



BARBADOS WATER AUTHORITY

TENDER FOR

THE

SUPPLY OF PIPES

AND FITTINGS

October 2021

1. GENERAL

- 1.1 The Barbados Water Authority invites tenders for the supply of pipes and fittings to support its mains replacement programme and maintenance of the distribution system.

For further information please contact the Manager of Procurement at the Barbados Water Authority, telephone number 434-4200 between the hours of 8:15 am and 4:30pm Monday to Friday.

2. INSTRUCTIONS TO TENDERERS

- 2.1 All bidders must supply the following information in their bids. Failure to provide the information will render the bid void: -

- a. Registration number of company.
- b. Country in which company is registered.
- c. The date on which the company was first incorporated and the names and addresses of all company directors. Certified copy must be issued by the Corporate Affairs Registry.
- d. A certified copy of company's Certificate of Incorporation, as evidence that the company is in existence at the date of the bid; Failure to provide the certified copy Certificate of Incorporation will render the tender null and void. Certified copy must be issued by the Corporate Affairs Registry.
- e. Registered office of the company.
- f. In the case of sole proprietorships or partnerships, the names and addresses of owners must be supplied. If the business is registered under the Registration of Business Names Act, a copy of the registration must also be provided. Certified copy must be issued by the Corporate Affairs Registry.
- g. Barbadian bidders must provide a copy of their VAT Registration Certificate and Tax Identification Number (TIN).
- h. Tenders should be submitted in sealed envelopes marked "**Tender for the supply of Pipes & Fittings #040121**" and addressed to:-

**The Chairman
Tenders Committee
Barbados Water Authority
Pine Commercial Estate
The Pine
St. Michael**

to reach the office no later than **Wednesday 13th October, 2021 at 4:30pm.**

- i. Tenders are to be placed in the Tenders Box which is located at the Barbados Water Authority's office at Pine Commercial Estate, The Pine, St. Michael.
- J. **Bidders should first proceed to the receptionist, sign the register, then placed their bids in the Tenders Box which is located at the Barbados Water Authority's Office at the BWA's Headquarters at Pine Commercial Estate, St Michael.**
- k. No Tender will be considered unless it complies with the conditions set out in the tender document.
- l. The Barbados Water Authority does not bind itself to accept the lowest or any tender.

Tenders can also be submitted via electronic mail with attachments in PDF format to the email address below with the subject: **"Tender for the supply of Pipes & Fittings #0410211"** and addressed to:

The Chairman
Tenders Committee
Barbados Water Authority
Email: bwatenders.committee@bwa.gov.bb

to reach the office no later than **Wednesday 13th October, 2021 at 4:30pm.**

- 2.2 All prices must be quoted in Barbados or US Dollars, **CIP BWA warehouse. All unit prices quoted must be inclusive of cost, insurance & freight.** Prices quoted in US dollars will be evaluated using the prevailing exchange rate at the close of the tender. Payment in US dollars shall be made at the buying rate set by The Central Bank of Barbados at the time of payment.
- 2.3 Prices tendered must be retained for the period of the contract. All terms of payment, lead time, country of manufacture and origin must be clearly indicated within your response.
- 2.4 It is the responsibility of the supplier to make all the necessary arrangements for letters of credit or other credit documents as deemed necessary in order to procure the goods. The Barbados Water Authority will not pay for any such documents.
- 2.5 The BWA reserves the right to refuse any tender for the delivery of goods and services that does not conform with the requirements of this document.
- 2.6 The successful bidder will be required to enter into a formal contract with the Barbados Water Authority. Contracts will be awarded to more than one bidder.
- 2.7 Complete specifications together with catalogue numbers or catalogues giving details of all items must be submitted with the tender. Certificates stating the date of manufacture, the country of manufacture, and the country of origin for all pipes and fittings must be provided.

3. PAYMENT

The BWA shall pay the Supplier 50% of the contract price upon satisfactory evidence that the Goods have arrived in Barbados and the balance upon satisfactory receipt of the Goods at the BWA's authorised location.

