THE HfISHEMITE KINGDOM OF JORDfIH

Ministry of Water and Irrigation

General Specifications

FOR

WATER MAINS & DISTRIBUTION SYSTEMS & APPURTENANCES

AMMAN - **1992**

GENERAL SPECIFICATIONS

FOR

WATER MAINS DISTRIBUTION SYSTEMS AND APPURTENANCES

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1 HE HASHEMITE KINGDOM OF JORDAN
WATER AUTHORITY
AMMAN GENERAL
SPECIFICATIONS
FOR
WATER MAINS DISTRIBUTION SYSTEMS AND APPURTENACES
SECTION 1 - GENERAL

1.1 Specifications :

The General Specifications cover the materials and works of civil engineering construction for water mains, distribution systems, pumphouses, water reservoirs and ancillary works.

Materials and works not covered by these specifications will be specified either in the Particular Conditions and Specifications or in the Bill of Quantities.

1.2 Particular Conditions and Specifications to Prevail :

In the event of any unforseen or unintended conflict between the Particular Conditions and Specifications and this Specification, the former shall prevail.

1.3 Location and Scope of Works :

The Site and Scope of the proposed Works shall be as delineated on the Drawings and set-out in the Particular Conditions and Specifications.

1.4 Contract Drawings :

The Contract Drawings shall be as set-out in the Particular Conditions and Specifications together with any other Drawings which may be issued by the Engineer during the currency of the Contract.

1.5 Works Included :

(i) General

The Contractor shall, unless otherwise specified herein, supply all materials, equipment, temporary works, piant and labour necessary to install, complete and maintain the works required under the contract.

The works shall include but not be limited to preparing the pipeline route including all setting out, etc., excavation of trenches and valve chambers to the requird dimensions for the transmission pipelines, distribution systems and house connections including extra excavation at joints and all working space for planking and strutting, etc., all works and temporary works necessary for maintaining the flow of traffic, provision of barricades, guards and warning lights, supply, lay and test the pipes, fittings, valves and coupling, construct all valve chambers and boxes, ducts, thrust blocks, anchors, etc., backfill and consolidate trenches, reinstatement of surfaces, remove surplus material, clean up site of work and maintain the whole works such that it may be handed over to the Employer in good condition and working order and in full compliance with the requirements of these documents.

The Contractor shall also furnish all equipment, tools, labour, materials, fittings, and specials required to make connections to the future mains and water distribution systems, house connections and to protect or rearrange the existing water distribution pipes, conduits, ducts, services or other structures, or to protect, transpose and rearrange subterranean and visible cables for electricity, telephone, etc., to demolish existing pipes and other structures when called upon to do so by the Engineer so that the whole works are delivered to the Employer in perfect condition and working order.

The Contractor shall also furnish all equipment, tools, labour and materials required for the levelling and fencing of the site and the construction of ground and elevated water reservoirs and pump houses together with all the civil works related thereto.

The Contractor shall supply all labour, supervision and technical services required for the work. All manholes, covers, pipes and fittings and other materials and items required shall also be supplied by the Contractor, and all materials and workmanship shall be in accordance with the requirements of this specification. In the event of any failure in respect of any tests carried out on any of the materials supplied by the contractor, the same shall be replaced or repaired to the entire satisfaction of the Engineer at the Contractor's expense.

(ii) Traffic.

The Contractor shall carry out at his own expense all protective works and strengthening of highways, streets and underground structures which may be found to be necessary in order to avoid damage from heavy loads and plant which the Contractor has to move when such work in considered necessary, and at least 2 weeks before the intention to undertake it, the Contractor shall submit all details and proposals for the consideration of the Authority and inform the Traffic Department, the Police and the Engineer and obtain their permissions.

The Contractor shall at his own expense maintain and make good any damage caused to highways, streets and underground structures by his vehicles, irrespective of any protective measure taken.

1 . b Temporary Contractor's and Engineer's Offices :

The Contractor shall provide offices for the use of his Agent and formen on the site in an approved position, all communications delivered at the Contractor's temporary Site Office shall be deemed as having been delivered to the Contractor's Formal Registered Address.

The Contractor shall also provide maintain separaie and proper offices for the Engineer and his representative on the site in an approved position.

The Engineer's office shall **not** be less than 32m2 floor area, shall have a minimum headroom of 2.4m and be divided into 2 rooms and shall have adequate car parking space.

The office shall have concrete floors and shall be water-tight, weather proof, properly ventilated adequately lighted, painted and fitted with secure lockable doors and windows and shall be furnished with 2 tables (1.40x0.80 meters) 8 chairs, 2 cupboards.

The office shall be cleaned by the Contractor daily and the Contractor shall provide drinking water, heating and lighting if required, all at his own expense. 1 .7 **Safety and Accommodation for Contractor's Staff :**

The Contractor shall ensure that all safety and welfare measures required under or by virtue of the provisions of any enactment or regulation are strictly complied with.

The Contractor shall provide and maintain suitable and sufficient shelters and mess rooms for his workmen and supervisory staff as are customary and necessary.

The Contractor shall provide at all construction sites sufficient closets or latrines to the satisfaction of the Government Medical Officer. They shall be properly screened and maintained in a clean and sanitary state at all times.

Camps for workmen, if provided, shall comply with all relevant Government Regulations and shall be laid out in an approved and orderly manner. Proper provision shall be made for the disposal of all waste and refuse, and there shall be an adequate supply of water for washing cooking and drinking purposes . Sleeping quarters shall be properly ventilated and lighted, and the whole camp shall be maintained and cleaned at all time to the satisfaction of the Government Medical Officer.

1 . 8 First Aid Outfits :

The Contractor shall provide and maintain for the duration of the Contract adequate first aid outfits at each construction site.

1.9 Precautions against Contamination of the Works :

The Contrator shall satisfy the Engineer that all his personnel working on the Site are medically fit to be in contact with a public water supply and his personnel shall undergo any necessary medical test to show that they are free from any infectious diseases and are not carriers of any such diseases.

The Contractor shall at all times take every possible precaution against contamination of the Works. The Contractor shall give strict instructions to all persons employed by him to use the sanitary accommodation provided.

Throughout the Contract the Site and all Permanent and Temporary Works shall be kept in a clean, tidy and sanitary condition.

The Contractor shall at all times take measures to avoid contamination of existing water-courses and drains by petrol oil or other harmful materials.

The Contractor shall be responsible for making all arrangement for the disposal of waste water including the disposal of water from the water testing of mains on his own expense.

1.10 **Contractor's Yards and Stores :**

The Contractor shall make his own arrangements for all yards, stores, workshops, offices, etc., and for all services in connection therewith. The location of all yards, stores, workshop, offices, etc., shall be agreed beforehand with the Engineer's Representative and shall be such as to avoid obstruction and nuisance to the public.

1.11 Access **Roads :**

The Contractor shall construct and maintain such temporary access roads as he mayrequire for carrying out the Works at his own expense.

Immediately after ceasing to use any of the temporary roads the Contractor shall restore the road to the satisfaction of the Engineer and the responsible Authority or Owner. The provision of this Sub-Clause shall apply also to the shoulders and verges of any existing sealed road used by the Contractor and affected by his operations.

1.12 **Restrictions on use of Roads :**

The Contractor shall not run tracked vehicles or tracked plant on any public or private road without the written approval of the Engineer and the respnsible Authority or Owner and subject to such conditions as each may require.

The Contractor shall observe all weight and dimension restrictions which apply to roads and tracks in Jordan and he shall comply with all reasonable restrictions which may from time to time be imposed by the Engineer, Employer, Police, responsible Authority or Ownor.

1.13 **Flagging, Lighting, Watching and Traffic Control :**

The Contractor shall be responsible for watching and lighting and he shall comply with the requirements of the Employer and Police and the oompetent Authority in these matters.

1.14 **Setting out Reference Points :**

The Contractor shall set out and establish by means of suitable pegs, bench marks and reference points to grid lines necessary for the setting out of the Works.

Before the commencement of constructional work the Contractor shall establish at each site in a position to the approval of the Engineer, a steel datum peg which shall be securely concreted in. The level of this peg shall be established and agreed with the Engineer and all levels used in construction of the Works shall be referred to this established datum.

1.15 **Levels and Dimensions :**

The levels of the ground and the levels and dimensions of existing features shown on the Drawings are believed but are not guaranteed to be correct. Wherever dimensions or levels are marked on the Drawings such

dimensions or levels shall take precedence over dimensions scaled from the Drawing, and scaled dimensions shall be used only in the absence from the Drawings and/or elsewhere of other more precise information. Large scale drawings shall be taken in preference to drawings of a smaller scale.

1.16 Temporary Water and Electricity Supplies:

The Contractor shall be responsible and shall make all arrangements for an adequete supply of water to the construction site both for carrying out the Contract and as potable water for his workmen at his own expense.

The water shall be of a chemical and purity standard such that it will not pollute, injure or cause any deterioration of the Works, and it shall generally comply with the requirements specified. The Contractor shall make arrangements for and provide any electricity supply for the execution of the Works, and the Engineer's office facilities.

1.17 Survey Labour :

The Contractor shall provide all labour, instruments (theodolite, level,... etc) and materials as may be required by the Engineer's Representative for survey work in connection with the Work.

1.18 Signboards :

The Contractor shall provide, erect and maintain signboards having messages written in both Arabic and English languages, as prescribed by the Authority and installed at each site of work and at the office, or at such other places as directed by the Engineer, and remove the same on completion. The sign boards shall generally show the following :

Name of Authority
Name of Contractor
Name of Work
Date of Commencement
Date of Completion

The minimum size of signboards shall be 1.0 X 1.5 meters and the color scheme shall be red letters on white background.

1.19 Site Cleanliness :

The Contractor shall make every effort to keep his site in a clean and orderly manner. He shall not deposit his builders' refuse indiscriminately but shall arrange for all waste to be transported to an authorised tip. He shall not deposit his refuse into trenches in backfilling.

Public highways services, streets, paved paths, passages, pavements, etc., must be kept clean and free of spoil and rubbish and must be brushed and washed as required by the Engineer.

If the Contractor fails to keep his site clean then the Engineer will instruct a third party to carry out the work and the costs shall be recovered from the Contractor through the Contract.

1.20 **Protection of Work :**

The Contractor shall, at his own expense, case up and suitably protect all work liable to injury, either by the weather or by the method adopted for execution of the Works.

1.21 Programme and Methods of Working : i)

General.

The Contractor shall submit to the Engineer full details of his proposed construction programme within the period stipulated in the Contract. He shall also submit details both of the construction plant and iabour force which he proposes to employ and shall broadly describe his proposed construction methods.

The details of construction plant shall include the make, type, capacity or rating and the number of units. Details of the labour force shall include senior staff, trade of specialist categories indicating the proportion of local labour which the Contractor expects to employ and shall show the variation in staff and labour levels and their distribution throughout the duration of the Contract consistent with the programme.

ii**) Details of Work Programme :**

The Contractor shall furnish the following agreed details of his work programme to the Engineer and to local Authorities responsible for traffic and traffic control at the times and in the manner detailed below.

a . Within two weeks of the Order to Commence, an overall programme of work indicating the period of executing each section of work in or alongside highways including details of anticipated road diversions. At the same time he shall provide a more detailed programme describing his proposal for the first month of work.

b . Every one month , the Contractor shall submit the Engineer and the above Authorities a detailed programme describing the areas in which he proposes to operate for the following two monthly period including descriptions of proposed road diversions.

c . Before commencing any new section of work the Contractor shall have obtained the formal approval of the above mentioned Authorities. The procedure leading to such approval is described as follows :

1 . The Contractor shall first discuss with and obtain the approval of the Engineer for the proposed working methods for each section of work.

2 . The Contractor shall then submit to the relevant Authorities as agreed with the Engineer notifications of his intention to commence work and give details of his proposals. The Contractor shall modify such proposed working methods if directed by the Authorities. Particular attention shall be given to the following :

— The diversion and control of traffic. Methods for dealing with and the crossing of other services.

— The reinstatement of excavated areas.

