**VOLUME 3**

**TECHNICAL SPECIFICATIONS**

1. **Technical specification for construction of the external installation**

These technical conditions define the conditions for civil and other works that will occur during the construction of the water supply pipe.

* 1. **Preparatory work**

Before the execution of the main works of a particular structure, it is necessary to perform various preparatory works and facilities, the contractor performs and other things that are necessary to smooth and normal execution of major works. These things include: surveying work, alignment positioning, testing and marking of underground installations on the ground prior to and during work in cooperation with representatives of utility organizations Water and Sanitation, PTT and electrical.

Different crossings and relocation of various installations, fence, bringing the field to its original position are also listed as preparatory works.

**Surveying work**

Before the work, along the route of the object, it is necessary to make the operating polygon with surveying the terrain and alignment positioning of the object.

Surveying operating range is designed on the basis of the information given in the design, namely: location of points (away from the existing facility) and setting items that are defined by the state trigonometric system. Means points have coordinates (X, Y, Z).

With the operating polygon marking shall be made on the route of the facility (break points of the route of the pipeline and elevation of the route and cross sections) and send the performance of the facility, actually determines the height and horizontal position of the object.

For execution of the geodetic works, in the design there is a sketch of the operating polygon and route of the object.

**Testing and detection of underground installations.**

Before starting the work, along the route of the object it is necessary to make investigations and to define the existing underground facilities (if any): water, sewerage, electricity and postal installation, hot water and gas, or to determine the precise locations of intersection with these facilities. For test and defining of the existing installations cadaster of underground installations can be also used in cooperation with representatives of utility companies supply, sewerage, PTT, the heat or gas pipeline.

At all locations where the alignment of the object or the channel intersects with the existing underground installations it should comply with terms of cut or displacement of existing installations at the request and agreement of the owner or user of these installations.

**Temporary fences**

Contractor shall submit the proposal for a temporary protective fence for acceptance of the Investor and the competent authorities and after obtaining the agreement and approval can set it. The fence should be strong enough and high to ensure the protection of workers from falling or slipping of the trench.

After completion of work temporary fence should be removed and the surrounding area should be again in original condition.

* + 1. **Prospection of the terrain**

Before the performance start, it is necessary to carry out prospection of existing ground by defining the elevation of the terrain, vegetation, buildings, plantations and entered in Protocol - Record.

Facility drawings are supplied with all the required dimensions and alignments with absolute elevations and coordinates x and y.

Positioning of the alignments of pipelines and the locations of the additional facilities, all geodetic measurements in relation to the transfer of data from the project site and integrated with state polygonal network.

Marking and ensuring the alignment axis should be out of the area of construction. The alignment of the trench and its position should be precisely defined and the elevation of the existing terrain. The lines of trenches and elevations should be as shown in the design. Before excavation start, after removing the topsoil should be made positioning of the trench and ground level.

Contractor will set axis and vertical alignment on the existing terrain. His responsibility is to administer the same and on the bottom of the trench.

Contractor will constantly monitor alignment and side inclination of fences and pipes

Responsibility of the Contractor is to protect the horizontal and vertical alignment.

* 1. **Pipeline**

For construction of the collector are foreseen polyethylene pipe, according to DIN 16961.

Is anticipated to lay pipes with longitudinal decline depending on the terrain and the diameter of the pipes.

* 1. **Trenching**

Trenches for laying the pipeline are rectangular and their depth and width is variable.

* 1. **Setting out**

Prior to the commencement of excavation for any particular pipeline it shall be the Contractor's responsibility to accurately set out the route of every pipeline in accordance with Drawings before commencing construction. The Works shall be set out and tied to the National Co-ordinate System. The route of the pipeline shall be clearly marked on the ground. The Contractor shall establish and maintain center line, change and level reference points

Setting Out must minimum be made in accordance with MKC EN 1610.

The Contractor shall be obligated to ascertain for himself the existence of any bench marks and/or boundary demarcations on Site and shall proceed with the setting out of the Works having physically checked any levels.

Before carrying out any work at any location, the location shall be inspected where necessary. The Contractor shall request in writing such inspections where in his opinion the situation shown in the Drawings has changed and/or is different from actual conditions.