4. PENALTIES

The Barbados Water Authority reserves the right to enforce penalties against a tenderer for delays occasioned by him in the late delivery of these goods. The penalty shall apply from the agreed delivery dates of the goods. The total penalty shall not exceed 5% of contract sum for the first tranche, and 10% thereafter for each additional tranche. When there is evidence that the lack of performance directly impacts the BWA's operations penalties in the form of a retention on payments due to the tenderer will be applied.

5. EVALUATION CRITERIA

The Barbados Water Authority will evaluate all tenders based on the following criteria:

- Compliance with instructions to tenderer
- Compliance with specifications
- Optimum pricing
- Optimum lead time

MATERIALS SPECIFICATIONS FOR PIPE, FITTINGS & APPURTENANCES

Scope

All materials shall be furnished in accordance with these specifications as well as all aspects of the referenced specifications/standards.

Note: All Standards and Codes given in this specification shall be the latest revision unless otherwise stated. All flanges must be machine cleaned prior to coating.

Acronyms

ANSI – American Standards Institute

ASTM – American Society for Testing & Materials

AWWA–American Water Works Association

BS – British Standard

WRC – Water Research Council – United Kingdom (U.K.)

WIS – British Water Industry Specification

WRAS – Water Regulations Advisory Scheme – U.K.

ISO – International Organization for Standardisation

References*

ANSI B16.1	Standards of Pipes and Fittings
ANSI/AWWA C151/A21.11	Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
ANSI/AWWA C800	Underground Service Line Valves and Fittings (Also Included: Collected Standards for Service Line Materials)
ANSI/AWWA C800-89	Underground Service Line Valves and Fittings (Includes Collected Standards for Service Line Materials)
AWWA C900	(PVC) Pressure Pipe and Fabricated Fittings
AWWA C906	Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,575 mm), for Water Distribution and Transmission
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM F714	Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
ASTM D2241	Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
ASTM D1238	Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D2000	Standard Classification System for Rubber Products in Automotive Applications
ASTM D2122	Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
ASTM D3261	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM F2206	Standard Specification for Fabricated Fittings of Butt Fused Polyethylene (PE) Plastic Pipe, Fittings, Sheet Stock, Plate Stock, or Block Stock
ASTM F1055	Standard Specification for Electro-fusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Cross-linked Polyethylene (PEX) Pipe and Tubing
ASTM 2737	Standard Specification for Polyethylene (PE) Plastic Tubing
ASTM 1973	Standard Practice for Collection of Surface Dust by Air Sampling Pump Vacuum Technique for Subsequent Lead Determination
BS 1400- LG2	Specification for copper alloy ingots and copper alloy and high conductivity copper castings
BS2872/ C2116/ CA104	Specification for copper and copper alloys. Forging stock and forgings
BS970 431-529	Specification for wrought steels for mechanical and allied engineering purposes.
BS 4504 PN16	Circular flanges for pipes, valves and fittings (PN designated). Ferrous
BS 4278	Specification for eyebolts for lifting purposes
BS 4190	ISO metric black hexagon bolts, screws and nuts. Specification
BS 2494	Specification for elastomeric joint rings for pipework and pipelines
BS 5155	Specification for Butterfly valves