— The discharge of water from excavations.

— Public safety.

1.22 Sequence of Construction :

When preparing the programme of works as specified, the Contractor shall take account of the priority order described for various activities of the Work.

Continuous Working :

If in the opinion of the Engineer, it is necessary for the safety of the Works or for any other reason, the Contractor shall carry out any part of the Works continuously by day and by night when so instructed in writing by the Engineer.

Limits and Restrictions to Working Site :

Gernerally, working sites shall be confined by physical restricitions and the maintenance of accesses and traffic flow. The Contractor shall agree on the extent of his working areas with the Statutory Authorities and the Engineer. **Other Construction Activities :**

There may be other construction activities proceeding in the Contract Area apart from those associated with the Works.

The respective statutory authorities for water, telephone andelectricityhave plans for the laying of their services and the Contractor is warned that other construction work may be carried out during the course of the Contract.

The Contractor shall cooperate with the concerned Authorities and Contractors carrying out work in the streets as for example for telephone and electric cables, road work, etc., which may be under construction. No claims by the Contractor for obstructions met with owing to other Contractors will be considered.

Commencement of Works :

The Contractor shall commence the works on site within the period stated in the tender after the receipt by him of an order in writhing to this effect from the Engineer and shall proceed with the same with due expedition and without delay.

1.27 Notices of Commencement of Work Cooperation with Authorities :

Before commencing any excavation the Contractor shall :

a . In railway, public highways, footways or verges, give two weeks notice to the Engineer, and shall also give such notices to the authorities as are required by the official regulations and shall not break open the road, footway or verge until receipt of approval from the concerned authorities. Cooperation shall be maintained with the Police and Local Authorities regarding the control and diversion of vehicular and pedestrain traffic as may be necessary.

b . In private lands or roads, give all necessary notices and make timely and reasonable arrangements with the occupiers before entry on the land.

c . Give notices to the Governorate of Amman, the Municipality Tele-communication Corporation the Electric Company and the Army of work which may affect their cables, manholes, etc., The Contractor is not allowed to break any cable or manhole without the written permission of their owener. The Contractor's attention is also draw to his responsibility to obtain approval by the Coordination Committee as described.

1.28 Standards :

All materials used and provided under this contract shall be in accordance with the latest edition of the standards stated.
Where no such standards exist, as for example in the case of patents or special materials, all such materials and workmanship be of the best quality and subject to written approval by the Engineer.

Although British and American standards for workmanship, material, and equipment have been selected in these specifications as a basis of reference, other recognized standards and specifications will be acceptable provided they are substantially equivalent to the designated standards and provided furthermore that the Contractor submits for approval detailed specifications which he proposes to use.

1.29 Late Submission For Testing :

It shall be the Contractor's responsibility to ascertain which materials and articles are required to be tested and to present such materials and articles or samples or specimens thereof for testing. Should there be doubt as to whether any material or article is required for testing the Contractor shall seek clarification from the Engineer and the Contractor will be entitled to no claim whatsoever for delay or any other cause arising from the rejection of materials or articles which the Contractor omitted to submit for testing.

It shall further be the Contractor's responsibility to prepare samples and specimens and submit for testing well in advance of the time the materials or articles will be required for use. The Contractor shall not be entitled to any compensation nor shall any claim be accepted by the Employer in respect of delay, inconvenience, damage, standing time or any other cause whatsoever, arising from or consequent on late submission of materials or articles for testing.

1.30 Contractor's Representatives :

Full information shall be given in the tender about age, theoretical education and practical training of the supervisors to whom is intended to entrust the performance on site of the works. Change of supervisors is not allowed without the written approval of the Engineer.

The Contractor will be required to send one or more qualified Engineer to all meetings with the Employer, the Engineer or other parties at which his attendance is deemed necessary by the Engineer. Such Engineer(s) must have the authority to act on behalf of Contractor and will be expected to take part in relevant discussions and

decisions. All decisions given to or by the said engineer(s) will be deemed to have been given to or by the Contractor and all ensuing action will be based on these decisions and no claims on the part of the Contractor will be entertained on account of misinterpreted or misunderstood decisions or instructions.

Should the Contractor fail to send engineer(s) any meeting at which his presence has been requested, all decisions shall be taken and instructions given as if the Contractor had been present and subsequent actions and orders based as aforesaid.

. 3 1 Traffic Diversions and Control :

i . Traffic Diversions.

Traffic diversions shall be planned by the Contractor with the Engineer, the Traffic Section of the Public Works Directorate and the Traffic Directorate of the Ministry of the Interior. No diversion shall be implemented without the written consent of the Engineer. Access to a closed road shall be made available to any vehicle of the emergency services, ii . Traffic Signs.

The Contractor shall provide, erect and maintain on the Site and such locations on the approaches to the Site, as may be required by the Traffic Directorate and/or the Engineer, all traffic signs and traffic control signals necessary for the safe direction and control of traffic. This shall apply whether the Site is in or immediately adjacent to the carriageway such that normal passage of traffic is affected.

The size of all such signs and the lettering thereon shall be approved by the Engineer before erection of the signs. All signs shall have directions written in both Arabic and English and shall carry direction arrows where appropriate. The signs shall be reflectorised or adequately illuminated by night in a manner approved by the Traffic Directorate and/or the Engineer and kept clean and legible at all times. The Contractor shall reposition, cover or remove signs as required during the progress of the Works.

Wherever single file traffic is necessary on a highway by reason of the construction of the Works, the Contractor shall provide and maintain a minimum carriageway width of 3 meters or wider where necessary as so instructed by the Engineer. Maintenance of Flow :

1.32

The Contractor shall, at his own expnese, maintain the flow in all sewers, drains, water mains and all water courses which may be met within construction of the Works, allowing none of the sewage to flow in the trench or the sewers constructed under this contract, except by permission of the Engineer. **Permanent Support of Kxising Pipes :**

1.33 When requested by the Engineer permanent concrete beams or other continuous support shall be provided for pipes
1.34 crossings-trenches, septic tanks or other excavations. The supports shall be acceptable to the owner of the existing
1.35 pipe or in lieu of other specific requirements shall be as shown. **Railway Crossings :**

Where it is necessary to install sewers or water pipes across railway tracks, the installation shall be made in accordance with the requirements of the Railway Authority at no extra coast. The Contractor shall make the necessary arrangements with the Railway Authority for the crossing and shall schedule his operations so as to avoid interference with railway operations.

Time Schedule :

The Governor of the Governorate conerned has appointed a Committee responsible for the corrdination of excavations and construction works in the streets of the municipaleties in his Governorate.
This committee consists of representatives from the Authorities concerned with this type of constructional works and the negative effects of the same, e.g. hindrance of traffic, inconvenience to citizens, etc. The committee is enabled by means of Governor's decree to order changes of time schedules»when deemed necessary. Any contractor working in the Governorate is obliged to provide successive plans and time schedules for actual parts of his works to the committee for consideration or a minimums of 2 weeks before commencement of the works and will not be permitted to commence until approval is obtained from the committee.
The Contractor thereafter shall contact the Police Authority for traffic arrangements in compliance with the approved plans and time schedules.

1.36 Inspection :

i. Inspection of Site.

The Contractor shall be deemed to have inspected and examined the Site and its surroundings and to have satisfied himself before submitting his Tender as to all matters relative to the nature of the site, details and levels of existing services, the quantities and nature of the work and materials necessary for the completion of the works, the means of access to the Site and the accommodation he may require, and in general to have himself obtained all necessary information as to risks, and other climatic hydrological and natural conditions or such contingencies which may influence or effect his Tender. No claim will be entertained in this connection, ii **. Shop Inspection.**

All materials furnished by the Contractor shall be subject, at the discretion of the Engineer, to inspection and approval at the plant of the Manufacturer. The Contractor will pay the cost for the Employer representative's attendance at the inspection.

iii **. Inspection of Adjacent Structures.**

Buildings and other structures in such close proximity to the trenches that they may be damaged by excavation and other work shall be inspected before work is commenced. All parties concerned shall be summoned to the inspection by the Contractor. The inspection shall be made by the Engineer and the Contractor together and the Contractor, at his own expense, shall set out an inspection report. The report shall describe the conditions of the buildings or plants in question. Any failure or damage caused by the excavation, shall be repaired and maintained by the Contractor at his own expense without delay.

iv **. Final Inspection of Works.**

Upon the request of the Contractor items that are completed will be finally inspected by the Engineer. The Contractor shall hereby provide at his own cost all facilities and labour required for the proper inspection. All work will be checked so as to meet with the specifications given in the Contract Documents, all streets in the contract area may be inspected by the municipality and test may be carried out to verify that the surface restoration has been completed in accordance with the Specification of the Municipality.

All restoration work not accepted by the Municipality, whether due to poor workmanship, settlement of trenches or damage to asphalt surface by the Contractor's heavy equipment shall be rectified by the Contractor at his own expense before the provisional handing over certificate is issued.

v. Inspection During Maintenance Period.

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The Engineer shall give the Contractor due notice of his intention to carry out any inspections during the] period of maintenance and the Contractor shall thereupon arrange for all necessary equipment labour, etc.,] and for a responsible representative to be present at the times and dates named by the Engineer. This I representative shall render all necessary assistance and take note of all matters and things to which his atten-1 tion is drawn by the Engineer.

1

1.37 Location of Existing Underground Utilities.

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i. The Contractor shall be responsible for the determination of the locations of existing underground utilities, I septic tanks and other obstructions which will be affected by his work. He shall take all necessary steps to I determine from the Municipality, the Electric Company, the Telephone Company and others the location of 1 their underground utilities. He shall locate these facilities sufficiently in advance of his construction opera-i tion to help to minimize the possibility of damaging them during excavation and installation of the pipelines 1 and/or house connections and the subsequent disruption of service. (Modern detection equipment,! satisfactory to the Engineer, shall be provided to facilitate the location of existing underground facilities). I

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li . The Contract Drawings do not show the location of existing sub-structures, septic tanks, and utilities along the route of the pipeline. In case any of the above utilities or sub-structures intercept the pipe line route, the Engineer shall have the authority to change the plans and order a deviation from the line and grade (or arrange with the owners of the structures for removal, relocation or reconstruction of the obstruction) at the Contractor's expense.

If the change in plans result in change of the length of pipes to be executed by the Contractor, such altered work shall be done on the basis of payment to the Contractor for extra length or credit to the Employer for less work. No payment will be made for extra valve chambers, excavation or backfilling or depth of line due to these changes. 1.38 **Pipelaying in Public Roads.**

Notwithstanding requirements stated elsewhere in the Specification, the Contractor shall comply with the additional requirements contained in this Clause whenever carrying out any work in connection with pipelaying in or adjacent to public roads.

The Contractor shall at all times carry out any work in or adjacent to public roads in manner to the approval of the Engineer and the competent Authorities and only at such times and during such hours as may be agreed by the competent Authority.

At no time shall the Contractor commence work in or adjacent to any public road without the prior approval of the Engineer.

The Contractor shall, when working in or adjacent to any public road, cause the least interference possible to the flow of traffic and shall at all times, except during blasting operations, maintain unimpeded sufficient width of the carriageway, at no time less than 3m, to permit single lane traffic.

The Contractor shall control the flow of traffic past restrictions caused by his operations by means of electrical controlled traffic lights positioned ahead of and behind the restricted section of road. The traffic lights shall be to the approval of the Engineer and be lit at all times and for as long as any restrictions caused by the Contractor's operations exist. Traffic lights shall be continuously attended by flagmen and the time interval between light changes shall be capable of adjustment to suit varying patterns of traffic flow. Warning signs shall be posted well in advance of any section of restricted road.

All sections of roadway affected by the Contractor's operations shall be bounded by barriers, tapes, bunting or similar means to afford adequate and effective warning to all road users. Such boundaries shall in addition be adequately lit by warning lanterns at all times during the hours of darkness.

The Contractor shall at no time string pipesonthe carriageway of any public road.

