

SECTION 3300 WATERSTOP, CONTRACTION JOINT, EXPANSION JOINT FILLER AND DOWEL BAR

3301 General

This section covers the requirement for materials and installation of waterstop, contraction joint, and expansion joint filler and dowel bars.

3302 Waterstop

- (1) Waterstop shall be of central hollow bulb type and shall be extruded from a high grade compound with no reclaimed material. The main constituent shall be dense, homogeneous and free from porosity or other imperfections.

At least 60 days prior to installing any waterstop, the Contractor shall submit drawings and data to the Engineer for approval.

The drawings shall show details of the waterstops, including dimensions, shapes, and details of intersections and splices between waterstops of the same sizes and of different sizes.

The Contractor shall submit detailed laboratory test reports on the physical properties of the compound, which will be used in the waterstops to be furnished.

- (2) Measurement, for payment, for furnishing and installing the various sizes of waterstops will be made of the number of meter of waterstop measured along the centerline of the waterstop as shown in the approved Shop Drawings or prescribed by the Engineer with no allowance for lap at splices and intersections.

Payment for furnishing and installing the various sizes of waterstops will be made at the unit price per linear meter, which unit price shall include the cost of furnishing all materials, preparing and submitting drawings and data, making field splices and intersections, and installing the waterstops; and of furnishing and installing coverings for protecting waterstops from damage.

3303 Contraction Joint

- (1) Contraction joints, where specified, shall be formed as deliberate planes of discontinuity in the concrete structure. To form such a joint the face of concrete slab or block first formed shall be painted with two coats of approved rubber bitumen paint or oil paint before the adjoining slab or block is placed.

- (2) Measurement, for payment, of contraction joint will be based on the area of contraction joint shown on the approved Shop Drawings. Payment for forming contraction joint will be made at the unit price per square meter, which unit price shall include the cost of furnishing rubber bitumen paint or oil paint and of painting.

3304 Expansion Joint Filler

- (1) Expansion joints shall be formed in the same way as contraction joints but, in addition, an approved compressible sheet or filler (The density of filler shall be 305 kg/cum or more) shall be supplied and placed in the joint to provide freedom for two adjacent concrete slabs or blocks to expand. In certain situations a highly compressible joint filler of foam rubber or other approved material shall be used. The exposed edges of the joints shall be sealed with an approved synthetic rubber or similar resilient sealing compound.
- (2) Measurement, for payment, of expansion joint filler including sealant will be made of the area of material shown in the approved Shop Drawings or prescribed by the Engineer. Payment for furnishing and placing joint filler will be made at the unit price per square meter, which unit price shall include the cost of furnishing and placing joint sealer, joint filler and other materials required to complete the expansion joint.

3305 Dowel Bar

- (1) Dowel bar will be D19 mm reinforcement bar of one meter long in which half length of the bar shall be painted with bituminous materials and is inserted into ϕ 25 mm PVC pipe with a cap. Dowel bar shall be installed as shown on the Shop Drawings or directed by the Engineer.
- (2) Measurement, for payment, of dowel bar will be made of the number of dowel bars shown in the approved Shop Drawings or prescribed by the Engineer. Payment for furnishing and installing the dowel bar will be made at the unit price per number, which unit price shall include the cost of furnishing all materials and installing the dowel bars, and of protecting the dowel bars from damage.

3306 Polyethylene Sheet

- (1) Polyethylene sheet will be 1.5 mm thickness. At least 60 days prior to installing any polyethylene sheet, the Contractor shall submit drawings and data to the Engineer for approval.

The Contractor shall submit detailed laboratory test reports on the physical properties of the compound, which will be used in the polyethylene sheet to be furnished.

The polyethylene sheets cover the canal sector completely with the welding and overlaps, in such a manner not be less than 10 cm.

- (2) Measurement, for payment, of polyethylene sheet will be based on the area of polyethylene sheet shown on the approved Shop Drawings or prescribed by the Engineer with no allowance for lap at splices and intersections.

Payment for furnishing and installing of the polyethylene sheet will be made at the unit price per square meter, which unit price shall include the cost of furnishing all materials, preparing and submitting drawings and data, making field splices and intersections, and installing the polyethylene sheets.

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DIVISION 4 STEEL PIPE

SECTION 4000 FABRICATION AND CONSTRUCTION OF STEEL PIPE

4001 General

(1) General

This Section of the documentation comprises the Particular Specifications for the Works of Delivery Pressured Pipeline of El Seikh Gaber El Sabbah Canal.