BS 6572	Specification for blue polyethylene pipes up to nominal size 63 for below ground use for potable water
BS 750 TYPE 2	Specification for underground fire hydrants and surface box frames and covers
BS EN 124	Gully tops and manhole tops for vehicular and pedestrian areas. Design requirements, type testing, marking, quality control
BS EN 1452 GRADE 50/250	Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure
BS EN 1561 GJL-HB-185	Founding. Grey cast irons
BS EN 1563 EN GJS 500-7	Founding. Spheroidal graphite cast irons
BS EN 10088 NO.1.4104	Stainless steels. List of stainless steels
BS EN 12613:2009	Plastics warning devices for underground cables and pipelines with visual characteristics
BS EN 45011	General requirements for bodies operating product certification systems
BS EN 45012	General requirements for bodies operating assessment and certification/registration of quality systems
BS EN 593:1998	Industrial valves. Metallic butterfly valves
ISO 9001	Quality management systems. Requirements
ISO 4427-1	Plastics piping systems. Polyethylene (PE) pipes and fittings for water supply. General
ISO 2230	Guidelines for Storage of Rubber Products
ISO 12162	Thermoplastics materials for pipes and fittings for pressure applications. Classification, designation and design coefficient
WIS 4-52-01, CLASS B	Specification for Polymeric Anti-Corrosion (Barrier) Coatings
UNI-B13-94	"Recommended Performance Specification for Joint Restraint Devices for Use with Polyvinyl Chloride (PVC) Pipe" (or equivalent standard to ASTM F1674 – 11- Standard Test Method for Joint Restraint Products for Use with PVC Pipe)

*Note that for each of the standards listed above the standard may be used as referenced in the body of this document. However the relevant equal or compatible standard in those published by the British Standards Institute, International Organization for Standardization or European Standards are also approved for use.

General

1. Material Testing Reports

The Manufacturer/Vendor shall provide a certified copy of the Materials and Testing Report for all pipes, fittings and appurtenances to be supplied which have been tested in accordance with the standards specified in this document and by a certified independent testing institution and approval obtained from the BWA, prior to the shipment of any items.

For the production of all plastic pipes (PVC and HDPE) the Material Testing Report shall confirm the properties of pipe and fittings by providing the following information as a minimum:

- Material (resin where applicable) and lot number
- Extruder Line (or production line)
- Material designation code
- Burst or apparent ring tensile strength
- Pipe diameter and Standard Dimension Ratio (SDR)
- Pipe manufacturing date
- Pipe reel or crate number

2. Manufacturer's Certification

The manufacturer shall be listed by Underwriters Laboratories (UL) of the United States or approved by Factory Mutual (FM) of the United States or listed and approved by the Water Research Council, United Kingdom (WRC-UK). A certificate of compliance shall be submitted and approval obtained from the BWA, prior to the shipment of any items.

3. Quality and Workmanship

All pipes, fittings and accessories shall be manufactured in compliance with the ISO9001:2008 quality management system standards for the manufacturing factory. The Manufacturer shall have a suitable quality assurance programme that assures that the quality of raw materials and finished products are in accordance with the Ductile Iron, PVC and HDPE piping specifications requirements, including reference industry standards. In addition to product quality control tests the manufacturers must also perform and satisfy long term type tests to demonstrate long term performance of pipe as detailed in relevant standards. Quality Management System Certification

shall be from an organization accredited to issue such certification and the manufacturer shall have this certification valid during the supply and delivery of the materials. Documentary evidence regarding quality assurance, certificate of compliance with the specifications and accreditation together with the scope of certification shall be provided.

- All metallic pipes, fittings, appurtenances and ancillaries shall be designed to resist corrosion in aggressive soils in the Barbados typical environmental conditions.

4 Specifications

Please provide detail specifications giving details on each item.

5. Records Retention

Permanent records regarding the manufacture and quality assurance of all pipes, fittings and appurtenances, fittings shall be maintained by the manufacturer for a minimum of five (5) years.

6. Warranty

All pipes, fittings, appurtenances, and ancillaries shall be covered by the manufacturer's limited warranty of a minimum of ten (10) years.

7. Transportation

- a. A methodology for transportation shall be provided for the protection of **All** materials (pipes, fittings and ancillaries) to the manufacturer's specifications and to the approval of the BWA and obtain written approval prior to these materials leaving the place of manufacture and shall maintain such protection (described in detail following) until the items reach their destination in order to guard effectively against damage during handling, transit and storage and ingress of foreign matter inside the materials.
- b. For transporting bulk loads, vehicles shall be provided with a clean flat bed, free from nails or other projections, which may cause damage. If high sided lorries are used, special care must be taken to prevent slippage or excessive bowing of pipes and extra protection given at all sharp edges.
- c. Care shall be taken to avoid positioning materials near or adjacent to exhaust systems or other heat sources and to avoid possible contamination from materials such as lubricating or hydraulic oils, corrosive gases, solvents and other aggressive chemicals.
- d. When transporting pipes of different sizes, pipes of higher pressure class shall be loaded underneath.