* 1. **Clearance of sites**

Prior to the commencement of any excavation work, the Contractor shall clear the site and remove all kinds of rubbish, shrubs, general vegetation, etc. Where so ordered, the Contractor shall remove and conserve the topsoil for later use.

The extent of Contractor’s clearing and grubbing operations shall be the minimum practicable necessary.

All vegetation, trees, etc. arising from the clearing and grubbing operations shall be dumped at a depot to a location. Remnants of vegetation, including trees, stumps and roots, shall be disposed off site by the Contractor.

* 1. **Protection of existing services**
     1. **Protection of Overhead and Underground Services**

Having identified the proposed pipeline route, the Contractor shall liaise with the utility companies before commencing any excavation. Any instructions given by these utilities shall be followed. With the assistance of the utility companies the Contractor shall satisfy himself as to the exact location of all existing underground services which may affect or be affected by the excavation of the pipeline.

The Contractor is responsible for identifying the exact location of these services, by inquiring and inspecting all the records available from the appropriate Authorities.

Before proceeding with any action relating to existing utilities, the Contractor shall notify the authority concerned in writing. In all cases he shall co-operate fully with the authorities and follow their instructions concerning protection, removal or relocation. All protection and relocation work shall be carried out in accordance with the standards of the relevant authority, including the maximum length of the utility which can be left exposed and supported before it is necessary to provide for relocation.

The Contractor may, at times be requested to permanently relocate existing utilities at the request of the Employer. The Contractor will be compensated for any additional work related to this type of utility relocation at the day work rates provisional sums given in the Schedule of Prices.

The Contractual Drawings show positions/location of existing underground services based on the best information available.

The Contractor shall excavate any trial holes he may require to determine the position of underground services. Such exploratory excavations shall be carried out in consultation with the Authorities concerned and either be protected until the general excavation meets this excavation or be re-filled after recording the nature and position of the service. He shall not use mechanical equipment to excavate within 3 m of the assumed position of any service and shall expose the service by means of hand excavation carried out under proper supervision. When so ordered, the Contractor shall backfill such observation trenches with approved material to the compaction density ordered. Once a service is exposed the Contractor shall take all measures necessary for the support and protection of the service.

For the complete construction duration existing cables and pipes shall be secured and supported. Cables, cable bundles and pipes, which are running parallel in the pipe trench, shall be supported safely. Possible existing cable conduits or similar shall be temporarily removed and stored on the Site. After completion of the works, cables, pipes and cable conduits shall be reinstated and marked with a cable warning tape.

Where water supply lines cross sewer mains with a clearance of smaller than 0.20 m or where the clearance between parallel pipes is smaller than 0.40 m a protection pipe around the water supply pipeline shall be installed. At pipe crossings the protective pipe shall extend at least 1.00 m to both sides of the sewer pipe.

* 1. **Earthworks**
     1. **Topsoil**

Where applicable, for the excavation of trenches and building pits the layer of topsoil (average thickness: 50 cm) including grass, shrubs and similar shall be removed and separated from the excavation of the deeper layers. For reuse the topsoil shall be temporarily stored on the construction site.

After refilling of trenches and building pits the Contractor shall transport the topsoil and fill the layer of topsoil in the required thickness on sloped and horizontal surfaces on the site.

The work includes transport on site and intermediate storage of soil on stable and well drained stockpiles within the area affected by construction operations. Topsoil shall be stockpiled in a manner to prevent its deterioration. Topsoil shall include any surface material capable of supporting vegetation and suitable for use in soiling areas to be grassed or cultivated.

* + 1. **Excavation**

Prior to commencing any excavation, the Contractor shall obtain relevant all permits as required to commence the work from service providers, the town hall and traffic police. The Contractor shall liaise with the Local Authorities; traffic police and service providers to determine the number of permits required and shall ensure they are obtained in accordance with the works programme.

The Contractor shall apply for such permission, giving notice in writing to the relevant authorities of his intentions to excavate in sufficient time to enable the necessary procedures and approval to be executed. He shall liaise with the relevant authorities with respect to the programming and execution of the crossing.

Trenches and manhole pits shall be excavated as specified in the standards (MKC EN 1610). The pipe trench for the pipelines shall be true to profile. Bottom width of trench shall be according MKC EN 1610 as required for the nominal pipe diameter. Depth of trench and depth of manhole pits shall be as indicated in the drawings.