The following terms shall have the meanings hereby assigned to them except where extent clearly renders these meanings inapplicable:

- “pipes” means pipes, bend, junctions and other fittings including internal and external coatings and includes jointing materials.
- “installation” means handling, placing and fixing in position, jointing, testing, earth works, and disinfecting whether in trench or elsewhere in the Works.

(2) Scope of Works

This specification covers the general requirements for supply, fabrication, laying, jointing, testing and commissioning of welded mild steel pipeline below ground and appurtenant facilities including associated civil works required for the pipeline systems.

4002 Applicable Codes and Standards

The following specifications, standards, and codes are part of this specification. All standards, specifications and codes of practice referred herein shall be the latest edition including all applicable official amendments and revisions.

In case of discrepancy between this specification and those referred to herein, this specification shall govern.

ISO599: 1991	Steel tubes for water and sewage
ISO630: 1995	Structural steels – Plates, wide plates, bars, sections and profiles
ISO2604: 1978	Steel products for pressure purposes—Quality requirements Part 2,3,6
JIS G 3106	Rolled steels for welded structure
ISO5252: 1991	Steel tubes - Tolerance systems
ISO6761:1981	Steel tubes - Preparation of ends of tubes and fittings for welding
BS 3601: 1987	Steel pipes and tubes for pressure purposes, Carbon steel: ordinary duties
BS 534: 1990	Steel pipes, fittings and specials for water, gas and sewage
BS 778–1966	Steel pipe and joints for hydraulic purposes
JIS G 3443:1987	Coated Steel Pipe for Water Service
BS 10: 1962	Flanges and bolts for pipes, valves and fittings

AWWA C602-89 AWWA Standard for cement - Mortar Lining of water pipeline
- 4 in.(100mm) and Larger - In Place

JIS G 3491-1977 Asphalt Protective Coating for Steel Water Pipe.

BS 21 Pipe threads for tubes and fittings where pressure - tight joints are
made on threads (metric dimensions)

JIS G 3452-1985 Carbon Steel Pipes for Ordinary Piping

ISO544: 1989 Filler materials for manual welding - Size requirements

ISO2560: 1973 Covered electrodes for manual arc welding of mild steel and low
alloy steel - Code of symbols for identification

ISO3834: 1994 Quality requirement for welding - Fusion welding of metallic
materials Part 1 to Part 4

ISO9606: 1994 Approval testing of welders - Fusion welding

ISO4136: 1989 Fusion welded butt joints in steel - transverse tensile test

JIS Z 2241:1980 Method of tensile test for metallic material

JIS Z 3121:1993 Method of tensile test for welded butt joints

JIS Z 3122:1990 Method of bend test for welded butt joints

ISO5173: 1981 Fusion welded butt joints in steel - Transverse root and face bend
test

ISO1106: 1984 Recommended practice for radiographic examination of fusion
welded joints

JIS Z 3104 Method of radiographic test for welded joints in steel

ISO544: 1989 Filler materials for manual welding - size requirements

ISO2560: 1973 Covered electrodes for manual arc welding of mild steel and low
alloy steel - Code of symbols for identification

BS4504: 1989 Steel, cast iron and copper alloy flanges

ISO7005: 1992 Metallic flange - Part 1: Steel flanges

BS5500: 1997 Specification for unfired fusion welded pressure vessels

JIS G 3101:1987 Rolled Steel for general structure

JIS G 3445:1983 Carbon Steel Tubes for Machine Structural Purposes

JIS G 5502:1989 Spherical graphite iron castings

JIS G 5702:1978 Blackheart Malleable Iron Castings

JIS K 6353: 1997 Rubber for water works

ISO5256: 1985 Steel pipes and fittings for buried or submerged pipe lines - External
and internal coating by bitumen or coal tar derived materials

BS 4504: 1989 Part 3: Section 1 Specification for steel flanges Types of circular
steel flanges from PN2.5 to PN40 and in sizes up to DN4000.
Facings, dimensions, tolerances, threading, bolt sizes, marking and
materials for bolting and flange materials with associated
pressure/temperature ratings

JIS G 3451: 1987 Fittings of Coating Steel Pipes for Water Service

BS 4515: 1996 Specification for welding of steel pipelines on land offshore

ISO10802: 1992 Ductile iron pipelines - Hydrostatic testing after installation

4003 Materials

Steel plates:	The steel plates for pipes, fittings, specials and stiffeners shall be of mild steel conforming to ISO 630/JIS G 3106, ISO 559/BS778/JIS G 3443, or ISO2604/BS3601/JIS G 3452.
Cement:	Portland cement conforming to ASTM C150 Type I , or Type V , and Sulphate resisting cement of the same Standard or other specified by the Engineer and in compliance with Sub-Section 3005.
Aggregate:	The aggregate shall conform to AWWA C 602 Sec.2.4 and in compliance with Section 3005.
Water	The water used in preparation of concrete mix shall conform to the requirements of mixing water specified in AWWA C 602 Sec.2.5. and in compliance with Sub-Section 3005.
Welding consumables :	such as electrodes, filler rods and wires shall conform to ISO 544 and ISO 2560.