The Contractor shall arrange his work in or adjacent to public roads in such a way that at no time the length of road restricted by his operations exceeds 50 meters. 1.39 **Record Drawings :**

As the work proceeds the Contractor shall make Record Drawings based on the Contract Drawings as modified to portray the Works as actually constructed. Drawings shall be supplemented as necessary by schedules, data sheets, etc.

Draft records shall be submitted to the Engineer's Representative for his approval and then finalised in accordance withany amendments required by him.

On completion of Works the Contractor shall prepare at his own expense, record drawings of the Worksas executed which shall show clearly all affected portions of the Works, in plan and profile and also all deviations from the original drawings. The Contractor shall supply to the Engineer the originals and three (3) copies of such record drawings of the works before any portion or the works may be considered as substantially completed.

1.40 Contractor to Verify all Documents :

a . The Contractor shall before pricing the Work check all Drawings, Specifications and Bill of Quantities and satisfy himself by meausrement, enquiry or otherwise as to their accuracy.

b . It shall be the responsibility of the Contractor to satisfy himself as to the Correctness of the Quantities of materials to be supplied and amount of works to be carried out before submitting his fixed bid price.

c . The Contractor shall notify the Engineer of any ommissions, errors or discrepencies found in the Specifications, Drawings, or Bill of Quantities prior to submitting his tender and shall include in his Fixed Bid Price for the particular section of the Works described in the Bill of Quantities and the cost of any materials and works missing or which have been over-looked in the preparation of the Tender Documents and which are necessary for the proper completion of work.

d . Ommissions from the Drawings or Specifications or the incorrect description of details of work which are evidently necessary to carry out the intent of the Drawings and Specifications, or which are customarily performed, shall not relieve the Contractor from rectifying such omissions and details of work, but they shall be performed as if fully and correctly set forth and described in the Drawings and Specifications.

1.41 **Bill of Quantities and Bid Prices.**

a . The Contractor shall, after a thorough and careful study of all the required works comprised in the various sections of the several Documents of the Contract, make an assessment of the amount of all the works so comprised and shall quote in the Bill of Quantities a Fixed Bid Price for each of the various items of Works described, which price shall be binding subject to the relative Clauses of the Contract.

b . The Bid Prices inserted in the Bill of Quantites are the full inclusive of the value of the Works described under the several items and shall cover, by way of illustration but not limitation, the cost of all labour, sub-sistence, **travelling, materials, fittings, temporary works, constructional plant, watching and lighting, overhead charges and any other expenses whatsoever together with all** risks, **liabilities and obligations setforth or implied in the Contract Dorcuments. The Bid Prices shall also include for all ancillary and other work facilities and services relaring to the construction of the water supply system, valves, valve boxes and chambers, cleaning and tidying of the Site on Completion and all that is required to handover the Works and surrounds complete in every respect and ready for immediate use in accordance with the Drawings, Specifications, Bill of Quantities and other Tender Documents to the full satisfaction of the Engineer.**

1.42 Line Detectors :

Reinforced Concrete posts. 20 cm X 20 cm X 150 cm and exposed 100 cm above ground level, painted black and white marked with the diameter and depth of the pipe. Shall be placed 500 meters apart along the pipeline.

Similar reinforced concrete posts painted red and white shall be placed over the valve champers.

SECTION 2 - EXCAVATION AND BACKFILLING

2.1 Conditions of Site and Alignment of Pipelines .

The pipelines shall be laid and maintained to the required alignments and grades with fittings, valves, hydrants, valve chambers, etc., at the required locations.

Before carrying out any work on any site, the Site shall be inspected by the Contractor in conjunction with the Engineer's Representative to establish its general conditions and to fix the alignment of the pipelines which shall be agreed and recorded in writing.

2.2 Clear and Grade the Pipeline Route :

The Contractor shall include for clearing the route of the pipeline of all surface obstructions, grading the route to provide access for his equipment and personnel, executing all cuttings to remove the high point of rises in terrain and in all respects prepare the route for pipe laying operations, all in accordance with the requirements of good pipeline construction practice.

2.3 Excavation for Pipes :

a . Unless otherwise shown on Drawings or instructed by the Engineer, pipelines shall be laid in trenches with a minimum cover of 70 cm for steel pipes and 100 cm for ductile iron pipes or as is necessary or in structed by the Engineer to secure proper alignment.

b . The bottom of the trenches shall be properly trimmed off, bottomed and prepared to provide a firm and uniform bearing throughout the entire length of the pipe. Care shall be taken to prevent excavation below the grade of the bottom of the pipe, and portions of trenches excavated below the grade shall be filled with suitable material and thoroughly compacted in layers of 15 cm. by the Contractor at his own expense.

c . Where rock is encountered, the excavation shall be carried below the bottom of the pipe for a distance of 15 cms. which shall be back-filled with earth or clay tamped to the proper grade.

d . Where pipe trenches are excavated across or along asphalted roads, side walks, stairs and pavements, the Contractor shall carefully break the asphalt, stairs and Pavements, remove the hardcore and paving tiles and store them for re-use. The excavated materials shall be deposited on the side of the trench farthest from the road metal and shall in no way obstruct the traffic or interfere with the flow of water in any gutter, drain, pipe culvert,ditch or water way. When excavated materials are deposited on or along a public highway, the Contractor shall provide and maintain free access to all adjacent properties. All excess excavation shall be immediately removed from the right-of-way and disposed of as directed by the Engineer.

e . Hand excavation must be applied where existing cables, water mains, sewers, etc., cross or are in the main roads where traffic is likely to be unreasonably dislocated by use of machine or where instructed by the Engineer. In other places hand or machine excavating may be employed at the discretion of Contractor.

Excavation by machine must not normally be deeper than 15 cm above the grade, unless the Engineer decides otherwise. The Contractor will be held responsible for making good at his own cost all additional damage to road surfaces and private lands caused by the use of mechanical excavators.

2.4 **Width of Trenches :**

The width of the trench shall be ample to permit the pipe to be laid and jointed properly, and the backfill to be placed and compacted as specified.

Unless otherwise shown on the Drawings or instructed by the Engineer the minimum width of trenches for the pipes of 150 mm diameter and above shall be equal to the pipe diameter plus 40 cm for steel pipes and 60 cm for ductile iron and concrete pipes, and shall be 50 cm for all kind of pipes less than 150 mm in diameter.

Trenches shall be of such extra width, when required, as will permit the convenient placing of timber support, sheeting and bracing and handling of specials.

Separate excavations are to be made for manholes, valve chambers, pipe junctions, etc,.

2.5 Care of Surface Material for Re-use :

All surface materials as e.g. top soil, road material, and tiles which in the opinion of the Engineer, are suitable for re-use in restoring the surface shall be kept separate from the general excavation material, as directed by the Engineer. 2**.** b
Drainage of Trenches :

The Contractor shall be responsible for the evacuation from the excavations of all surface and sub-surface water. He shall at his own expense bail and/or pump out all water or sewage which may arise or be brought into excavations of any kind from existing drains and water courses and shall where necessary throughly drain the works.
Pumping, However, if recoursed to, shall be done in such a way as not to disturb the condition of excavations.

2.7 Excavation in Poor Soil and Refilling to Grade :

Where the bottom of the trench at grade is found to be unstable or to include ashes, cinders, all types of refuse, vegetable or other organic material or large pieces or fragments of inoraganic material or for any other reason which in the judgement of the Engineer justifies that the bottom shall be removed, the Contractor shall excavate and remove such unsuitable material to the width and depth ordered by the Engineer.Before the pipe is laid, the fill up to grade shall be made by filling with an approved material in layers not exceeding 10 cm thick. The layers shall be thorougoly compacted as directed by the Engineer so as to provide a uniform and continuous bearing and support for the pipe at every point between joint holes. The finished grade shall be prepared accurately by means of hand tools.

The Contractor will not be allowed any compensation for the additional work, for the extra excavation and the material ordered for backfilling.

2. 8 Exeavation in Rock :

The tender shall cover the whole cost of all excavation that is necessary in whatever type of earth strata or ground conditions which may be encountered, rock included. The tender shall cover all extra costs, which result from rock being encountered, including, not only the cost of excavation of the rock, but also the cost of removal and disposal of rock which is not suitable for backfilling and the provision, transport and placing of approved backfill material to take its place.

2.9 **Blasting :**

The Contractor is informed and shall in general assume that balsting and handling of explosives are restricted in Jordan and he shall price his Tender accordingly.

2.10 Braced and Sheeted Trenches :

The Contractor shall be responsible for upholding the sides of excavations. He shall, at his own expense, supply and fix all required shuttering for the support of the sides of the excavation, for the security of adjacent structures and for every purpose for which it may be required and he shall maintain the same until in the opinion of the Engineer the work is sufficiently advanced to permit withdrawal of the shuttering.

The Contractor shall be responsible for any damage caused to roads, mains, cables, pipes, sewers, etc., during the execution of the work. When close sheeting is required, it shall be so driven as to prevent adjacent soil from entering the trench either below or through such sheeting. Where sheeting and bracing are used,the trench width shall be increased in order to maintain the required minimum width between the sheeting.

The Engineer reserves the right to order sheeting driven to the full depth of the trench or to such additional depths as may be required for the protection of the work.

Where the soil in the lower limits of a trench has the necessary stability, the Engineer, at his discretion, may permit the Contractor to stop the driving of sheeting at some designated elevation above the trench bottom. The granting of permission by the Engineer, however, shall not relieve the Contractor in any degree from his full responsibility under the contract.

Trench bracing must be removed when the backfilling has reached the respective levels of such bracing. Sheeting must be removed after the backfilling has been completed or has been brought up to such an elevation as to permit it safe removal.

The cost of furnishing, placing and removing the sheeting and bracing shall be included in the price bid for the work.

2.11 **Disposal of Excavated Material :**

All excavated material shall be piled in a manner that will not endanger the work or any buildings, structures or property and that will avoid obstructing sidewalks and driveways, and cause the minimum or obstruction to traffic generally.

2.12 **Barricades, Guards and Safety Provisions :**

To protect persons from injury and to avoid property damage, adequate barricades, construction signs, torches, red lanterns, and guards as required shall be placed and maintained during the progress of the construction work and until it is safe for traffic to use the road. All materials, stock-piles, equipment and pipes that may serve as obstructions to traffic shall be enclosed by fences or barricades and shall be protected by proper lights. Safety rules and regulations of local authorities shall be observed.

The Contractor shall comply with regulations relating to the placing of danger signals, lights or flares. In the absence of such regulations, the Contractor is to place danger signs visible during day-light and red lanterns or flares visible during darkness at least 50 (fifty) meters from excavated road crossings in both directions of traffic. Danger signs are to be in Arabic and Engilish and must be recognizable at 30 (thirty) meters .

Should the Contractor fail to erect any barrier, safety guards, signs, lights or any other danger signal or protection after being requested to do so by any authorized person or body, the Employer shall erect such signs and barriers etc., which he considers necessary for the safety of the works and the public at the Contractor's expense .

2.13 **Maintenance of Traffic and Closing of Streets :**

The Contractor shall carry on the work in a manner that will cause the least interruption to traffic and he shall not close nor partly close any road or street without a written consent of the Authorities, the Police and the Engineer .

After such consent, the Contractor shall, at his own expense, provide means of access to all buildings, rights of way, etc., warnings and danger signs, lights, barricades and diversion notices .

All road crossings shall be in open-cut, adequately shored and timbered, with arrangements to maintain the flow of traffic as directed by the Authorities and the Police .

Special attention shall be given to the backfilling of road crossings and the Contractor shall repair and replace road surfacing material of like kind and quality, maintain and make good all such works as directed by the Engineer .

The Contractor, shall, in all respects, comply with the requirements of the Authorities, the Police and the Engineer. Except as provided above, the Contractor shall at all times maintain free passage over all roads for all traffic .

1.14 **Structure Protection :**

The Contractor shall be responsible for the care and protection of all existing sewer pipes, water pipes culverts, or other facilities and structures which may be encountered in or near the area of his work. Temporary support, adequate protection, and maintenance of all underground and surface structures, drains, sewers, and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his expense and under the direction of the Engineer .