Pipe trenches shall be excavated to the typical cross-sections shown on the Drawings. The Contractor shall ensure that at any point the width of the pipe trench is sufficient to permit the pipe to be laid, jointed, bedded/surrounded and backfilling, to be placed and compacted around the pipeline. The trench invert shall, at any location, be at the proper level and trench width of the proper dimensions to allow for gravel, sand and/or concrete bedding or surrounds as shown on the Drawings. Should any part of a trench be excavated, in error, deeper than required, the Contractor shall fill in the trench with suitable material, to meet the required levels. Where welding or jointing of pipes and/or accessories is required to be done in the trench, the trench shall be widened and/or deepened to form bell-holes. This enlargement must easily permit the proper execution of all welding, connecting and fixing work in all their stages, all necessary repairs to the pipe and coating, and the thorough inspection of all these operations. Trench formations shall be in undisturbed ground.

Boulders and other materials bigger than 25 cm diameter shall be collected and disposed.

Suitable excavated soil for the backfill of the trench and sub-base (between surround and macadam/gravel road base) shall be transported to an intermediate storage on the Site. Excavated excess soil shall be removed immediately from site.

As preparation for the underlay (pipe bedding) the subgrade at the bottom of the trench shall deviate not more than 2 cm from the specified excavation depth. The subgrade shall be trimmed by hand immediately prior to the laying of pipes.

* + 1. **Trench shoring**

During the excavation of trenches, the Contractor shall use trench shoring on both sides and at begin and end of the pipe trench at all depths, which are bigger than 0.90 m (except in cohesive soil and rock).

The Contractor shall take all necessary precautions during the excavations to protect his workmen and the public. The sides of excavations shall be supported whenever necessary by means of timber, steel or other type of struts, walling, boards, sheeting or any other approved system. These shall be provided by the Contractor and shall be of proper design and sound construction.

* + 1. **Pipe bedding**

For a uniform foundation of the pipe, the Contractor should provide a layer of sand or gravel (maximum grain size as specified by the pipe manufacturer but no greater than 20 mm) in accordance to MKC EN 1610 in a thickness of 100 mm. Each and every pipe shall be supported evenly throughout its entire length.

Granular bedding for pipes shall be formed by spreading and compacting material over the full width of the trench. Sufficient granular material shall be provided to allow the pipes to be worked into the granular material and firmly supported to true line and level. Sufficient space shall be left to enable the joints to be made, tested and inspected and the Contractor shall ensure that at least three quarters of each pipe length is fully supported.

Provision of the bedding layer includes compaction by hand to a degree of compaction of at least 95 %. The bedding works shall be carried out in compliance with MKC EN 1610.

Cables and cable conduits shall be laid on a 100 mm compacted sand bed graded 0/2 mm and embedded by hand up to 150 mm above the top of the pipes in accordance to the methods prescribed for pipes.

* + 1. **Gravel bed for manholes**

Prior to the construction of the manholes the Contractor shall install a gravel bed. A degree of compaction of 97 % is required. The Contractor shall carry out tests (i.e. plate load test acc. to DIN 18134 - Soil – Testing procedures and testing equipment) to verify the specified degree of compaction.

* + 1. **Pipe zone backfill (surround)**

After the pipeline has been tested the trench shall be carefully filled with granular material.

The trenches shall be backfilled in layers as specified hereafter. Each layer shall be separately compacted and any subsidence resulting from insufficient compaction shall be the Contractor's liability and he shall forthwith add the necessary extra material, which shall then be thoroughly compacted.

Up to 30 cm above top of pipe (or in accordance with Design) the Contractor should fill up the trench with gravel or sand (maximum grain size as specified by the pipe manufacturer but no greater than 20 mm). The sand material and surround shall be wetted and thoroughly hand-tamped in layers not exceeding 15 cm in thickness after compaction. Special care shall be taken to obtain proper compaction around the pipe. This filling shall be carried out with the utmost care. The difference in level of backfill on either side of pipes shall not exceed a maximum of 0.15 m. spreading and compaction shall be carried out evenly without dislodging, distorting or damaging the pipe or the joints. Power rammers shall not to be used within 0.30 m above any part of the pipe or joint. Backfilling of pipe trenches, except at joints, shall be done as soon as practicable after the pipes have been satisfactorily laid in position and jointed.