When requested by the Engineer, the contractor shall provide test samples of the materials to be used in the works for testing. The cost of such tests shall be borne by the contractor and shall be included in contract unit rates.

4004 Inspection

All works and material under specification will be rigidly inspected during all phase of manufacture and testing and such inspection shall not relieve the Contractor of his responsibility to furnish materials and performed work in accordance with this specification..

The Contractor shall notify the Engineer, in advance of the procurement of materials and fabrication thereof, in order that the Employer may arrange for mill and shop inspection. The Engineer may reject any or all materials or work that do not meet with any of the requirements of this specification. The Contractor shall rectify or replace such rejected material/ performed work at his own cost, to the satisfaction of the Engineer.

The Engineer shall have free access to those parts of all plants or any other premises and sites that are concerned with the furnishing of materials or the performance of work under this specification.

The Contractor shall supply free of cost required specimen of materials for testing by the Engineer at any time during the progress of work and shall bear the cost of all such tests or retests to the satisfaction of the Engineer.

The Contractor shall provide 2 (two) sets of accurate 'Go' and 'No Go' ring gauges to measure the diameter of pipes, specials and fitting for the use of the Engineer at no extra cost.

4005 Manufacture of Pipes and Specials

(1) General

All pipes and specials shall be manufactured out of new mild steel plates which conform to ISO 630 E275A to D Grade Steel, or as specified Sub-Section 4003.

The pipes shall be truly cylindrical, and straight in axis. The ends shall be accurately cut and prepared for field welding. The external circumference of the pipe pieces which are to be fixed adjacent to flange adapter with fixed outer diameter shall not deviate from theoretical one by more than 2 mm. To obtain this accuracy the pipe shall be rolled several times, if necessary, as pipe pieces should be truly cylindrical. The external longitudinal welding of this pipe shall be ground smooth flush with surface to the satisfaction of the Engineer, for a length of 200 mm from the ends of the pipe. No extra cost shall be charged by the Contractor for this grinding work.

Minor repair by welding or otherwise shall be permitted at the discretion of the Engineer, but such repairs shall be done only after obtaining the prior permission from the Engineer. Any pipe or part thereof which develops injurious defects during welding or other operations shall be rejected.

(2) Fabrication Yard

Fabrication shall be carried out by the Contractor at their fabrication yards. This fabrication yard meant for fabrication of pipes, specials etc. shall be equipped with facilities for testing, coating, painting etc. For completing the work under the present contract within the contract period, the fabrication yard shall be equipped with adequate numbers of equipment and plant including:

- (i) Plate bending machine for rolling of pipe drums
- (ii) Automatic welding machines (suitable for circumferential as well as longitudinal welding)
- (iii) Hydraulic testing machines, X-ray or Gamma-ray apparatus
- (iv) Travelling gantry or crane of capacity 10 Tons or above
- (v) Mobile cranes for loading/ unloading of plates, pipes etc. 25 tons capacity each
- (vi) Lathe for machining of the flange rings, plates etc.
- (vii) Equipment for sand blasting, cement mortar lining, if necessary coating and for applying paint by spray gun
- (viii) Equipment for cold pressing of plates up to 25 mm thick to the required curvature (domes, plug plates, M.H. cover etc.)

The fabrication yard shall have adequate area, and shall also have stacking areas for the stacking of plates, pipes and fittings. The Contractor shall make his own arrangements for any area required.

(3) Demonstration

Contractor shall demonstrate the works in this contract at fabrication yard with a minimum of 4 demonstrations of each individual item of work before commencement of works and during the works at intervals specified and as directed by the Engineer. No payment shall be made in this regard.

The works under demonstration shall be include but not limited to the following:

- (i) Manufacture of pipe and specials
- (ii) Machine and manual welding to qualify 'Welding Procedures'
- (iii) External guniting
- (iv) Cement mortar lining
- (v) Hydrostatic testing before and after cement mortar lining
- (vi) Pipe handling procedures

(4) Cutting Plates to Size

The plates shall be utilized so as to minimize wastage and so as to make the pipes as far as possible with one longitudinal joint. Plate sizes are generally suitable for fabrication of 2.0 to 3.0 m long pipes for 2,400 mm diameter, to be made up to 9.0 m to 12.0 m lengths to suit Contractor's proposed working methods.