Any structures that have been disturbed shall be restored upon completion of the work .

In the event of any damage to the existing facilities and services during the progress of the work and of the failure of the Contractor to exercise the proper precautions, the Contractor will be held liable for the cost of all repairs and protection to said facilities and services .

2.15 **Interruption of Service :**

No valve or other control on the existing system shall be operated for any purpose by the Contractor. The Employer will operate all valves, hydrants, blow-offs, and kerb stops etc., which may be necessary during the course of the .works. The Contractor shall give the Employer notice at least three working days in advance of such operation .

BACKFILLING

2.16 **General :**

Excavations shall be backfilled without unnecessary delay, but not until pipes and construction details have been inspected, tested and approved by the Engineer. All necessary precautions shall be taken during backfilling to ensure that pipes and construction details are not damaged .

The Contractor shall provide necessary testing equipment for control of compaction .

2.17 **Backfill Material :**

Backfill material which, in the opinion of the Engineer, is unsuitable shall not be used. From the bottom of the trench to at least 30 cm above the crown of the pipe the backfill material shall be such that it will not cause damage to the surface of the pipes .

2.18 **I'se of Kxcavated Material as Backfill :**

file Contractor may backfill with the excavated material provided that such material meets with the approval of the Engineer. If there is a deficiency of backfill material due to rejection of the excavated materi;:' for use as backfill as e.g. when excavating in rock, the Contractor shall furnish the required amount of appiowu material at his own cost .

2.19 Backfilling under and over pipe :

All trenches shall be backfilled by hand from the bottom of the trench to a level of 30 cm above the top of the pipe, with approved material, screened with 15 to 30 mm mesh width as directed by the Engineer, placed in layers not exceeding 10 cm, watered to optimum moisture and well compacted by tamping. Compaction beside the pipe shall be with handtampers of 3" x 2 " bottom size and to a dry density not less than 90 per cent of the dry density according to heavy compaction test (B.S. 1377). From the top of the pipe and 30 cm up ordinary hand-tampers may be used. Backfilling material shall be deposited in the trench for its full width on each side of the pipe, fittings and appurtenances simultaneously .

2.20 **Backfilling to Surface :**

From 30 cm above the pipe to the finished ground level shown on the drawings or specified elsewhere, the trench shall be backfilled and consolidated by approved mechanical methods in layers with a thickness not exceeding 20 cm for the first layer and 50 cm for the following layers each layer to be compacted separately. In roads the dry density of the compacted soil shall not be less than 95 per cent of the dry density found after laboratory test of the soil applying the heavy compaction test in accordance with B.S. 1377. If necessary to obtain the required density, and with the permission or instruction of the Engineer, the trench shall be watered during backfilling and compaction operations. For this purpose a safe amount of water shall be available at hte trench when backfilling.

2.21 **Backfilling under Roads, Pavements and Paved Areas :**

Where excavation is made through roads, highways, pavements, curbs, sidewalks or any paved or pedestrian areas, the trench shall be backfilled and thoroughly compacted to the requirements of clause 2.20 hereof. The backfill shall be replaced in the same sequence of layers as it was removed, unless otherwise directed by the Engineer, up to the underside of the subbase or foundation of the road or highway, etc. The Contractor shall furnish at his own cost the required amount of approved material should a deficiency of backfill material occur due to rejection of excavated material. The surface shall be reinstated in accordance with the requirements of the appropriate and relative clauses of the Specifications.

2.22 **Backfilling where Settlement is Unimportant :**

The Contractor may backfill the trench from 30 cm above the pipe to the top of the trench with the excavated material, if approved and without compaction provided that the requirements of all other clauses of this chapter are complied with, and the backfill shall be neatly rounded over the trench to a sufficient height to allow for settlement to grade after consolidation .

2.23 **Removal of Surplus Material :**

The Contractor shall, immediately after the excavations have been filled in and embankments completed, remove and clear away all surplus material and transport and deposit it at a place within the boundary of the city as directed by the Engineer .

2.24 **Embankments, Earth Filling and Made-up Ground :**

If no suitable material is available for filling on the site, the Contractor must supply it from elsewhere at his own expense. Filling shall be carried out in such a way and to such extra height as to ensure that the final surfaces will conform with the levels called for in accordance with the Particular Specification and the Drawings when the filling has settled .

2.25 **Settlement of Ground :**

Should any subsidence or movement of earth occur at or close to any place where the Contractor has excavated or filled at any time during the maintenance period, the Contractor shall within 48 hours carry out at this own expense all necessary repairs and reinstatment which may be required as a result of such movements .

REMOVAL, RESTORATION AND MAINTENANCE OF SURFACE

2.26 **Removal of Pavement :**

The Contractor shall remove pavement and road surfaces as a part of the trench excavation, and the amount removed shall depend upon the width of trench specified for the installation of the pipe and the width and length of the pavement area required to be removed for the installation of valves, fitting, valve chambers, thrust blocks, manholes, or other structures. The width of pavement removed along the normal trench for the installation of the pipe shall not exceed the width of the trench specified by more than 15cm on each side of the trench. The width and lengths of the area of pavement removed for the installation of valves, fittings, valve chambers", thust

blocks, manholes, or other structures shall not exceed the maximum linear dimensions of such structures by more than 15 cm on each side. Wherever, in the opinion of the Engineer, existing conditions make it necessary or advisable to remove additional pavement, the Contractor shall remove it as directed by the Engineer but shall receive no extra compensation therefore. The Contractor shall use such methods, either drilling or chipping, as will assure the breaking of the pavement along straight lines. The face of the remaining pavement shall be approximately vertical.

2.27 Restoration of Damaged Surfaces and Property :

If any pavement, trees, shrubber, fences, poles, or other property and surface structures have been damaged, removed, or disturbed by the Contractor, whether deliberately or through failure to carry out the requirements of the contract documents, state laws, municipal ordinaces, or the specific direction of the Engineer or through failure to employ usual and reasonable safeguards, such property and surface structures shall be replaced or repaired at the expense of the Contractor. If the Employer specifies that the replacements or repairs shall be made by the Contractor, he shall replace or repair and restore the structures to a condition equal to that before the work began and to the approval of the Engineer and shall furnish all incidental labour and materials.

2.28 Replacment of Pavements and Structures by the Contractor :

Unless otherwise shown on Drawings the Contractor shall restore all pavements, sidewals sidewalks, Kerbs, gutters, shrubbery, fences, poles, sod, or other property and surface structures remvoed or distrubed as a part of the work to a condition equal to that before the work began, and shall furnish all incidentals labour and materials. No permanent pavement shall be restored unless and until, in the opinion of the Engineer, the condition of the backfill is such as to properly support the pavement and not before written approval from the Engineer to commence such works.

Streets and sidewalks in Amman are generally constructed in one of the following manners: Type 1
- Roads

Pitching 20 cm layer, blinded
Gravel 3-7 cm (Sarar) in 10 cm layer
Grouting Ac 80/100 4 kg/sq.m
Blotting with 20-25 mm gravel (Fulieh)
Tack coat AC 80/100 0,5 kg/sq.m
Bituminous plant mix 6-12 cm layer

Type 2 - Paved passages less than 3,0 m wide

Pitching 20 cm layer

Plain Concrete 1 : 3 : 6 mix 10 cm. thick layer

Type 3 - Asphalted sidewalks

Pitching 10-15 cm layer
Plain Concrete 1 : 3 : 6 mix 10 cm. thick layer Sand asphalt 3-5 cm thick layer.

Type 4 - Tiled sidewalks

Pitching 10-15 cm layer.
Plain Concrete 1 : 3 : 6 mix 10 cm. thick layer
Tiles set in cement-mortar 1 : 3

The tender shall cover for a reinstatement of roads surfaces and pavements according to the above types as specified on the drawings or if the Engineer deems it suitable, it shall be of the same kind and quality of the existing. Reinstatement of pitching may, however, he made with a layer of macadam of the same thickness as that of the pitching. Where the original construction and the reinstatement is not specified the tender shall cover for a reinstatement according to type 1 above.

2.29 Preparation of Road Foundation :

The road foundation shall be carefully reformed with all the road material removed and set apart during excavation. During the replacement of the existing road material and the placing of the wearing surface the whole shall be compacted with suitable power driven roller (8 to 10 tons for roadways and 1^-/v—1 tons for footpaths).

In case of asphalted road the backfill shall be brought up to the required level leaving the necessary space for hard-core and the asphalted layer. Both the hard-core and the asphalted layer shall be thoroughly compacted as specified above.

In restoring asphalted surfaces in roads, the top of the asphalt shall be rounded over the trench slightly higher than the street level to allow for subsequent settlement.

In case of unmetalled roads the compacted backfill shall be brought slightly higher than the street level to allow for any possible settlement.

Where the Engineer considers that the material found in the existing road or footpath foundation is insufficient for the satisfactory reinstatement of the foundation, the Contractor shall, if so instructed, add such additional approved hardcore or foundation material as may be necessary. Required amount of approved materials shall be furnished at the Contractor's own cost. The Contractor is informed and shall assume that removed pitching stone is unsuitable for reuse and shall provide in his tender price for removal of same and furnishing of new material. Where in the opinion of the Engineer the stability of the trench becomes unsatisfactory for the proper reinstatement of the road foundation the Contractor shall on receiving written instructions from the Engineer re-excavate the trench as may be necessary and refill with approved hardcore or other solid foundation material.

The standard specifications for construction of roads and bridges and up dating modifications published in 1974 by Ministry of Public Works (Jordan) should be used where applicable.

2.30 **Cleaning Up :**

After installation and backfilling of the pipeline and also after restoretion of surfaces, the Contractor shall clear the site and the surrounding ground and he shall dispose of all waste material, debris, and rock resulting from his operations. The Contractor shall restore the site and the surrounding ground as may be required by the Engineer.

All surplus pipe material furnished by the Contractor and all tools and temporary structures, huts, offices, stores, etc., shall be removed by the Contractor from the Site or depots whether owned by himself or by the Employer. All dirt, rubbish, and excess earth from the excavation shall be immediately hauled to a dump indicated by the Employer and the construction sites left clean and tidy to the satisfaction of the Engineer. All surplus pipe material furnished by the Employer and delivered to the site by the Contractor shall be removed and delivered by the Contractor to a location designated by the Employer. The Contractor is to leave the right-of-way in a condition suitable for vehicular traffic where applicable.

2.31 **Maintenance of Works :**

All material and labour required for the maintenace of the trenches and adjacent structures shall be supplied by the Contractor and the work shall be done in a manner satisfactory to the Engineer.

PAYMENT.

2.32 **Measurement and Payment :**

Unless otherwise specified in the Bid Schedule the excavation, bottomming, backfilling, compactions of pipe trenches and the reinstatement of roads, side walks and paved surfaces in accordance with the Specifications shall not be measured for direct payment but the cost of all these works shall be included in the Unit Bid Price for the supply and installation or the installation of the relative pipelines as the case may be.

SECTION 3 PIPE WORKS AND PIPELAYING

3 .1 Handling and Transport of Pipes :

a . The Contractor's arrangements for handling, lifting, transporting and stacking pipes, valves and specials, shall ensure that these articles are brought to their final place in the works undamaged and in good order.

Cranes and other appliances approved by the Engineer shall be provided wherever it is necessary to lift or lower pipes, valves and specials, such articles shall not be dropped and the Contractor shall provide the facilities and supervision necessary to ensure that the coating and lining of pipes and specials are undamaged and the ends of pipes prepared for jointing are not dented or distorted in transit or in storage.

b . The Contractor shall provide cranes for lifting and lowering pipes at the site of work and at the Storage Area of the Authority and wherever pipes are being handled.

For ductile iron pipes, slings of canvas, ruber belting or other nonabrasive material, or special fittings shaped to fit the pipe ends and approved by the Engineer, shall be used for lifting and lowering pipes and specials. Pipes shall not be lifted by hooks nor shall they be dropped or dragged.

c . Ductile iron pipes being transported, shall be supported on timbers, sand bags or padding arranged so that pipes do not rest on their sockets and adjacent pipes do not touch.