A degree of compaction of at least 95 % is required.

The Contractor shall carry out tests (i.e. plate load test acc. to DIN 18134) to verify the specified degree of compaction.

Except in roadways and other paved areas, backfill of trenches shall be brought up to the natural ground level. Where topsoil is at the surface on the line of the trench, the upper section of the backfill shall be topsoil of the thickness described, or of the same thickness and quality of topsoil as the surrounding ground.

* + 1. **Backfill of Manholes**

After construction of the manholes the Contractor shall supply and backfill the excavation pits with non-cohesive, compactable soil (soil class 3-4, sorting coefficient: U = 6 –10, Clay/Silt content (grain sizes  = 0.06 mm): max. 10%, free of slimy, perishable material or vegetable matter. The backfill shall be carried out in layers of 40 cm each. Each layer shall be thoroughly compacted by an approved mechanical compacter before each succeeding layer is placed. A degree of compaction of 97 % is required.

* 1. **Pipe works**
     1. **General**

For the new water pipeline the Contractor shall furnish and install the complete pipes and fittings as required for the construction of the water supply network according to the drawings.

The Contractor shall submit manufacturer's certificates and certificates from approved laboratories certifying that the pipes have been subjected to, and have satisfactorily undergone the required tests according to the specified standards. All materials shall comply with the standards mentioned hereinafter.

Pipes shall be labelled according to MKC EN 13476, including: manufacturer mark and reference to the standard, pipe material, nominal diameter and stiffness class.

The pipes must be manufactured by an ISO 9001 certified company.

Transport, handling, storage and installation of pipes shall be in accordance with the pipe manufacturers’ instructions.

Pipe characteristics such as ring stiffness and ring flexibility will be tested.

The Contractor shall remove pipes which failed the tests from the Site immediately and replace them with acceptable pipes at his own expense. Only pipes marked as accepted shall be incorporated in the Works.

* + 1. **HDPE Pipes**

All HDPE pipes and fittings shall be manufactured by a quality assured manufacturer in accordance with the ISO 9000 system. PE pipes and fittings shall comply with the relevant provisions of CEN-standard for water and wastewater and for gas.

The pipes shall be manufactured from high-density polyethylene containing only those antioxidants, UV stabilizers and pigments necessary for the manufacture of potable water black pipes. The Contractor shall provide an approved third party certi­fi­cate to verify the above.

HDPE pipes shall be manufactured from PE 100 material. In accordance with relevant standard the PE 100 material shall have a minimum required strength (MRS) value of 10 MPa. The pipes and fittings shall be colored blue (potable water), yellow (gas) or black (wastewater) and be suitable for below-ground use.

Gravity pipes shall be engineered light weight pipes with (structured wall pipe type) with ring stiffness larger than SN 8 kN/m2.

Pressure pipes shall be of pressure class appropriate for fulfill the design purpose. The couplings and fittings shall be designed for a nominal working pressure (at least the same as for pipes) and a temperature of 40°C and shall fit the HDPE pipes.

Generally, all buried pipes shall be jointed using either butt or electro fusion welding techniques.

The minimum diameter of the rollers for coiled pipe should be such that kinking of the pipe is prevented. The mini­mum internal diameter of the rollers shall not be less than 24 times the nominal out­side diameter of the pipe. The ends of the pipe shall be plugged or covered.

Pipes and fittings shall be stored, handed, laid and jointed strictly in accordance with the manufacturer’s instructions and recommendations.

Plastic pipes shall be capable of withstanding ultraviolet degradation.

The Contractor shall advise the manufacturer of the climatic and conditions at the site of the Works and shall seek his advice on the storage of plastic materials on site.

* + 1. **Connection to existing services**

To connect to existing pipe the Contractor shall provide the required fittings and pipe adapters.

For the transition of the different pipe materials pipe adapters as specified by the manufacturer for the selected pipe material or double sliding flexible sockets shall be used.

The connection to existing water network in the town of Resen shall be in accordance with technical requirements of the PE “Proleter”.

* + 1. **Testing of pipelines**

**General**

Pipelines for water supply shall be tested in accordance with MKC EN 805.