Before cutting, all the edges of the plates shall be cleaned by brushing / grinding both the sides.

After the plates are cut, the edges shall be made smooth and even by polishing with an electrical or pneumatic grinder to remove all inequalities. Care shall be taken to see that the cut edges of the plate are perfectly straight. Jigs to be used for this purpose shall depend upon the types of cutting machine used. The plates cut to the required shape shall be checked for correctness before they are rolled into pipe drums. If any corrections are required, the Contractor shall do the same by re-cutting, if necessary. If any plate or flat is found to be warped, to have corrugations, the defects shall be removed by putting the plate or flat into a roller press and rectified. Laminated or heavily corroded plate shall not be used in manufacturing of the pipe.

The ends of the finished pipe in the factory shall necessarily have bevel ends conforming to ISO 6761 to facilitate field welded joints.

(5) Rolling of Plates

The plates cut to the exact size shall be put into a rolling machine to form a pipe of the required diameter. The Contractor shall adjust the rolling machine so as to give a uniform curvature to the pipe throughout its circumference. The curvature obtained shall be checked by the Contractor's foreman during the process of rolling and if proper curvature is not obtained at any place including the ends, the rolling operation shall be repeated at this stage of even after the longitudinal welding or the drum where directed. Heating of plates to obtain the desired curvature shall not be permitted.

(6) Tacking the Drums

The rolled drums shall be kept on an assembly platform for tacking care being taken to ensure that the tacked drums have their end faces at right angles to the axis of the pipe. While tacking the drum, a gap of 2 mm to 4 mm shall be maintained, where manual arc welding is permitted. However, where the welding is to be done by automatic welding machine, there is no need to maintain such gap. To achieve this objective, clamp spiders, tightening rings and/or any other approved gadgets shall be used. Each such drum, before being taken to the assembly platform, shall be numbered on the inside with oil paint, stating the plate thickness as well.

(7) Assembly of Drums into Pipes

The tacked drums shall then be transported to an assembly platform where they shall be welded together to form suitable pipe-lengths. Plate shall be bent in the maximum possible width to reduce the number of circumferential joints. The number of longitudinal joints shall be as per ISO 6761.

The longitudinal joints shall be staggered at 90 degrees. The drums shall be tacked together as above. The assembly shall be truly cylindrical and without any kinks. The faces shall be at right angles to the axis of cylinder. A suitable arrangement for testing the correctness of the pipe shall be provided by the Contractor at the assembly platform.

(8) Specials

Specials shall be fabricated to the dimensions shown on drawings. Specials, such as tees, bends, etc. shall necessary be in steel and shall be in accordance with BS10, BS534, AWWA C208, JIS G 3451 and/or ASME standards and tested and laid in the same manner as the pipes.

Standard fittings shall be used wherever possible in preference to fabricated fittings. Standard fittings shall be manufactured in accordance with standards specified above. Where fabricated fittings are supplied, with approval of the Engineer they shall be fully workshop fabricated and tested in accordance with above standards.

Tees and Branches on steel pipelines must be reinforced by welding reinforcement collars around the base of the branch in accordance with standards specified above.

The fittings shall be designed and, if considered necessary by the Engineer, fabricated by a specialist contractor and the design calculations and Drawings shall be submitted to the Engineer for approval. All other fittings, tees, branches, crosses and bends are to be designed by the contractor and/or fabricator.

Steel specialists shall have the same chemical and mechanical properties and shall be compatible in all respects with pipes with which they are to be used. The marking of pipes and fittings shall be as specified.

(9) Electrodes

The contractors shall use appropriate type and size of electrodes with suitable flux covering depending on the thickness of plate and the type of joint. They shall also use standard current and voltage required for the machine in use as per manufacturer's directions. Welding electrodes shall conform to ISO544, ISO2560, BS534, JIS Z 3211, and/or JIS Z 3351/3352. Egyptian made or equivalent foreign made electrodes of the approved quality shall be used. The Contractor shall provide suitable equipment and ovens to keep the electrodes dry at the desired baking temperature.

(10) Welding

Upon receipt of the order and prior to the start of fabrication, the Contractor shall submit to the Engineer for his approval "the Welding Procedure Method Statement" he intends to use in the shop work. At the same time the procedure for the field welding must be submitted to the Engineer for his approval.

All components of pipe shell, either straight or bent etc. shall be welded by use of automatic arc welding machine by submerged arc process with alternating current. The strength of the joint shall be at least equal to that of the parent material. Manual welding shall be adopted only when machine welding is not possible.