The height of the load for the various pipe diameters shall be as recommended by the Manufacturer and approved by the Engineer.

Each load shall be secured by ropes or other lashing arrangements so that pipes do not move or chafe, and suitable padding shall be used to ensure that the pipe coating is not damaged by these lashings.

f . Pipe specials shall be supported by sandbags or other padding and lashed down as described above so that they are not damaged during transport.

3.2 **Stacking of Pipes :**

a . The Supply Contractor shall properly stack the pipes in the storage yard of the Authority and the stacks shall be laid out in a regular pattern and the limits of each stack marked to that the movement of cranes and vehicles is restricted to access tracks between stacks and the control of delivery and removal pipes is facilitated.

b . The number of tiers of steel and ductile iron pipe stacks shall be as per the Manufacturer's instructions and approval of the Engineer and each pipe, including those in the bottom course, shall bear evenly upon not less than three timbers with an aggregate width not less that 300 mm. The pipes shall be stacked parallel to each other and arranged so that in each course all sockets are at one side and in the next course all spigots are on the other side .

The timbers supporting each course of pipes in a stack shall be of uniform thickness and stiff enough for the pipes to be rolled across the stack and shall be supplied by the Contractor at his own expense .

The outermost pipes in each course shall be secured against rolling by sandbags or by wedges .

c . Where the pipes are to be delivered and stacked by the Supply Contractor on designated sites lying on the pipeline route, unless it is otherwise specified elsewhere, the areas where the pipes are to be stacked shall, if required, be graded flat by the Supply Contractor at his own expense to provide a firm even surface, and kept free from loose stones, rubble or waste liable to damage the pipe coating .

3 .3 Materials supplied by the Employer :

a . In case the pipes and ancillary fittings, specials and valves are to be supplied by the Employer the latter shall supply to the Contractor free of charge at his stores or at the place indicated in the Particular Conditions

and Specifications, the required quantities of different pipes of various diameters together with the respective fittings,specials, adapters and valves as outlined in the Particular Conditions and Specifications and the Contractor shall load transport and unload the materials so supplied at the site of works and shall be responsible for proper unloading, stacking and storing .

b . The pipes shall be unloaded from the trucks in an approved manner and the Contractor shall take utmost care not to damage the pipes or any of the materials so supplied. Any damage caused to the materials in loading, transport and unloading at the site of works shall be repaired by the Contractor at his own expense in accordance with the Engineer's instructions and to his satisfaction .

Material irreparably damaged shall be replaced by the Contractor at his own expense or charged to his account .

The Contractor shall stack the pipes in a secure, sale and approved manner and in a way to allow easy handling .

d . Pipes found damaged before handling them over to the Contractor shall be counted and stacked by the Contractor separately each diameter aside and the damage of each pipe, shall be fully described .

Such pipes shall not be used in the works unless and until the Contractor has used all the sound pipes delivered to him and is so ordered by the Engineer .

e . The Contractor will be required to sign the vouchers tor the materials supplied to him, and shall keep proper stores book to show at any time the quantity of materials received and those which have taken from the Stores for use in the works. The Engineer or his representative shall ha\e the right to inspect at any time the store books, and to check the materials in the stores and on site of works to satisfy themselves that everything is in order and the Contractor will be required to account for any discrepancy found .

f . The Contractor shall at his own expense provide and constantly maintain day and night watching and shall be responsible for the theft or loss of any materials supplied to him by the Employer whether theft occurred from the stores or from the site of works. Any materials so found missing shall be immediately replaced by the Contractor at his expense .

g . On completion of works, the materials used in the works shall be counted and/or measured and the balance shall be handed over by the Contractor to the Employer at his indicated storage yard. The loading, transport, unloading and proper stacking of materials shall be carried out in accordance with the relative clauses of the Specifications and shall be at the Contractor's expense .

Any materials not accounted for shall be replaced by the Contractor at his own expense or shall be charged to the Contractor's account C.I.F site plus 20(r o as the Engineer deems it suitable . 3 .4 **Pipe Laying in Trenches :**

General .

a . In as much as possible pipeline shall be laid along the road in trencnes excavated and subsequently backfilled with a minimum cover and width of trenches as specified in Clauses (2.3) and (2.4) .

b . The pipe route shall be determined by the Engineer. The Engineer reserves the right to vary or abandon any part or parts of the routes of pipelines indicated on Drawings and the Contractor shall lav the pipes in accordance with any such variations which the Engineer may issue .

c . The Contract Drawings show the approximate lines and levels to which the pipeline is to be built and are subject to amendments by the Engineer on site. Before setting out any sections of the pipeline, the Contractor or his representative shall make an inspection of the site in company with the Engineer and obtain from him his instructions in this respect .

All pipes, curves, bends and other specials shall be laid accurately in accordance with the alignment, levels and gradients so determined, so that the top of the pipe is not less than the minimum specified depth below

the finished ground level along the pipline. Changes in gradient and the numbers of air valves and wash-out valves will be the minimum necessary to secure effecient operation and economy in excavation .

d . The Contractor shall provide the surveying instruments, surveyors, skilled staff and everything necessary for setting out the works to line and level and for checking the accuracy of pipe-laying and jointing . He shall attend upon the Engineer and provide him with such assistance as may be necessary to enable him to check the setting out of the works .

e . The finished pipeline shall run straight between bends or curves and a uniform gradient shall be accurately maintained between changes of gradient shown on the drawings or authorised by the Engineer .

f . The bottom of the trenches shall be graded and prepared to provide a firm and uniform bearing throughout the entire length of pipe and bell holes shall be provided. The Contractor shall inform the Engineer sufficiently in advance when the formation levels of the trenches are ready for inspection. No pipe laying will be allowed until the bottom of trenches have been inspected and approved by the Engineer and the depths of the trenches and the kind of excavation have been recorded and agreed upon by both the Contractor and the Engineer .

g . The pipe shall be positioned and bedded in the trenches in an approved manner and properly aligned. Before being positioned, each pipe shall be thoroughly examined to ensure that it is free from defects and shall have all dirt removed from the inside thereof. The Contractor shall cut the pipes if and where needed to the required length and shall thread, chamfer or bevel the cut ends of pipes as the case may be and shall supply and install all fittings, specials and adapters as may be necessitated for the proper execution of the works and shall joint the pipes in accordance with the Specifications and to the Engineer's Satisfaction .

h . Any injury to the protective coating of the pipes from any causes during the construction of the pipeline shall be repaired by the Contractor at his own expense to the satisfaction of the Engineer .

i . At the end of each day's work a strong wooden plug or iron disc shall be firmly fixed in each open end in order to exclude all foreign materials .

3 .5 Laying of Steel Pipes :

a . Galvanized steel pipes shall have screwed joints. When jointing threaded pipes all joints shall be made in accordance with the best practice and the threads shall be wrapped with approved lead free jointing Compound .

b . Black steel pipes shall be jointed to gether by electric fusion butt-welding, the welding shall be in accordance with A.P.I, standard 1104 or approved equal. The electrodes used shall be suitable for over head welding and shall deposit weld metal of not more than 0.2% carbon and shall be subject to the Engineer's approval .

c . The Contractor's welders shall pass welding tests as prescribed by the Engineer and no welder shall work on the pipes before passing the test and approved in writing by the Engineer .

d . After passing the prescribed pressure test the joints of all black steel pipes shall be coated with bitumen and properly wrapped with bituminous felt in accordance with the Engineer's instructions and to his satisfaction . 3 .6 **Laying of Spun Ductile Iron Pipes :**

a . When handling and/or placing large diameter ductile iron pipes, fabric slings shall be used at the balacing points and every pipe and fitting shall be thoroughly examined to ensure that it is free from defects and shall be rapped, while supported by the sling, with a light hammer to detect oracks .

b . The pipes shall be positioned and bedded in the trenches on the backfilled compacted and finished subgrade or directly on the undisturbed bottom of the trench and jointed in an approved manner. After placing a length of pipe in the trench, the spigot and shall be centred in the socket of the corresponding pipe and using the proper lubricant, rubber rings and methods in accordance with the Manufacturer's instructions, the pip

shall be forced home and-brought to the correct line and grade. Particular care should be exercised to ensure that the spigot end of the pipe does not damage or displace the rubber joint ring. The pipe shall be secured in place with approved backfill material tamped around it except at the socket .

c . The assembly of " Tyton " joints socketted pipes and fittings 8" in diameter and above shall be carried out by the " Rack and Lever " method. Pipes of smaller diameter may be assembled by the " Crowbar " or " Fork Tool " method. The jointing of the pipes shall be carried out in strict accordance with the Manufacturer's Specifications and instructions to the satisfaction and approval of the Engineer. The Contractor shall supply all the materials, equipment and tools required for the proper jointing of the pipes at his own cost .

3 . 7 Pipe Laying Across Stream Beds :

Pipes running across stream beds shall be laid according to one of the following methods depending on site conditions and stream bed being lower or higher than the invert level of the pipe trench .

A . Stream Bed is Lower Than the Invert of Pipe Trench .

a . In this case the pipe shall be laid on supports made of 1:2:4 concrete mix with nominal reinforcing steel and shall have the sides vertical or slanting as shownon Drawings and/or necessitated by the site conditions and instructed by the Engineer .

b . The concrete shall have the proper water cement ratio and shall be properly tamped and the face of the concrete shall be free from honeycombs or other defects and shall have a reasonably smooth finish without plastering .

c . The middle part of the top of the support shall have a semi-circular shape to suit the external diameter of the pipe it is to receive and the pipe shall rest on two layers of 3 ply bituminous felt paper .

d . The pipe supports and foundations shall be constructed in accordance of the typical Detailed Drawings or otherwise as instructed by the Engineer for every particular case and location .

B . Stream Bed is Higher than the Invert of Pipe Trench .

In this case the pipe shall be wrapped with two layers of 4 ply bituminous felt paper tied in position with a steel wire, laid in the trench and covered with 1:2:4 concrete mix reinforced in accordance with the Detailed Drawings or otherwise as instructed by the Engineer .

3 . 8 Bends and Angles :

For ductile iron, pipes, where a curve is to be formed with a series of straight pipes, the deflection at each joint on the curve shall be constant not exceeding 3 , and the gradient of the pipe inverts shall be held constant through the curve. Where a bend is installed, the straight pipes on either side of it shall be accurately aligned so that the angle formed by their center lines is the same as the nominal angle of the bend .

Ctianges in direction in excess of an angle of eleven degrees shall be accommodated using bends provided in the Contract together with joint deflection where the change in direction falls between standard bends .

3 .9 Cutting Pipes :

The cut shall be made with an approved mechanical pipe cutter and in conformity with the pipe manufacturer's recommendations. The edges of the cut shall be clean true and square. The use of an oxy-acetylene flame cutter will not be permitted in any circmstances. The edges of the cut together with those parts of the pipes from which the coating has been removed shall be given twocoats of bituminous paint and the internal lining repaired, if damaged, to the approval of the Engineer, when the cut pipe is to be inserted in a " Tyton " type joint it shall be bevelled for 10 mm at 30° to pipe axis to remove sharp or rough edges.

Hie Contractor shall be solely responsible for the provision of all equipment necessary for cutting and preparing pipes .

Spare cut lengths shall as tar as practicable be used elsewhere in the pipeline .

3.10 **Protection of Pipes :**

Where shown on the Drawings or where instructed by the Engineer, ductile iron pipework shall be surrounded with polyethylene sleeving in tubular form conforming to the American Standard ANSI A21.5-1972 (AWWA C 105-72) or approved equal . The application of the sleeving shall be carried out generally in accordance with the method described in the

British Steel Corporation (B.S.C) Publication Ref. No. P.J.F. 217/1/1973 or as may from time to time be agreed by the Engineer or the Engineer's Representative.

3.11 **Flanged Joints :**

The flanges shall be scraped clean and correctly positioned and the component parts including any insertion ring cleaned and dried. Insertion rings shall be fitted smoothly to the flange without folds or wrinkles. The faces and bolt holes shall be brought fairly together and the joints shall be made by gradually and evenly tightening bolts in diametrically opposed positions. Only standard length spanners shall be used to tighten the bolts. The protective coating, if any, of the flange shall be made good when the joint is completed .

