CTM11-CTP21-CTP31-CTP23

In spite of its low price, this sensor stands out because of its high reliability and such a rating that makes it perfectly fit to be installed in heating plants and a number of industrial appliances.

Modello Type	Gas rilevato Detected gas	Simbolo taratura Cylinder calibration	Durata Average time	Stoccaggio Sensors
ST 441KM	Metano - Methane	BC200	5 anni / 5 years	5 anni / 5 years
ST 441KG	GPL - LPG			


CE IP44

Alimentazione: 12Vdc

Power supply: 12Vdc

Assorbimento: 1W

Absorption: 1W

Uscita: 4÷20 mA - Campo di misura: 0÷20% LEL

Output: 4÷20 mA - Measuring range: 0÷20% LEL

Sensore: Catalitico

Sensor: Catalytic


SE193K

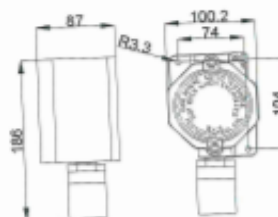
Sensore catalitico in due versioni, per metano (SE193KM) e per GPL (SE193KG). Completamente insensibile a temperatura ed umidità, con elemento sensibile di livello professionale. Ideale per installazioni in centrale termica o piccole e medie attività, ma con esigenze di custodia antideflagrante.

- Grado di protezione: antideflagrante II 2G Ex d IIC T6 Gb - Certificazione CESI 03 ATEX 323 X
- Alimentato direttamente dalla centrale
- Collegabile alle centrali: CTM31-CTM21-CTM11-CTP21-CTP31-CTP23

The article SE 193K only differs for its explosion-proof case certified by ATEX, which makes it fit for industrial installations where the area classification requires this type of cases. It can be equipped with an (optional) explosion-proof joint Art.-Nr. ZT163 required for the connection to the cable raceway. Such connection is made easier by coupling terminals. It can be connected to central units: CTM31-CTM21-CTM11-CTP21-CTP31-CTP23.

Type of protection: II 2G Ex d IIC T6 Gb - Certificazione CESI 03 ATEX 323 X

Modello Type	Gas rilevato Detected gas	Simbolo taratura Cylinder calibration	Durata Average time	Stoccaggio Sensors
SE193KM	Metano - Methane	BC200	5 anni / 5 years	5 anni / 5 years
SE193KG	GPL - LPG			


CE ANTIDEFLAGRANTE

Alimentazione: 12Vdc

Power supply: 12Vdc

Assorbimento: 1W

Absorption: 1W

Uscita: 4÷20 mA - Campo di misura: 0÷20% LEL

Output: 4÷20 mA - Measuring range: 0÷20% LEL

Sensore: Catalitico

Sensor: Catalytic

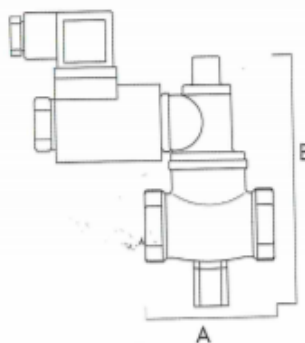
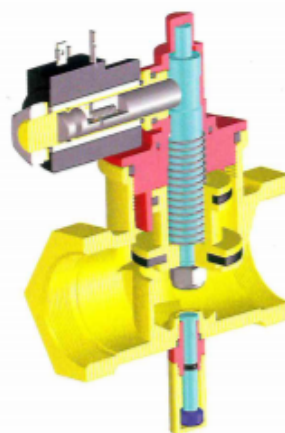
ELETTRORVALVOLE N.A. 6 bar. Misure $\frac{1}{2}$ " - $\frac{3}{4}$ " - 1" - 1 $\frac{1}{4}$ " - 1 $\frac{1}{2}$ " - 2" GAS ELECTRO-VALVES N.O. 6 bar, dimensions $\frac{1}{2}$ " - $\frac{3}{4}$ " - 1" - 1 $\frac{1}{4}$ " - 1 $\frac{1}{2}$ " - 2"



Alimentazione: 230 Vca - 24 Vcc/Vca - 12 Vcc/Vca
Power supply: 230 Vac - 24 Vcc/Vac - 12 Vcc/Vac
Corpo: in ottone verniciato giallo (giallo metano) RAL 1018
Body: brass, yellow colour
Temperature di esercizio: -15°C / +70°C
Working temperature: -15°C / +70°C
Tempo di chiusura: < 1 sec
Closing time: < 1 sec
Pressione massima di esercizio: 6 bar
Max. pressure: 6 bar
Grado di protezione: IP65
Protection rating: IP65
Attacchi: filettati secondo ISO 228/1
Connections: ISO 228/1 thread

Le elettrovalvole GAS GAS sono nate per essere abbinate a qualunque sistema di rilevazione gas o monossido di carbonio che preveda, in caso di allarme, un segnale per la chiusura della mandata principale.
 Installate sul tubo di adduzione e collegate ad un rilevatore di gas o di CO, interrompono il flusso del gas in seguito ad una situazione di pericolo. L'elettrovalvola è normalmente posizionata, dopo un filtro, all'esterno dell'ambiente di misura e a monte degli organi di regolazione. Deve essere installata con la freccia (indicata sul corpo) rivolta verso l'utenza. Il riarmo della valvola (dopo verifica che la bobina sia alimentata) si ottiene premendo assialmente il dispositivo di riarmo dopo avere svitato il tappo di protezione (da riavvitare al termine dell'operazione).