The Contractor shall use electrodes of approved make and size, the size depending on the thickness of plate and the type of joint. Standard current and arc voltage required for the machine shall be used with necessary modifications as may be found necessary after experimental welding. For this purpose, samples of welded joints shall be prepared and tested in the presence of the Engineer for qualifying "the Welding Procedure Method Statement". Only approved welding procedures shall be used throughout the work and if any modifications are to be made, the written permission of the Engineer shall be obtained.

All longitudinal and circumferential joints shall be Single-V or Double-V butt joints with or without backing plates. After completing the welding joints of pipes or plates from one side, and before the welding on the other side, the joints shall be back chipped/gouged and ground to remove irregular penetration till the even surface is exposed. Gouging shall be resorted to when the plate thickness is more than 6 mm.

All circumferential welds involving plates of unequal thickness shall be so kept that the inside surface of plates match to provide stream lined joints without alteration in the internal diameter.

The welding shall be of the best workmanship free from weld defects. In order to maintain a good standard in welding, welders shall be tested by the Contractor before they are entrusted with the job. Qualification standard for welding procedures, welders and welding operators shall conform to ISO3834, /ISO9606. Only those who pass the test shall be allowed to work on the job. Periodical tests as regards their competence shall also be taken at suitable intervals and those

found incompetent shall be removed from the job. If an incompetent welder has already welded some pipes, all welding done by him previously shall be fully checked by X-ray in addition to the regular X-ray inspections. The defects if any, shall be rectified to the satisfaction of the Engineer. All such check tests and rectification of defects shall be entirely at the cost of the Contractor. No pipes or steel sections shall be erected unless the work of the welder concerned has been proved to be satisfactory and qualified. Site welds shall be done by welders qualified for the various welding positions as per applicable Egyptian codes and related standards.

A record shall be maintained showing the names of welders and operators who have worked in each individual joint. Manual arc welding shall preferably be carried out by a pair of welders so that, by observing proper sequence, distortion can be avoided. A joint entrusted to a particular individual or a pair shall be as far as possible, completed by them in all respects, including sealing run. No helper or other unauthorized person shall be permitted to do any welding whatsoever.

The weldment should not become brittle or sensitive to blows and there should be no loss of toughness due to welding or heat treatment. The material after welding and heat treatment shall match with the base metal properties including original ductility. The weld should in no part be less than the nominal thickness of plate a slight reinforcement as per Egyptian codes shall be maintained on all weld joints. Final welding of closure gaps should be carried out within a temperature range of average air temperature ± 8 C.

Where required by the Contractor's working methods the pipes shall have cable holes/entries installed in the fabrication shop; they shall comprise a hole in the pipe with a reinforcing plate welded to the pipe with a tapped hole in it large enough to allow the passage of cables and other paraphernalia necessary for welding the pipes. A screwed plug shall be provided to close the hole.

4006 Testing and Marking

(1) Testing of Weld Coupons

Test pieces shall be provided by the Contractors for both longitudinal and circumferential welded joints at the positions pointed out by the Engineer. The sample so taken out shall then be cut to the exact shape and dimensions and machined as described in relevant standards before testing for chemical and mechanical properties.

The entire cost of the tests including provision of test samples, machining the test pieces, transport to and from the laboratory and testing them in a laboratory, payment of all testing fees, cleaning and painting etc. shall be borne by the contractors. The tests shall be carried out in specified yard and/or factories approved by the Engineer. This shall be arranged by the Contractor with the approval of the Engineer. The testing laboratory shall have instruments/equipment which are having calibration requirements traceable to National or International standards.

The following tests shall be carried out:

(a) Mechanical Tests

The test plates shall be subjected to all mechanical tests as per the approved Method Statement, or as otherwise reasonably directed by the Engineer. Test shall be carried out in accordance with relevant standards. The tests shall include determination of yield strength, tensile strength, elongation and bend test. Tensile tests shall be carried out in accordance with ISO 4136 and/or JIS Z 3121. One test plate shall be provided for from each lot of 100 lengths.

If a test specimen shows defective machining or develops flaws not associated with welding, it may be discarded and another specimen submitted. The welded joint shall exhibit mechanical and chemical properties not lower than those specified for ISO 630 Grade E275 or JIS G 3106 SM400A or equivalent.

Guided Bend test shall be in accordance with ISO5173 and/or JIS Z 3122. One bend test shall be carried out from each lot of 50 lengths. The test shall comply with the requirements specified in ISO5173 and/or JIS Z 3122.