3.12 **Viking Johnson Couplings :**

Plain-ended pipes shall be jointed using " Viking Johnson Coupling ". The Contractor shall assemble and fix the couplings so as to be equally spaced over the adjacent spigot ends in accordance with the manufacturer's instructions .

The bolts shall be evenly tightened in diametrically opposed positions using the manufacturer's standard spanners .

3.13 **Future Connections :**

Where future connections and extensions are shown on the Drawings of the lines to be constructed under ihe Contract the Contractor shall provide at such points Tees and/or the proper and appropriate fittings to facilitate such connections. The dead ends shall closed with blind flanges. In case of ductile iron pipes the blank flanges or caps shall be provided with thrust blocks in accordance with the Detailed Drawings .

3.14 **Connections to Existing Mains :**

Where connections are to be made to any part of the existing mains the Contractor must make all necessary arrangements with the Engineer and have all necessary material, plant and labour in readiness on the ground and shall complete the work as rapidly as possible with the minimum of inconvenience to consumers. The actual connection to an existing main will be made by the Contractor under the close supervision of the Engineer .

3.15 **Flotation of Pipeline :**

The Contractor shall be solely responsible for ensuring that flotation of the pipeline does not occur during construction. The extent of the backfill placed over each pipe after laying and before testing shall be such as will prevent flotation of the pipeline .

Should any section of the pipeline float out of line or level the section of pipeline so affected shall be removed and re-laid in accordance with the Specification to the satisfaction of the Engineer's Representative .

3.16 **Valves Etc :**

Sluice valves, check valves, pressure reducing valves, pressure gauges air valves, washouts, service connection angle valves, fire hydrants etc. shall be in accordance with the Specifications and shall be installed on the pipelines in the positions and to the details shown on the Drawings.

To facilitate their removal for maintenance or repair, flanged gate valves installed on ductile iron lines shall have a flange-spigot connector on one side and a flange-socket connector with a clearance assembly of 35 to 45 mm on the other side .

Flanged gate valves installed on black steel lines with welded joints shall be provided on one side with the appropiate Viking Johnson flange adaptor and those installed in galvanized steel threaded pipelines shall be preceded or followed by the appropriate galvanized iron union .

Pressure reducing valves shall be provided with by-passes and strati be preceded and followed by the appropriate pressure gauges in accordance with the Detailed Drawings and Specifications .

Covers and surface boxes shall be securely fixed either by bedding and haunching in cement mortar or by building into concrete, as indicated on the Drawings. They shall be accurately positioned (and refixed if necessary) such that they are level with the finally reinstated surface .

1.17 Fittings and Specials :

a . The fittings and specials required for the construction of the pipe lines of the various types of pipes shall be as recommended by theManufacturerfor each particular case, and the pressure rating of all the fittings and specials shall be equal or greater than the pressure rating of their respective pipeline and shall be installed in accordance with the Manufacturer's specifications and to the satisfaction of the Engineer .

b . The Contractor shall study the Drawings and survey the transmission lines and/or the lines of the distribution system and shall find for himself the different galvanized steel, black steel and ductile iron pipe fittings, specials, reducers and adapters etc. needed for making the different pipe connections between the various kind of pipes, valves, water meter etc. required for the proper construction completion of the Works in accordance with the Drawings and Specifications .

.18 Protection of Joints :

All buried steel and ductile iron flange joints, flange adaptors and couplings shall be protected by wrapping with " Denso Tape " or similar approved material .

The joints shall be thoroughly cleaned to remove all loose rust and extraneous matter and thoroughly and adequately wrapped with the protective tape to the satisfaction of the Engineer .

5.19 Thrust and Anchor Blocks :

Bends, tees, tapers, plugs, caps, valves etc. on ductile iron pipelines or as indicated on Drawings shall be well braced against undisturbed soil at the edge of the trench with concrete anchor and thrust blocks. The concrete shall contain 300 kgs of cement per cubic meter of concrete and the aggregate well graded and the workmanship shall be in accordance with good practice to the satisfaction of the Engineer. The dimensions and steel reinforcement shall be in accordance with the typical sections shown on the Detailed Drawings or otherwise as directed by the Engineer.

The blocks shall, unless otherwise shown or directed by the Engineer, be so placed that the pipe and fitting joints will be accessible for repair .

Where it is not possible to brace against undisturbed soil, suitable fetters shall be arranged as directed by the Engineer .

3.20 Express Locking Joints :

Where expressly specified on the Drawings the Contractor shall supply and install on the lines express 2GS locking joints and this "would be mainly at places where thrust or anchor blocks could not be constructed and at stream crossings or where in the opinion of the Engineer the use of such joints is necessary .

3.21 Clamps:

Where the thrust on the valves installed on ductile pipes with " Tyton " type joints, is to be taken by the pipes, the " Tyton " joints shall be provided with clamps fora length of 50 diameters at each side of the valve .

These clamps shall be in accordance with the Detailed Drawings and shall not be measured for direct payment and their cost shall be deemed to be included in the Unit Price of the relative pipeline .

3.22 **Wash-Outs:**

a . At points indicated on Drawings the Contractor shall supply and install on the line gate valves to be used as wash-outs. The gate valves shall be in accordance with the Specifications.

b . The pipes at the wash-out side shall be as shown on the Drawings and shall extend to such a length as to insure that the wash-out water discharged will not flood the pipe trench nor cause any damage to the surrounding property.

3.23 **Valve Chambers and Valve Boxes :**

a . Where shwon on Drawings, valves shall be located in valve chambers or valve boxes. The particular types of chambers and boxes are indicated on the Typical Drawings and construction details of each said type of chamber and box are shown on the Drawings.

b . Where specified or indicated on Drawings, valves shall be provided with concrete chambers. Where these are precast, they shall be constructed with precast circular rings of appropriate size and diameter and shall be provided with the appropriate castiron cover as shown on the typical Detailed Drawings.

c . Where the valve chambers are cast in-situ, they shall be constructed of 1:3:6 mix plain concrete with the dimensions shown on the Drawings and/or as instructed by the engineer to suit the valves and pipe connection in site.

The face of the concrete shall be free from honeycombs or other defects and shall have a reasonably smooth finish without plastering, i.e. the concrete shall be well vibrated during castings.

d . The covers of the valve chambers shall be of checkered steel plates 3 mm. thick welded on a 30x30x3 mm. steel angle frames and shall fit in a 40x40x4 mm. steel angle frame securely fixed to the walls of valve chambers. All the steelworks of the cover shall be hot dip galvanized steel.

e . A flat steel bar 50x5mm. shall go through the handles across the steel plate covers and shall be provided at one end with a yale type pad-lock and shall serve to lock the valve chambers in accordance with the Drawings. All padlocks of the valves' chambers' covers shall have master keys.

3.24 **Surface Boxes :**

Cast iron surface boxes shall be supplied and installed for the extension spindle of each valve in accordance with the typical Drawings. The boxes shall be of the indicated type obtained from manufactrers approved by the Engineer.

3.25 **Valve Chambers Covers :**

Manhole covers shall be of the size and grade indicated on the Typical Drawings. Covers and frames shall be of presently used type and shall be obtained from manufacturers approved by the engineer. The contact surfaces of the cover and the frame shall be precisely turned down to prevent rocking.

The following types of covers shall be provided. Type "L"Light duty, test load not less than 4 tons, for places where vehicles cannot enter.

Type "M"Medium duty, test load not less than 25 tons, for streets.

Type "H" Heavy duty test load not less than 40 tons, for streets and roads with heavy traffic.

The different types shall be installed as indicated on the Drawings or as may be directed by the Engineer.

Frames shall be accurately set to level. Holes for lifting hooks shall be carefully protected and filled with an oily rag after installation to prevent the ingress of foreign matter.

3.26 **Other Works:**

Works included in the Contract and which do not have specifications herein shall be carried out in accordance with the Particular Conditions and Specifications or as specified in the Bid Schedule.

3.27 **Testing of the Lines for Watertight ness :**

The pipelines of the transmission and water distribution system and all the joints shall be tested by the Contractor to a pressure 1.5 times the working pressure. The pipelines shall be tested with water before the joint holes are filled in and the testing shall be carried out in sections as the pipes are laid.

The length of sections and the procedure of testing shall have the prior approval of the Engineer. The Contractor shall furnish and fix on the pipelines at locations indicated by the Engineer Tees provided with 1/2" stop-cooks for the purpose of releasing the air from the pipelines. After pressure testing of the lines the stop-cook shall be removed and the opening properly plugged.

An efficient stop and strutting block shall be placed at the end of the section to be tested. After the pipes have been completely filled with water and all air has been exclude therefrom, the pressure shall be raised by pumping to the specified test pressure as instructed by the Engineer.

The pipeline shall be maintained under this pressure for a period of 24 hours, during which period the pressure shall not be allowed to fall below *15%* of the test pressure but shall be restored to the full test pressure by such pumping as may be necessary.

The test pressure shall be calculated as one and a half times the maximum working head at the lowest point in the section to be tested.

The test shall be deemed to be satisfactory if the pipeline holds after the initial 24 hours the specified pressure for a final period of not less than two hours or such final period as is determined on site by the Engineer,with a loss not exceeding 2 $^{l}/_{z}$ per cent of the total test pressure during this two hours period. No pumping shall be permitted during this final test period.

If the test is not successful, the Contractor shall proceed to locate immediately and rectify the defects, after which he shall re-test until a satisfactory test result can be secured.

The Contractor shall provide the clean water, all pumps, meters, pressure gauges and other appliances required for the purpose of the test. The Contractor shall at his own cost arrange for meters and gauges to be tested for accuracy, if required to do so by the Engineer. The testing of distribution system will be not paid for directly but its cost shall be deemed to be included in the unit price of the respective pipeline.

3.28 **Sterilization of the Lines :**

After the lines have been hydraulically tested and before they are put into service, they are to be flushed with clean water to remove foreign matter.

After flushing they are to be sterilized by the Contractor by the use of chlorine compounds or a gas chlorinator. The Chlorine solution shall be fed at such a rate as to obtain 30 ppm. chlorine at the point of introduction. The tine shall be blown-off until a residual of 5ppm. is obtained at the point of blow-off.

When 5 ppm. chlorine residual is obtained the blow-off shall be closed and this chlorinated water shall be allowed to remain in the line for a minimum period of 24 hours. After this period the water shall be tested for a chlorine residual at the point of blow-off.

If no chlorine residual remains, the process shall be repeated until a satisfactory result is obtained. After the sterilization process is satisfactorily completed, the main shall be flushed with 0.5ppm. chlorinated water. Flushing shall continue until the chlorine residual at the point of blow-off is less than O.5ppm.

The sterilization of the lines can be done in sections, and the process shall obtain the prior approval of the Engineer.

The Contractor shall provide the clean water, the chlorine compounds or the chlorine gas and all the necessary equipment, and shall make all connections necessary to carry out the sterilization of the system. The pressure testing and the sterilzation of the lines shall not be measured for direct payment and their coast shall be deemed to be included in the unit price for the supply and/or the collection from the Employer's store and laying of the respective pipelines.

SERVICE AND MAINS CONNECTIONS

3.29 **Service Connections - Installation :**

The lines of the newly constructed water distribution systems shall, while being constructed, be provided by the Contractor at locations shown on Drawings, with the appropriate fittings and specials required for the mains connection or the installation of service connections in accordance with the Detailed Drawings and the Engineer's instructions .

Service connections on existing pipelines shall be done by under pressure tapping .

Unless otherwise specified, shown on the Drawings or instructed by the Engineer, the service pipes shall be galvanized steel threaded pipes in accordance with BS 1387 of the Medium or Heavy Series as indicated in the Bill of Quantities .

No tapping for any service connection shall be made until the main has passed the initial pressure test to the satisfaction of the Engineer. The Engineer will issue instructions regarding the size, location and fitting of each service connection and no connection shall be commenced until the Contractor has received such instruction from the Engineer .