e. Pipe

- i. Preparation for transport shall protect the pipe wall and joining ends from damage. End protection shall be purpose made one-piece polymer, e.g. polyethylene caps, which shall fit tightly over the pipe ends.
- ii. End caps shall be left in place until the pipe/spool is ready to be joined.
- iii. Pipe shall be transported packed on a flat rack container, stacked in bundles based on their size and strapped onto pallets. Spacer stripping shall be used as both supports for the pipes and as separators between pipe layers to ensure that adjacent pipes do not rub or chafe. Maximum distance between supports shall be 3 m and the supports shall be placed at a minimum of 1 m from the end of the pipes. Suitable tie-downs such as nylon straps shall be used to secure the stack.
- iv. Pipe with bell ends shall be stored with the bell ends in alternate directions to avoid contact and possible damage to ends. Spacer stripping shall be located clear of the bell ends.
- v. **Nesting smaller pipes inside larger pipes is not allowed.**
- vi. Pipe spools shall be packed by the Manufacturer to avoid damage during transportation.

f. Fittings

- i. All fittings shall be transported in crates or boxes, and flange faces shall be protected by timber sheet or similar.
- ii. All fittings shall be packed in such a way to allow instant use on site without additional cleaning.
- iii. All electro-fusion fittings shall be packed in transparent protective bags and then packed in carton boxes.
- iv. All crates and boxes shall be marked clearly, legibly and indelibly.

8. Handling

- g. The Manufacturer's instructions regarding use of slings, spreader bares, or other handling devices and all specifications on handling shall be followed.
- h. Chains, wires or hooks shall not be used for lifting.

- i. When pipe is being loaded or unloaded, each length shall be handled individually.
- j. Unloading pipe by pulling out side stakes or sideboards and allowing the pipe to roll off the trailer is not permitted.
- k. Under no circumstances shall piping components be dropped, or set on sharp objects, chains, wire ropes or clamps shall not be used for lifting pipe components.
- l. Short pipe sections up to 3 metres (10 ft.) in length may be lifted by a crane using at least one 100mm (4 ins.) wide canvas or nylon sling. Longer pipe sections, up to 12 m (40 ft.) in length may be lifted with a 6 m (20 ft.) spreader bar and two 100mm (4 ins.) wide nylon slings. The lifting point or points shall be such that the pipes are well balanced.
- m. Forklift trucks shall not be used to load and unload polyethylene pipes except where coils are neatly stacked on pallets or coils are provided with slings.
- n. Fittings shall be loaded by hand onto pallets, or into crates or baskets, with inter-component packing material to avoid transportation damage, and shall be strapped down during lifting.
- o. For lifting pipe spools, two or more 100 mm (4 ins.) wide canvas or suitable polymer slings shall be used.
- p. HDPE pipe and fittings
 - i. The HDPE pipe and fittings throughout their manufacturing processes and shipment to the BWA shall remain free of any visible defects including pinholes, blisters, laminations, porosity, gouges, scrapes and cuts.
 - ii. Coiled HDPE pipe shall be placed on reels for shipping with only one segment placed on a reel. No joining of lengths on a single coil is permitted. All coiling of pipe onto reels shall be performed with the HDPE pipe temperature between 5 and 40 degrees Celsius or 41 and 104 degrees Fahrenheit.
 - iii. The materials storage procedure shall be at the direction of the Manufacturer and shall be in a manner that ensures no excessive ovality of the polyethylene pipe is produced that exceeds 5%.
 - iv. The pipe and fittings shall be handled and lifted in a manner that causes no cuts or gouges or any excessive mechanical damage. Minor isolated abrasions, cuts and gouges associated with handling and storage may be accepted by the BWA provide they are no greater than 10% of the wall thickness.
 - v. Pipe and fittings that are loaded at the Manufacturer's plant shall be loaded and secured for transport using methods that cause no mechanical damage.