(b) Field Joints

The field welded joints shall be tested in accordance with the procedure laid down in ISO1106/1 to 3, ISO5579 and/or JIS Z 3104. One test plate shall be taken for every 100 joints and shall be subjected to mechanical and chemical tests as specified above.

(2) Re-tests

If the results of tests of any lot do not conform to the requirements specified, retests of two additional specimen from the same lot shall be made, each of which shall conform to the required specifications. In case of a failure of one or both, gouging and repairing shall be carried out to the particular lot of joints from which the samples have been taken as directed by the Engineer before the lot can be accepted. The rectification process also shall have adequate test plates and they shall be tested for compliance with the Egyptian or related ISO codes/standards.

In case both the samples yield satisfactory results in the re-test described above, gouging and repairing will be required to be carried out on the joint which has failed in the initial test only.

All changes in connection with re-testing of the welded samples including machining, testing etc. shall be borne by the contractor.

(3) Radiograph of welded joints

As soon as practicable, after welding is done at fabrication yard, every longitudinal and circumferential welded length minimum 10 % (ten percent) length of the weld at random or as direction of the Engineer for each pipe shall be radiographed, to detect welding defects as per the requirement of ISO1106 BS4515 /BS2910 and/or JIS Z 3104, and as directed by the Engineer. This 10 % sampling will be at random but ensure 100% coverage of junctions of

longitudinal and circumferential joints. If the results of such radiography fail to conform the requirements, the Contractor shall carry out 100 % radiography test for the pipe as directed at the Contractor's cost to the satisfaction of the Engineer.

The weld ripples or weld surface irregularities and slag etc. on both inside and outside shall be removed by any suitable mechanical process to a degree such that resulting radiographic contact due to any remaining irregularities cannot mark or be confused with that of objectionable defect. The radiograph shall be made in strict accordance with the latest requirements and as per the latest and most efficient technique either with X-ray or gamma ray equipment. The safety requirements during radiography shall be in accordance with Egyptian codes/standards.

The radiographs are to be marked in such a way that the corresponding portion of the welded seam and the welder can be readily identified. All radiographs will be reviewed by the Engineer to identify the defects and determine those which requires rectification. Defects that are not acceptable shall be removed by chipping, grinding or flame gouging to sound metal and the resulting cavities shall be welded. After rectification, the joint is to be radiographed again to prove the quality of the repair. The radiographs will be judged as acceptable or unacceptable by the Engineer based on the latest standards prescribed by relevant Egyptian Standard specification.

All X-rays shall be taken with equipment and by personnel of the Contractor. Films shall be developed within 24 hours of exposure and be readily accessible at all times for inspection by the Engineer. The Contractor shall provide for the use of the Engineer suitable X-ray viewing equipment. X-ray films shall be properly maintained by the Contractor. A complete set of radiographs and records as described in ISO1106 and/or ASTM E94, for each job shall be retained by the Contractor and shall be handed over to the NSDO on completion of the Contract. All films shall be identified by the number and chart prepared indication location of any work associated with the pipe erection and such inspection shall be performed by the Radiographer at the discretion of the Engineer.

Radiographic Inspection of welded joints:

All welded joints to be radiographed shall be examined in accordance with the followings:

- | | |
|------------------|--|
| ISO1106 - 1:1984 | Recommended practice for radiographic examination of fusion welded joints- Part 1 in steel plates up to 50 mm thick |
| ISO1106 - 3:1984 | Recommended practice for radiographic examination of fusion welded joints- Part 3: Fusion welded circumferential in steel pipes up to 50 mm wall thickness |
| BS4515 | Field welding of carbon steel pipings |
| BS2910 | General recommendation for the radiographic examination of fusion welded circumferential butt joints in steel pipes |
| JIS Z 3104 | Method of radiographic examination for welded joints in steel |

Radiographers performing radiograph shall be qualified in accordance with SNT-TC-1A. Supplements and Appendices "Recommend Practice for Non-destructive Testing Personnel Qualification and Certification" published by the American Society for Non-destructive Testing

as applicable for the technique and method used.

Final acceptance of radiographs shall be based on the ability to see the prescribed penetrometer image and the specified hole.

Sections of welds that are shown by radiography to have any of the following types of imperfections shall be judged unacceptable and shall be repaired.

- (i) any type of crack, or zone of incomplete fusion or penetration,
- (ii) any elongated slag inclusion which has length greater than 6 mm
- (iii) any group of slag inclusion in line that have an aggregate length greater than thickness in a length of 12 times thickness, except when the distance between the successive imperfections exceeds 6 L where L is the length of the longest imperfection in the group,
- (iv) rounded indications in excess of that specified by the acceptance standards given earlier.