Pressure pipelines (together with all specials and valves incorporated) shall be tested with water in accordance with relevant standard. The trench must be filled on the pipe barrels, leaving the joints uncovered so as to prevent the pipeline from moving whilst leaving the joints accessible. Thrust blocks must also be constructed before testing.

The test pressures shall be:

* 1.5 × the maximum working pressure or the maximum surge pressure, if applicable, whichever is the greater.
* Pipes shall be filled and tested in sections of convenient lengths, which must not exceed 1000 meters. Where pipes are laid with steep gradients the length of pipes tested at any one time.
* The ends of pipes under test shall be closed by means of caps or blank flanges with anchors all provided by the Contractor. Valves must not be used for this purpose. All scour valves and air valves shall be replaced by blank flanges before commencement of the test.
* After laying, jointing and anchoring the pipe shall be slowly and carefully charged with water so as to avoid water hammer and all air shall be released through the upper pipe end or in case of an intermediate high point by installing a service connection with a tap. Pipes internally lined with mortar shall be allowed to stand full for at least 24 hours before testing.
* The test pressure shall be applied by means of a manually or motor operated test pump connected to the pipe and to two parallel installed pressure gauges calibrated at an approved testing laboratory. The test pressure shall be maintained for at least 30 minutes without the pressure decreasing by more than 0.2 bar.

During the test the pipe joints shall be inspected for leakages, but the duration of the test shall under no circumstances exceed 2 hours in which case a pressure drop of 0.3 bar shall be permissible.

Should leakage of water occur at the joints, the joint shall be reassembled to eliminate such leakage or, should this not prove possible, the Contractor shall supply and assemble new joints. Should any pipe or joint burst or should water leak through the body of a pipe or joint the Contractor shall forthwith remove the faulty pipe or joint and replace them with new. In all the above cases the length under test shall be re-tested as above described and the process repeated, if necessary, until the pipeline satisfactorily withstands the prescribed test.

A test report shall be prepared in respect of each and every test performed. The test report shall contain as a minimum the following data:

* Number and date of the test
* Description of the section tested with unambiguous indication of the extremities of the section
* Sketch showing in the order of laying, the number and the characteristics of the pipes, the fittings, the specials and other apparatus incorporated in the section
* Duration of the test, test pressure, results obtained
* Decisions relative to possible repair works and conclusions.

The test report shall be signed by the Contractor and the Engineer’s Representative.

The Contractor shall provide labour, install and work the test pump, pressure gauges and all other equipment required for the test and he shall fill the pipes with water and subsequently empty them after the test. The water used for testing shall be obtained from an approved source. Water drained from the pipes shall be discharged in a way that does not affect the stability of the Works or adjacent structures.

* + 1. **Cleaning of pipelines**

During installation the Contractor shall keep the interior of pipes clean and free from water, dirt, stones, rubbish and other foreign matter. Upon completion of laying and jointing the interior of the pipes shall be thoroughly flushed to remove remaining traces of foreign matter.

* + 1. **Disinfection**

After the construction of water supply pipeline, pipelines shall be disinfected by flushing and the use of disinfectants, according with MKC EN 805 and with requirements and procedures of lokal PUC.

* 1. **Manholes and Chambers**
     1. **Cast-in-place manholes**

This section refers to the all manholes and chambers.

The grade of concrete used for this works shall be in accordance with Design, or as it is described hereinafter.

As sub-base for the reinforced concrete floor slab of the manhole the Contractor shall place a layer of non-reinforced concrete, at least 10 cm thick, C12/15.

Access shafts, walls, and cover slabs shall be constructed in cast-in-situ Concrete Class C20/25 reinforced or in precast construction using units made of Concrete Class C30/37.

Concrete strength class C30/37 shall be used for the cast-in-place reinforced concrete manholes.

Half-round gutter for sewer manholes and chambers shall be in Concrete Class C20/25 and carefully formed to shapes and forms as shown on the drawings. The benching shall be sloped towards the channel at a gradient of 1 in 20.

The wall thickness of manhole’s/chamber’s shall be at least 25 cm. The bottom slab shall be at least 25 cm thick.

All pipes entering and leaving manholes and chambers shall be laid soffit to soffit unless otherwise specified.

**Concrete quality**

Generally, concrete works shall comply to relevant standards issued by ИСРМ ТК 25.