Tappings shall be made direct into the main or into saddles affixed to the main, as may be shown on the Detailed Drawings and/or specified in the Bill of Quantities, and care shall be taken to avoid breaking away the concrete lining whilst the drill penetrates the concrete .

Tappings shall be positioned on the main so that the ferrule is inserted into the main at the crown. The jointing of the threaded ferrule to the main line shall be made using lead-free jointing compound .

The outlet of the ferrule shall be set to point in the direction in which the service pipe is to be laid. The service pipe shall be laid with a cover of not less than 30 cm below the ground surface unless shown otherwise on Drawings .

All joints shall be made in accordance with the best practice. Threaded joints shall be made using approved lead-free jointing compound .

Care shall be taken in the handling and gripping of the tubes to avoid distortion of the tube and damage to the galvanizing. Any damage to the galvanizing on tube or fittings shall be made good to the satisfaction of the Engineer. Tubes shall not be bent to form without the permission of the Engineer and where such permission is given any special requirements attached thereto shall be strictly observed .

Where tubes are to be cut prior to threading the cut shall be made using an approved mechanical pipe cutter and in conformity with the pipe manufacturer's recommendations. The edges of the cut shall be clean and true and square .

Threading of tubes shall be carried out using suitable hand or power driven threading machines. All tools and equipment shall be carefully maintained in good working order and cutting edges shall be regularly sharpened. During the threading operation the tube shall be firmly clamped and adequately supported .

The die-head shall be centred carefully and supported concentrically with the axis of the tube .

Ample lubricant shall be used during threading to ease the load on the dies. The machine manufacturer's recommendations shall be followed in respect of the choice of cutting heads and feed rates for the material being threaded. Where hand threading machines are used care shall be taken to ensure a balanced turning force .

3.30 **Service Connections - Testing and Sterilization :**

All service connections shall be subjected to a hydrostatic pressure test in the presence of the Engineer's Representative .

The Contractor shall give the Engineer's Representative not less than 48 hours notice of his intention to carry out a pressure test .

The service connection shall be tested to the point indicated in the Engineer's instructions for the service connection and before any connection is made to an existing service pipe. Any leakage shall be rectified such that the service connection is rendered completely watertight. Under no circumstances shall the trench excavation be backfilled until the watertightness of the service connection has been accepted by the Engineer .

Sterilization of the service connection will be carried out at the same time as the main to which it is connected .

3.31 **Service Connections Excavation and Backfilling :**

Excavation and backfilling will generally be carried out in accordance with the relevant clauses of Section 2 of this Specification .

The width of the trench for the service connection shall be restricted to the absolute minimum consistent with the required compaction of the backfill. All stones and hard material which in the opinion of the Engineer could damage the service connection shall be removed from the trench bottom so that the pipe may be laid in soft material for its full length .

After completion of the pressure test to the satisfaction of the Engineer's Representative all flanged and mechanical joints shall be wrapped in accordance with Clause 3.18. The trench shall then be backfilled around and over the pipe and the reinstatement carried out .

Particular attention shall be taken to remove stones from the backfill material in the first 200 mm placed over the pipe. The remainder of the trench shall be backfilled in layers no greater than 150 mm compacted thickness using hand rammers to the approval of the Engineer. Where necessary water shall be added to the backfill to facilitate compaction .

3.32 **Connections to Existing Mains and Service Pipes :**

The Engineer will issue to the Contractor detailed instructions regarding each interconnection that has to be made to the existing mains and service pipes. Cutting into the existing main or service pipe and effecting the interconnection shall only be made in the presence of the Engineer or Employer at the time specified by the Employer. (See also Clause 3.14) .

Cutting into the existing main or service pipe and installation of the interconnecting pipework shall be carried out efficiently and rapidly so as to reduce to a minimum the interruption of the public water supply .

Existing mains and service pipes shall only be cut using special equipment approved by the Engineer. Under no circumstances shall oxyacetylene or electric are cutters to used. The cut shall be perpendicular to the centreline of the pipe and special care shall be taken with respect to the location of the cut to ensure that the new pipework shown on the Drawings may be installed. The Contractor shall agree with the Engineer's Representative the length of existing pipework to be removed .

The Contractor shall take every care to avoid any dirt or extraneous material entering the existing main or service pipe .

The Contractor shall have available at the site of the connection an efficient dewatering pump before commencing any cut into the existing main or service pipe in order that the excavation remains dry at all times and to reduce the risk of dirty or contaminated water entering the existing distribution system. The work shall be carried out in a clean and efficient manner .

The Contractor shall provide at the site of the connection sufficient quantities of clean water containing 10 ppm chlorine in solution. Every item of new pipework to be installed shall be submerged in the chlorine solution for at least 15 minutes immediately before being installed in the permanent works .

The Employer may put into use the interconnection as soon as possible after its installation and will carry out an inspection to detect any evidence of leakage; any remedial work necessary to eliminate leakage shall be carried out by the Contractor. No pipework shall be covered or back-filled until the Engineer's Representative is totally satisfied that the interconnection is free of all leakage .

PAYMENT

3.33 Measurement and Payment :

The construction of water mains and the pipelines of the water distribution systems and the installation of service connections and service pipes shall be measured and paid for by the meter run respectively for every kind of pipe and diameter of completed and accepted works in accordance with the Drawings and Specifications to the satisfaction of the Engineer and the unit price for each shall include for but shall not be limited to the following :

1 . Clearing, grubbing, grading and preparing the pipeline route to provide access for the Contracrtor's equipment and personnel .

2 . The excavation in all kind of soils includirg asphalt pavements and rock and the subsequent back-filling of trenches and reinstatment of surfaces in accordance with the Specifications .

3 . The supply and laying and/or the collectio i and hauling from the Employer's stores to Site of Works, laying and proper jointing of the respective pipeline including all fittings and specials and all incidental required for the proper laying and completion of the relative pipeline and service lines and connections in accordance with the Drawings and Specifications .

4 . The supply and/or the collection and hauling from the Employer's stores to the Site of works and the installation on the respective pipeline of all k inds of valves, fire hydrants and the appropriate valves or saddles and ferrules for service connections etc., i icluding all fittings, specials, flanged adapters, Viking Johnson couplings and flanged adaptors and all inridentals required for the proper installation and proper function of the relative valves in accordance with the Drawings and Specifications .

5 . The supply of all materials and the constr iction of all valve chambers and valve boxes including extension spindles, covers, surface boxes etc., in accordance with the Drawings and Specifications .

6 . The supply of all materials and the construction of plain and reinforced concrete anchor and thrust blocks to valves, tees, bends, plugs, caps etc., on the ductile iron pipelines and where so insturcted by the Engineer .

7 . The supply of water, pumps, chlorine and the necessary equipment and the pressure testing of the lines for water tightness and the sterilization and flushing of the lines in accordance with the Specifications and the instruction of the Engineer .

8 . All ancillary works relating to the construction of the water supply, distribution systems and service connections which are not explicitly mentioned in the Contract but could be inferred therf rom or which are customarily performed or evidently necessary to carry out the intent of the Drawings and Specifications and all other liabilities an»i obligations setforth in the Tender Documents.

SECTION 4 SPECIFICATION OF MATERIALS

A. 1 Black Steel Pipes :

The black steel pipes shall have the ends either :

a . Calibrated and bevelled for electric fusion butt-welded joints or.

b . Spigoted and socketed ens for fillet welded joints.

4.2 Steel Pipes with Bevelled Ends :

a . Unless otherwise specified, these pipes shall be black steel spirally or seamwelded pipes in accordance with DIN 2458, DIN 1626 or approved equal with the ends calibrated and beveled by 30°minus O + 5°) for electric fusion butt-welding. The wall thickness of the pipes shall be as specified in the Particular Conditions and Specifications or in the Bill of Quantities for each particular project.

b . The pipes shall have an internal bitumen lining of 40 microns which shall be odourless and tasteless suitable

for the passage of chlorinated water for drinking and domestic use. Furthermore they shall have an external bitumen coating protected by glass felt strip wrapping soaked in bitumen andlimewashed (tropical quality) with a total thickness of not less than 3.mm. The coating show no tendency to creep or flow at a temperature of 70°C. The internal and external coating shall be stopped 6" from the ends of pipe lengths.

c . A sufficient quantity of insulating materials shall be included with the consignment of pipes to make good any possible damages during transport and to cover the joints and fittings after welding the pipes and its cost shall be deemed to be included in the respective unit prices.

4.3 Steel Pipes with Spigotted and Socketted Ends :

Black steel pipes with spigotted and socketted ends for fillet welded joints shall have inside cement mortar lining and outside coating. They shall be suitable for conveying chlorinated potable water under pressure and shall be laid under ground.

The pipes shall be in accordance with API Standards 5L or approved equal and shall comply with the following requirements :

1 . Manufacture and Welding :

The pipes shall be longitudinally or spirally welded by the submerged arch method, union melt process, using at least two weld passes, one of which shall be on the inside.

2 . Sleel Grade and Wall Thicknesses :

The steel Grade, wall thicknesses and the Working Pressure of the pipe shall be as specified in the Particular Conditions and Specifications or in the Bill of Quantities.

3 . Tolerances :

The following tolerances shall be applied on the pipes, except around weld.

1 . Nominal wall thickness ; ± 10%
2 . Theoretical O.D. : ± 1%
3. Weight of bare steel pipe : ± l0%

4 . Hydrostatic Test Pressure :

Each length of pipe shall be tested at the mill in accordance with API Std 5 LX and shall withstand without leakage the mill inspection hydrostatic test pressure specified in the Particular Conditions or in the Bill of Quantities.

5 . Average Length :

The steel pipes shall have an average lenght of 12 meters. However 10% of the total length could be supplied in lengths of 6 to 10 meters.

6 . Pipe Joints and Jointing :

The pipes shall have spigot and socket ends and the jointing shall be by fillet welding. The cylindrical socket shall be forged in plant and shall form with the spigot of the following pipe "slip joint". The length of the socket shall be from 120 to 140 mm.

7 . Internal Coating :

a . The steel pipes shall have an internal cement mortar coating applied centrifugally and shall be odourless, and tasteless suitable for the passage of chlorinated potable water, using sulphate resisting Portland cement to BS 4027 or Equivalent International Standards (EIS).

The sand shall consist of inert granular material having durable uncoaked grains and shall meet the requirements of BS 882, or Equivalent International Standards (EIS), sampled and tested in accordance with BS 812 or EIS.

b . The cement mortar internal coating shall have a thickness as specified in the Particular Conditions and Specifications and the density of the finished lining, measured in a saturated surface dry condition shall not be less than 2325 kg/M^3.

c . The cement mortar lining shall cover the whole pipe on the spigot side.

On the socket the cement mortar lining shall be stopped in the bevel of the socket at a special rubber ring. The rubber ring shall be of a special shape and shall be securely fitted, by glueing in the plant, into the bevel of the sockets against the cement mortar stop.

d . The length of the sockets shall be such that the rubber ring cannot undergo any damage during welding operation. The internal unlined wall of the sockets shall be protected by suitable harmless paint.

8 . Fittings and Specials :

The fittings and specials shall have factory internal cement mortar lining and their pressure rating must be equal or greater than the pressure of their respective pipe.

9 Control of Internal Coating :

The cement mortar coating surface condition shall, after curing and storage, be inspected for cracks using a light source and a mirror mounted on a rod and shall be free of the following defects :

1 . Spalled or loose areas.
2 . Fractures or cracks extending to more than halfway through the lining.
3 . Surface defects indicating honey-combed or open texture. (Superficial crazing shall not be cause of rejection).
4 . Any other defects which indicate imperfect proportioning, mixing, moulding or curing.
5 . Lining thickness not as specified.
6 . Lining end not perpendicular to the longitudinal axis of the pipe .
7 . Lining end over-hanging pipe or being chipped or oracked.

10 . External Coating :

The steel pipes shall have an external coal-tar or petroleum bituminous enamel coating reinforced by glass fiber strip wrappings properly embedded in the bitminous coating. The coating shall show no tendency to creep or flow at temperature of 70°C and shall be limewashed (Tropical quality) or approved equal.