(4) Tolerances

Tolerances for straight pipes shall be in accordance with ISO5252 or as amended below.

Finished pipe sections shall be truly straight with walls parallel to the axis of the pipe and shall not be out of the alignment by more than 0.2 % of the total length.

The outside circumference of the pipe shall not vary by more than 0.5 percent.

Outside diameter of the pipe shall not vary by more than plus or minus 0.5 per cent.

The permissible tolerances for specials for diameter, arm length and angular deviation shall be in accordance with ISO5252, BS 534, and/or JIS G 3451.

Whenever any dent, i.e. a significant alteration of the curvature of the pipe shell is noticed, the depth of the dent shall be measured between the lowest point of the dent and the pipe shell curvature line. All dents exceeding 2 percent of the outer diameter of the pipe shall be removed by cutting out a cylindrical portion of the pipe and replacing the same by an undamaged piece of the pipe. The Engineer may permit insert patching if the diameter of the patch is less than 25 percent of the nominal diameter of the pipe. Repairs by hammering with or without heating shall not be permitted. Any damage to the coating shall also be carefully examined and rectified.

(5) Pipe Testing in Fabrication Yard

A hydraulic test shall be carried out at the fabrication shop for each pipe length fabricated, to the satisfaction of the Engineer. All pipes and specials shall be subjected to hydraulic test at the fabrication yard after fabrication, but before application of protective coatings.

Prior to testing, the pipe shall be inspected thoroughly and all the apparent defects in welding such as slag, porosity etc. shall be repaired by gouging and re-welding.

Each pipe shall be filled with water slowly and the pressure increased uniformly until the required test pressure is reached. The test pressure shall be as follows:

- 22 mm thick pipes and fittings: 20 bar
- 12 to 6 mm thick pipes and fittings: 20 bar

The pipe to be tested shall be given a serial number which shall be painted with details such as pipe number, shell thickness, diameter, length etc. as directed by the Engineer. It shall be entered in the register to be maintained by the Contractor. The register shall be maintained in suitable giving the following information for each shell tested:

- a) Serial No.
- b) Pipe No.
- c) Date of test
- d) Specification and thickness of steel
- e) Weight of pipe shell tested
- f) Maximum test pressure
- g) Details of test performance
- h) Details of radiographic examination of welds
- i) Name of the Engineer's representative witnessing tests

A copy of these details shall be furnished to the Engineer.

For indicating the pressure inside the pipeline an accurate pressure gauge of approved make duly tested and calibrated for the accuracy of readings shall be mounted on one of the closures which close the pipe ends.

The pressures shall be applied gradually by approved means and shall be maintained for at least 10 minutes or till the inspection of all welded joints is done during which time the pipe shall be hammered throughout its length with sharp blows, by means of a 1 kg. hand hammer.

The pipe shall withstand the test without showing any sign of weakness, leakage, oozing or sweating. If any leak or sweating is observed in the welded joints, the same shall be re-tested to conform to the specified pressure.

If any leak or sweating is observed in pipe shell the pipe under test shall be rejected temporarily. The Contractor shall stack such rejected pipes separately in the Contractor yard. The Engineer shall inspect the same and shall determine the nature of repairs to be carried out thereon and shall then decide as to how and where they shall be used. No payment shall be made of handling or carrying out repairs, but, payment for, fabrication and shop hydraulic testing of the pipe shall be released only after acceptance of the pipe with necessary repairs and subsequent testing etc. are carried out by the Contractor to the satisfaction of the Engineer. The Engineer shall be

supplied with two copies of the results of all the tests carried out.

No pipe shall be transported out of the fabrication yard to the site unless they have been hydraulically tested except permitted by the Engineer in writing to do so.

(6) Marking

All pipes and specials shall bear the following markings. The marking shall be on the side which will be the inside of the pipe after bending. The marking operation shall be conducted with full size rulers and templates. Only blunt nose punches should be used.

The plates used for fabrication of pipes shall be laid out in such a way that when the shells are completed one set of original identification markings for the material will be plainly visible. In case there markings are unavoidably cut out, they shall be accurately transferred by the Contractor to a location where markings will be visible on the completed work.

After the hydraulic tests on the specials the direction of flow shall be stamped in a prominent manner.

- (a) Outside Diameter (mm)
- (b) Length of pipe/angle of the bend (m/degrees)
- (c) Plate thickness (mm)
- (d) Approximate of weight of the pipe/ special (Tons)

4007 Joints

(1) General

Unless detailed otherwise, all pipes and fitting shall have welded joints as detailed in Drawings. Where shown on the Drawings, flanged joints or collar sleeve joints shall be provided.