The main standards are as follows (but shall not be limited to):

* МКС EN 1992 Eurocode 2: Design of concrete structures
* МКС EN 13670 Execution of concrete structures
* DIN 1045-3 Concrete, reinforced and prestressed concrete structures - Part 3: Execution of structures - Application rules for DIN EN 13670

Concrete mixes have to be in accordance with the following table:

|  |  |
| --- | --- |
| Characteristic compressive  strength (N/mm2) (28 days)  Maximum water/cement ratio  Minimum cement con­tent (kg­/m3)  Maximum size of aggre­gate (mm) | 35  0.55  350  32 |

Unless otherwise approved, blast furnace cement CEM III/B DIN 1164 shall be used throughout, according to National Standards and shall have maximum concentration of C3A (Tricalciumaluminat) 3%.

With regard to the expected loads the concrete should be impermeable to water (Penetration depth: ≤ 5 cm), resistant against “weak” chemical corrosion according to DIN 4030 and proof a high frost resistance.

The temperature of the freshly mixed concrete shall not fall below +5 C and not exceed + 30 C.

The quality control and the analysis of the required wet and hardened concrete parameter shall be carried out in accordance to DIN 1045. Tests shall be done in accordance to DIN 1048 Part 1 and 5.

**Testing of Concrete**

***Sampling***

The Contractor shall be obliged to take samples of concrete and make concrete cubes for testing purposes in accordance with the requirements outlined below.

Cubes for concrete sampling shall be 150 mm x 150 mm x 150 mm. The number of cubes to be taken for testing shall be as follows:

1. 1-3 cubes per load of concrete for loads of 4-6 m3;
2. 1-2 cubes for every 4 batches if each batch is of the order of 0.5 m3;
3. 1-2 cubes for every 10 batches, if every batch is less than 0.5 m3.

Samples shall be taken at the point of discharge from the delivery testing obtained. All concrete cubes taken shall be numbered for recording purposes.

The number of cubes made may be reduced if consistently satisfactory results are obtained or increased if additional tests are required as, for example, in the early stages of the Works. The Contractor shall be obliged to make, cure, store, transport, and test in compression concrete cubes in accordance with BS 1881. The tests shall be carried out in a laboratory. A record of such tests, identifying the test cubes with the part of the work executed, shall be kept by the Contractor on Site.

**Reinforcement**

Reinforcement steel shall be ribbed (in horizontal and vertical direction) with yield strength of 500 N/mm2 according to DIN 488. The concrete coverage of the reinforcement should be 4.0 cm. To fix the reinforcement in the forms during pouring of the concrete and ensuring the required coverage the Contractor shall use spacers.

**Formwork**

Formwork shall be sufficiently rigid and tight to pre­vent loss of mortar from the concrete-mix and to maintain the correct position, shape and dimensions of the fin­ished work. Formwork shall be constructed so as to be removable from the cast concrete with­out shock or dam­age.

* + 1. **Manhole Accessories**

**Access Covers and Frames**

Manhole cover and frame for sewer control manholes shall be shall be made of cast iron and comply with MKC EN 124. All covers shall be Class D400 for traffic, circular, with hinge - maximum opening to 130º, safety blocking at 90º, ventilated type, with sealed handling box, with anti-theft cover lock, with lifting rings integral with the frame. The covers shall be lockable.

Dimensions:

Clear opening: 610 mm

Frame depth: 100 mm, with anchoring slots

Frame/cover seating: Elastomer ring

The manhole covers shall be installed in a manner to prevent surface water runoff from entering.

Manhole covers and frames shall be constructed flush with the final ground level on roads and pavements, but they shall be 75 mm above final ground level elsewhere.

Each manhole cover shall be equipped with a galvanized steel mud pan according to DIN 1221 Form F with cross rod and four suspension legs resting on the elastomer ring. Compatible to the manhole cover, the mud pan should not impair the proper functioning of the cover.

* 1. **Cleaning of the site**

The Contractor is responsible for cleaning the site and the adjacent areas, complying with the provisions of the Local Authorities. After finishing all the work, the Contractor shall clean up the site, by removing any objects, soil heaps, obstacles, etc., which would cause inconvenience. The site should be free of rubbish, dust and dirt. The Contractor shall restore the site to the conditions existing prior to commencement of the Works.