- vi. HDPE pipe ends shall be squarely cut plain ends. Coiled pie ends shall be covered and protected with a suitable covering that will prevent dust or water entry and that is adequately secured for shipment.

9. Storage

- a. All materials shall be stored in an approved location and in such a manner as to preserve their quality and condition as recommended by the manufacturer.
- b. In the event that storage of piping components is required prior to installation, special precautions to avoid possible damage to any item shall be taken. Consideration shall be given to the state of the storage surface (i.e. level and no sharp objects), high winds, extreme temperatures and exposure to ultraviolet (UV) radiation.
- c. Adhesive bonded –connection surface of pipe and fittings shall be protected against contamination by moisture or dirt (e.g. moulded –on rubber end caps). Silicon based rubbers or release agents shall never be used.
- d. Pipes
 - (i) Pipes shall be stored on flat timbers or polymer spacers to facilitate placement and removal of lifting slings. The support timbers shall be of sufficient width to prevent point loading.
 - (ii) The manufacturer’s recommendations shall be strictly followed with regards to the maximum stack height. Spacer stripping shall be used both as supports for the pipes and as separators between pipe layers. The maximum distance between supports shall be 2.5 m (approximately 8 ft.) and the supports shall be placed at a minimum of 1 m (3 ft.) from the end of the pipes. Strapping down of pipe stacks may be necessary to prevent damage during high winds. Suitable tie-downs such as nylon straps shall be used to secure the stack. Stacking heights shall also not exceed the manufacturer’s recommendation and adequate space shall be allotted for lifting machinery to manoeuvre without causing accidental damage.
 - (iii) All pipe stacks shall be made on sufficiently firm, leveled ground and free from stone to support the weight of the pipes and any necessary lifting equipment. Pipes with bell ends shall be stored with the bell ends in alternate directions to avoid contact and possible damage to the ends. Spacer stripping shall be located clear of the bell ends.
 - (iv) End protection shall remain in place during storage.
 - (v) All PVC or polyethylene pipe shall be stored under cover and protected from direct sunlight until required for use. Where storage facilities necessitate the

material to be exposed externally, suitable good protective sheeting shall be used.

e. Fittings

- (i) Fittings shall be stored in their original packing crates or boxes provided the package is undamaged and suitable for long-term storage.
- (ii) Polyethylene fittings shall be stored under cover, preferably on racking and in the manufacturer's protective wrapping or cartons which shall be kept intact until the fitting is required for use.
- (iii) End protection of fittings and flanges shall remain in place during storage.

f. Pipe spools

- (i) Pipe spools shall be stored with temporary protection in place. End protection of fittings and flanges shall remain in place during storage. Pipe spools shall not be stacked.

g. Adhesive/ Resin system

- (i) Adhesive kits and resin systems shall be stored in the original packaging in accordance with the resin Manufacturer's recommendations and safety regulations applicable to the storage location.
- (ii) Storage conditions for the adhesive and resin systems shall be in accordance with the Material Safety Data Sheet (MSDS). Particular attention shall be paid to the recommended storage temperatures, and the requirement to keep certain materials apart for fire safety reasons, both during longer term storage and storage on the site during installation.

h. Ancillaries

- (i) Ancillary materials (elastomer O-rings, flange gaskets, locking strips, reinforcements, lubricants, sealant etc.) shall be stored in accordance with the Manufacturer's recommendations. Ancillary materials shall not be exposed to direct sunlight (UV radiation), chemicals, biological growth, moisture or extreme temperatures. Manufacturer's recommended shelf life shall be followed.
- (ii) ISO 2230 – "Rubber products – Guidelines for storage" provides general guidelines for storage of elastomer O-rings, gaskets etc.

i. Long Term Storage

- (i) For materials that have to be stored for a period of 3 months or more after delivery from the manufacturing plant, consideration shall be given to appropriate storage procedures.
- (ii) The Manufacturer's guidelines shall be followed.