(2) Welded Joints

The use of butt welded joints for joining pipes shall be in accordance with Clause 4005 (10) Welding and end preparation shall be in accordance with ISO6761.

(3) Sleeve collar joints

The use of sleeve collars shall generally be limited to the joining pipes at tie-ins. The thickness of the external steel sleeve collar shall be not less than that of the pipe itself and the length a minimum of 300 mm. The sleeve shall be jointed to the pipe with an internal full depth structural weld and external sealing welds to allow the joints to be gas tested. A gas testing hole shall be made at each end of the sleeve and for the purpose of gas testing the joints.

(4) Flanged joints

Flanges shall comply with ISO5252 / BS 4504. The nominal pressure rating shall be at least equal to the highest pressure rating of the pipes or fitting to which they are attached, but with a minimum 7.5bar. The Contractor shall fabricate flanges meeting the requirements of pipe sizes under this contract or otherwise to suit the abutting valves or other connections, if they are not readily available. Flanges shall be provided with all necessary nuts, bolts, washers and gaskets, as specified herein. The Contractor shall also supply in suitable containers sufficient graphite for application to the bolt threads when joints are made.

(5) Flexible joints

Flexible joints made of steel barrel shall be applied for buried steel pipe at position of pipe passing through structural wall unless otherwise specified and shall be closer joint, CL-A type as manufactured by the Victaulic Company or other type as approved by the Engineer. Flexible joints shall be designed to withstand any forces or any combination of forces due to expansion and contraction, shear deflection, distortion and other forces to the pipeline.

Flexible joints shall be designed as maximum working pressure 13 bar and shall ensure the pipeline against any anticipated forces and deflections to meet condition of construction, design requirements and operating conditions.

Flexible joints shall consist of slip pipes, a sleeve pipe, two rubber rings and housings and others, and shall have bevel end for welding joints.

Each slip pipe shall have the continuous ring type reinforcing rib and slip pipes and sleeve pipes shall be fabricated from steel sheets or plates, with minimum yield point of 216 N/mm², conforming to JIS G 3101, Class 2, JIS G 3445, STKM 370, JIS G 3454, STPG 370 or the International Standard Specifications whenever applicable or the Standard Specifications of the country of manufacture.

Rubber ring housing shall be made of ductile iron casting conforming to JIS G 5502, Class 2, FCD 450, JIS G 702 Class 2, FCMB 310 or the International Standard Specifications whenever applicable or the Standard Specifications of the country of manufacture.

External and Internal coating and lining of the flexible joints shall, unless otherwise specified, be painted or lined in accordance with Sub-Section 4011 and Sub-Section 4013 of the Specification.

Testing and inspection of the flexible joints shall be carried out and shall be prevailed safety by the Engineer in the similar to the working condition with application of maximum deflection angles and maximum working pressure of 13 bar.

(6) Slip on Type Couplings

Slip-on type couplings shall include the following couplings:

- (a) Straight flexible couplings
- (b) Stepped flexible couplings
- (c) Flange adapters
- (d) Dismantling joints (Loose flange)

Slip-on type couplings shall be from the Viking Johnson System manufactured by the Victaulic Company or from approved suppliers whose fitting meet the same Specification.

The preparation of pipe ends for slip-on type couplings shall be in accordance with the requirements of and the tolerances specified by the joint manufacturer. Couplings shall be installed fully in accordance with the manufacturer's recommendations.

Slip-on type couplings shall be protected if buried with Densomastic and Densotape wrapping or similar approved material applied in accordance with the manufacturer's recommendations. Flexible joints shall be harnessed or tied where shown on the Drawings. Flexible couplings and flange adapters shall be supplied with transit protection.

4008 Storage

Pipes and fittings shall be stored raised off the ground and shall be carefully supported, cushioned and wedged. Special care shall be taken to ensure that steel pipes are cradled and supported in a manner that prevents any distortion of the pipes.

All gaskets, nuts and bolts flange adapters and other similar items shall be stored in dry conditions, raised off the ground in shed or covered areas.

Until required for incorporation each rubber ring or gasket shall be stored away from windows, electrical equipment and other materials like oil and chemicals and also from heat.

Where items require special storage requirements, the method of storage shall be to the approval of the Engineer and in accordance with manufacturer's requirements.

Storage areas shall be set out to facilitate unloading, loading and checking of materials.

All pipe materials shall be inspected when deposited in the storage area any defects or damage shall be noted and reported to the Engineer. The pipe material shall only be repaired or replaced with the Engineer's Approval.

End covers and other protection shall not be removed until incorporation of the pipes or fittings into the Works.