GAS GAS solenoid valves have been designed to be combined with any gas detection system. Shut off the main outlet when an emergency situation is detected.
 They have been installed at the gas piping and connected with a gas detector. Interrupt the gas flow in a danger situation.
 The electro-valve is normally located after a filter, upstream of the regulation apparatus and preferably outside the measurement zone. It has been installed with the arrow stamped on the body turned towards the user appliance. To reset the solenoid valve, check that the coil is receiving current and pull the reset knob after having unscrewed the protection cap. Screwed it when the operation is finished.



Modello Type	Attacchi Connections	Portata(m ³ /h) Flow	Potenza Power	A (mm)	B (mm)	Omologazioni Approvals	Alimentazione Power supply
36700721	$\frac{1}{2}$ "	4,5	19 W	65	165	-	12Vcc
36700722	$\frac{1}{2}$ "	4,5	17 VA	65	165	-	230Vac
36710723	$\frac{3}{4}$ "	6	19 W	65	165	-	12Vcc
36710724	$\frac{3}{4}$ "	6	17 VA	65	165	-	230Vac
36720725	1"	13	19 W	78	170	Dir. 97/23/CE (PED)	12Vcc
36720726	1"	13	17 VA	78	170	Dir. 97/23/CE (PED)	230Vac
36730727	1 $\frac{1}{4}$ "	40	19 W	114	195	Dir. 97/23/CE (PED)	12Vcc
36730728	1 $\frac{1}{4}$ "	40	17 VA	114	195	Dir. 97/23/CE (PED)	230Vac
36740729	1 $\frac{1}{2}$ "	50	19 W	114	195	Dir. 97/23/CE (PED)	12Vcc
36740730	1 $\frac{1}{2}$ "	50	17 VA	114	195	Dir. 97/23/CE (PED)	230Vac
36750731	2"	80	19 W	139	200	Dir. 97/23/CE (PED)	12Vcc
36750732	2"	80	17 VA	139	200	Dir. 97/23/CE (PED)	230Vac

SECTION 8 - BILLS OF QUANTITIES

PREAMBLE

1. The Tenderer shall tender for the above Works in accordance with the appended drawings, Specification and Bills of Quantities.
2. The Tenderer is required to check the numbers of the pages of these Bills of Quantities against the Contents Page and should he find any missing, in duplicate or indistinct he must inform the Engineer at once and have the same rectified.
3. Should the Tenderer be in doubt about the precise meaning of any item or figure, for any reason whatsoever, he must inform the Engineer in order that clarification is provided prior to the date for submission of the tenders. In addition, should the Tenderer find any of the specified items and / or reference numbers indistinct or inconsistent, for any reason whatsoever, he must inform the Engineer in order that clarification is provided prior to the date for submission of the tenders.
4. No liability will be admitted or claimed in respect of errors in the Tenderer's Tender due to mistakes in the Bills of Quantities which should have been rectified in the manner described above.
5. The annexed Bills of Quantities must be fully priced in ink. The Tenderer shall not alter or otherwise qualify the text of these Bills of Quantities. Any alteration or qualification made without authority will be ignored and the text of the Bills of Quantities as printed will be adhered to.
6. Fully priced Bills of Quantities **must be accompanied by brochures and technical literature for the major mechanical and electrical items.**
7. Preliminaries have been captured in the bills of quantities for main works. The Tenderer shall be deemed to have made allowance in his prices generally to cover items of Preliminaries.
8. All items of measured work shall be priced in detail and tenders containing lump sums to cover trades or groups of work must be broken down to show prices of each item before they will be accepted. Lump sums to cover items of Preliminaries shall be likewise broken down if so required.
9. The Tenderer is solely responsible for the timely and accurate ordering of materials in accordance with the Drawings and architect's instructions and no claim for any loss or expense will be entertained for orders for materials based upon the Bills of Quantities.
10. The rate entered against each item shall be exclusive of VAT. The Total of Tender for Mechanical Installations shall be carried to the Main Builder's Work Summary Page where VAT shall be factored. The Total of Tender shall include for the design, manufacture, inspection and testing, packing for shipment, insurance, customs dues, delivery to site, unloading, and all other charges, complete erection, testing, setting to work, finishing, painting, maintenance for a period of six calendar months and the instruction period all to the

satisfaction of the Architect and Engineer, of the items of Plant described or implied within the Specification and shown on the Drawings.

11. The bidder or tenderer shall fill in rates and prices for all items of the Works in the contract bills. Items against which no rate or price is entered by the bidder will not be paid for by the Employer when executed and shall be deemed to be covered by the rates for other items and prices in the Bills of Quantities.
12. The rates and prices quoted by the bidder shall not be subject to adjustment during the performance of the Contract on account of price fluctuations or fluctuations in the rate of exchange of the various currencies.
13. These Bills of Quantities have been measured from the Drawings listed, but do not purport to schedule the works in more detail or accuracy than is necessary to obtain a reasonable and comprehensive tender.
14. The contractor shall nevertheless be deemed to have included in his prices for all labour and all materials, accessories, components, quantities and commissioning to provide complete installation as described in Specification and shown on the Drawings as required by the true meaning and intent hereof. It shall be deemed that the contractor has included all requirements contained within the Specification, Drawings, Data Schedules and Bills of Quantities.
15. The Contractor's attention is drawn to the fact that the quantities in these Bills of Quantities are estimated and they are not to be considered as limited or extending the amounts of work to be done by the Contractor.
16. Irrespective of the requirements contained within the local Standard method of Measurement it shall be deemed that the contractor has included all requirements contained within the Specification, Drawings, Schedules and Bills of Quantities.
17. The Client reserves the right to omit / phase certain works, if necessary, at any stage of the contract. The contractor shall spread his profit uniformly across all items as no claims for loss of profit shall be entertained.
18. In no case will any expense incurred by Tenderers in preparation of this Tender be allowed.
19. The copyright of these Bills of quantities is vested in the Engineer and no part thereof may be reproduced without their express permission given in writing.