The coating shall have a total thickness of not less than 3mm. and its continuity shall be checked at the Manufacturer's works with an electric brush at 10000 Volts. The wrapping shall be stopped 20mm. from the ends of socket and spigot pipes.

4.4 Spun Ductile Iron Pipes and Fittings :

a . Spun ductile iron pipes of the various diameters shall have a standard length of 5.00 and b.OO meters with "Tyton" joints complying with BS4772 or ISO. 2531 Class K9.

b . The fittings shall comply with same specifications as for the pipes but shall be of Class K 14 for the Tees and Class K 12 for all other fittings.

c . All pipes and fittings shall have an internal cement mortar lining, odorless, tasteless, and suitable for the passage of chlorinated potable water, using sulphate resisting portland cement to BS 4027, or E1S. The sand shall consist of inert granular material having durable uncoaked grains and shall meet the requirements of BS 882, or EIS, sampled and tested in accordance with BS 812, or EIS. (Equivalent Internatioanl Standard). The water used for mixing the concrete shall be potable, fresh and clean, free from organic or inorganic matter in solution in excess of that normally present in domestic potable water.

The cement mortar shall be of one part cement to two parts dry sand by weight and shall be applied to straight pipes by centrifugal spinning process and to the fittings by an approved method which will produce a similar finish to that of the straight pipes.

Small areas of damage in the lining shall be repaired by the contractor in accordance with the Manufacturer's instructions.

The thickness of the internal cement mortar lining of the pipes shall be as follows :

Pipe N.D.	**Average Thickness**	**Minimum Thickness at one point**
600	mm.4.8 mm. 3.6	mm.
500.	mm 4.8 mm. 3.6	mm.
400	mm. 4.8 mm. 3.6	mm.
300	mm. 3.2 mm. 2.2	mm.
250	mm 3.2 mm ..2.2	mm.
200	mm. 3.2 mm. 2.2	mm.
150	mm. 3.0 mm. 2.0	mm.
100	mm. 3.0 mm. 2.0	mm.
80 mm. 3.0 mm. 2.0 mm.		

d . The pipes and fittings shall be coated externally with a coating of cold applied bitumen conforming to the requirements specified in BS 3416 (or equivalent approved standard) for material Type II .

e . The joint rings and gaskets shall comply with the requirements of BS. 2494 or BS 3514. (joint rings, gaskets and yarn for use in water pipeline shall not permit bacterial growth).

f . The pressure rating of all fittings and components (including bends, tapers, flexible couplings, etc.) and specials shall be equal or greater than the test pressure of the respective pipeline in which they are to be fited .

Unless otherwise specified, the test pressure shall be at least 1.5 times the working pressure (including surge).

4.5 Galvanized Mild Steel Pipes and Fittings :

Steel tubes and tubulars shall be seamwelded in accordance with BS 1387, Heavy or Medium Series as specified in the Particular Conditions and Specifications or in the Bill of Quantities and shall be galvanized. Tubes shall be screwed in accordance with BS. 21 Pipe Threade.

The fittings shall be of wrought steel to BS 1740 and shall be galvanized. Steel flanges shall be

of the screwed boss type with parallel threads and shall be galvanized.

4.6 Flanged Joints :

Flanges shall be faced and drilled to conform with the dimensions specified in BS 4504 for the nominal working pressures stated in the Paricular Specification and/or the Drawings and shall be of the raised face type. The requisite number suitable bolts, nuts, washers and gaskets shall be supplied for each flanged joint. Gaskets shall be of the "inside bolt circle" type, manufactured from Class A natural rubber in accordance with BS 2494.

4.7 Mechanical Couplings :

Mechanical couplings for jointing plain-ended pipes shall be of the Viking Johnson or similar approved type, which central register on the sleeve unless otherwise specified.

The joint rings shall be of Class A natural rubber in accordance with BS 2494. All mechanical couplings shall be painted with a coat of shop primer.

Range adapters for jointing flanged valves and fittings to plain ended pipes shall also comply with the general requirements of this clause.

4.8 Sluice Valves :

Sluice valves shall be to BS 5163, or approved equal, flanged, and suitable for maximum working pressures stated in the Particular Specification and/or the Drawings. They shall be bronze trimmed or the body internally epoxy or rubber lined and the disc completely rubber clad, clockwise closing, with non-rising spindle, and suitable for key operation unless otherwise stated. The direction of closing shall be clearly marked on the valve cap or handwheel, as appropriate.

The test pressure shall be 1.5 times the working pressure gate open.

4.9 **Check Valves:**

a . Check valves of the various diameters and working pressures shall be double flanged swing gate for horizontal mounting. The body shall be of cast iron, bronze mounted with cast iron disc and bronze seat ring machined to water-tight surface. The disc shall be hung from brass or stainless steel hinge pin with heavy solid bronze hinges.

b . Check valves shall be to BS 5153 or approved equal respectively for the various corresponding working pressures, c . The working pressure of the check valves shall be as specified for each on the Drawings or in the Bill of
Quantities and the test pressure shall be 1.5 times the working pressure.

4.10 **Air Valves:**

Air valves shall be of the "Double" or "Single" type, as specified in the Particular Specification and/or the Drawings, and obtained from an approved manufacturer.

Double air valves shall be fitted with large and small orifices suitable for the admission and discharge of bulk volumes of air during drainage and filling of the main, and for the release of small quantities of air during normal working .

Single air valves shall be fitted with one large or small orifice as may be specified in the Particular Specification and/or the Drawings, suitable for the automatic release of small quantities of air during normal working conditions in the main.
Each air valve shall be suitable for the maximum working pressure stated in the Particular Specifications and/or the Drawings. Each air valve shall be supplied or fitted with an isolating valve. Where possible these shall be of the integral screwdown type and shall have gunmetal seats and stoppers and forged bronze spindles fitted with cast iron caps for key operation. The spindle of the isolating valve shall be threaded so as to close the valve when rotated in a clockwise direction. The isolating valves shall be suitable for manual operation against the maximum working pressure stated. In cases where separate isolating sluice valves are supplied, these shall be so arranged, with the provision of bevel gearing if necessary, so that they may be operated by tee key from above.

The design of the air valves shall be of such that the balls do not blow shut under any working or test conditions when large volumes of air are being released.

The balls and other parts shall be suitable for operating in tropical temperatures.

4.11 Pressure Reducing Valves

a . The pressure reducing valves shall be so designed as to maintain constant down-stream pressure regardless of varying inlet pressure and changing flow rates and to be droptight at zero flow. They shall have bronze seat and pistion guide bush, resilient diaphragm, globe body, flanged ends, spring-loaded, direct acting with pilot control valves and shall be suitable for the inlet and outlet pressures specified in the Particular Conditions and Specifications. The Valves shall be of the type that can berepacked without removing it from the line.

b . Every pressure reducing valves shall be supplied with two pressure gauges provided with seperate isolating cocks, the pressure gauges shall be suitable to read the specified pressure.

c . One spare diaphragm and a set of gaskets shall be supplied with every pressure reducing valve and their price shall be deemed to be included in the respective unit price.

2.12 Saddles:

Saddles employed for connecting ferrules to ductile iron mains shall be of stainless steel or gunmetal, with gunmetal bolts or wedges for securing them to the main.

4.13 Ferrules :

Ferrules shall have a gunmetal body and be of the right-angled swivelling screwdown type, with outlets screwed female galvanized steel pipe. They shall be fitted to the main by means of a Talbot or VAG or other approved **underpressure drilling and tapping machine, and be suitable for a working pressure as specified in the Particular Specifications and/or the Drawings.**

4.14 Gatevalves:

Gatevalves shall be of gunmetal, to BS 1952. **They shall be fitted with handwheels, have outlets screwed female for galvanized steel pipes and be suitable for a working pressure as specified in the Particular Specifications and/or the Drawings.**

4.15 Stopvalves :

Stopvalves shall be of gunmetal to BS 1010. They shall be fitted with crutch or square heads as may be specified in the Bill of Quantities, have outlets screwed female for galvanized steel pipe, and be suitable for a working **pressure as specified in the Particular Specifications and/or the Drawings.**

4.16 Water Meters :

a . Water meters of the various diameters shall be flanged ended of the hellical type and shall have a registration dial with six digit integrator calibrated to read in cubic meters and shall be of the straight reading type and shall have a cover plate .

b . Each water meter shall be supplied with a blank lid to be fitted in place of the lid affixed to the metering mechanizm, in case the latter is removed for repair .

c. The water meters shall be suitable for a working pressure as specified in the Particular Specifications and/or the Drawings.

4.17 Fire Hydrants :

Fire hydrants shall be to BS 750 : 1964 Type 2 with Captive internal valve, clockwise-closing, and suitable for a maximum working pressure of 10 bar . Inlet flanges shall be 80 mm nominal diameter, drilled to NP 16. Outlets shall be threaded 2i/2 inch diameter round thread to BS 750 : 1964 and be protected by a nonthreaded cap chained to the valve body .

4.18 Butterfly Valves :

The butterfly valves shall be manufactured by a reputable firm and shall comply with recognised international standards .

The butterfly valves shall be double flanged with a horizontal mounted disc and the shaft shall be provided with a screw and nut multi-turn irreversible spindle gear manully operated by square operating nut and spindle closing clockwise and shall be provided with a disc-position indicator. The valves shall have renewable rubber seats drop tight closure, uninterrupted disc edge, stainless steel shafts, self lubricating bearings, good closing characteristics and robust construction. The Valve components which are likely to corrode shall be internally and externally coated with the proper protective materials. The Valves shall be suitable for the working pressures specified in the Particular Conditions and Specifications .

4.19 **Float Valves:**

Unless otherwise specified in the Particular Conditions and Specifications or the Drawings, (he float Valves shall be flanged, of the angle pattern, lever operated, direct acting, with the body made of " Meehanite " cast iron fitted with gunmetal seat rings and cylinder liner .

The seat rings shall be leather packed, the lever of galvanized steel and the float of copper. The valves shall be suitable for the specified working pressures .

4.20 **Surface Boxes :**

All surfaces of cast iron covers and frames shall be coated with a coating of cold applied bitumen conforming to the requirements specified in BS 341b for material Type II or approved equivalent standard .

Surface boxes for stop valves shall comply in all respects with BS 1425 and 34bl, Medium Grade, Type M with plug lid or approved equivalent standard .

Surface boxes for sluice valves shall comply in all respects with BS 142t> and 34bl, Heavy Grade, Type H with plug lid or approved equivalent standard and lettered " SV. "

Surface boxes for fire hydrants and air valves shall conform to BS 750 or approved equivalent standard and shall have a clear opening 230 mm x 380 mm and be suitable for installation in roads. Surface boxes for fire hydrants shall have the letters 'FH' cast on them in accordance with BS 750 or approved equivalent standard .

Surface boxes for air valves shall have the letter 'AV cast on them to the same size as that specified for fire hydrants and shall have ventilation holes having a total ventilation area of not less than 0.002 m^2

The Contractor shall submit to the Engineer's Representative for approval full details of all surface boxes to be supplied .

All surface boxes shall be set in cement mortar or built into concrete slabs as shown or directed to the correct levels, camber or falls .

4.21 **Catalogues :**

Catalogues and leaflets with the necessary information, technical data, cross-sectional drawings showing the component parrs and materials of the various valves and other materials intended to be used in the works shall be submitted with the tender .

4.22 **Radiographic & Coating Tests**

Hundreed percent (100%) of all welded joints of steel pipes 12 inch N.D. and above, shall be inspected by Radiogrphy by the Royal Scientific Society (R.S.S.) or any other Spececialized firm according to the requirments of A.P.I Specifications 1104. Coating of 100 percent of the pipes must be tested according to the Holiday Method. These tests shall be at the contractors expence.

4.23 **Other Materials :**

All other materials comprised in the Contract and which do not have particular specifications herein, shall he as specified for in the Particular Conditions and Specifications or in the Bill of Quantities .