A. Pipe

All pipes shall be marked with the following information where lettering is a minimum of one (1) inch in height, starting no less than three (3) inches from both ends of the pipe and having a maximum spacing distance of three (3) feet apart. The markings shall also be stenciled on the pipe or otherwise applied so as to be clear and legible.

- i. Name and/ or trademark of the Manufacturer
- ii. Nominal Pipe Size
- iii. Dimension Ratio (or Standard Dimension Ratio)
- iv. Abbreviated Material type (e.g. Polyvinylchloride – PVC) followed by the grade in accordance with the appropriate standard (e.g. PE 3408)
- v. Manufacturing Standard Reference e.g. ASTM F714 as required
- vi. Pressure Rating or Class of the pipe
- vii. Date and Place of Manufacture (or relevant production code/record)
- viii. The letter W shall also be included at the end of the pipe marking to indicate its intended use as potable or drinking water.

Note that any pipe, fittings and appurtenances manufactured more than one (1) year prior to shipping or having been previously used will not be permitted. Additionally the manufacturer shall not make use of multiple production or factory sources in facilitating the supply of all materials required.

1. Ductile Iron Pipe

- 1.1. All ductile iron pipes shall be manufactured to ANSI/AWWA C151/A21.51 Class 53 with rubber push-fit joints.
- 1.2. Pipes must be cement-mortar lined to ANSI/AWWA C104/A21.4 and have an asphaltic seal coat.
- 1.3. Joints should be ABSU/AWWA C111/A21.11 and joint lubricant must be included.
- 1.4. The pipes shall have a working pressure of 16 bar (236 psi) minimum.

2. PVC Pipe

- 2.1. All pipes shall be AWWA C900 Pressure Class 200, DR14 or equivalent for sizes 4" – 14" in diameter. Pipes larger than 14" in diameter shall be AWWA C900 Pressure Class 200, DR18 or equivalent.
- 2.2. All Pipes shall have gasketed joints of the integral bell design, pipe lubricant must be included.
- 2.3. All pipes shall have external dimensions compatible with ductile iron pipe, manufactured to ANSI/AWWA C151/A21.51 or equivalent.
- 2.4. All pipes shall be capable of a continuous working pressure of at least 14.1 Kg/cm² (200 psi) and have an additional surge allowance, for 0.6 mps (2fps) flow velocity, of at least 2.8 Kg/cm² (40 psi) at 23°C (73.4°F), per factor of safety of 2.5.
- 2.5. All PVC pipes shall be tested in accordance with ASTM D2241 - Standard Specification for Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series).
- 2.6. All pipes shall be BLUE in colour.

3. HDPE Pipe

- 3.1. All pipes shall be AWWA C906 Pressure Class 254, DR 7.3 with a minimum SDR of 7.
- 3.2. All pipes 4 inches in diameter and larger shall have external dimensions compatible with ductile iron pipe, manufactured to ANSI/AWWA C151/A21/51 or equivalent.
- 3.3. All pipes shall be capable of a continuous working pressure of at least 17.8 kg/cm² (254 psi) and have an additional surge allowance for 2.1 mps (6.9fps) flow velocity, or at least 8.9 kg/cm² (127 psi) at 23°C (73.4 °F) per factor of safety 0.5.
- 3.4. All HDPE pipe shall be blue in colour.
- 3.5. Manufacturing Process and Materials
 - 3.5.1. Materials used for the manufacture of polyethylene pipe shall be made from PE 3408 high density polyethylene resin compound meeting cell classification 345464C per ASTM D3350; and meeting Type III, Class C, Category 5, Grade P34 per ASTM D1238 or equivalent.

- 3.5.2. The manufacturing process for HDPE pipe shall be by pipe extrusion of molten polyethylene resin compound through various sizing stages to form pipe of the specified diameter and wall thickness and shall conform to ISO 4427 standard for Plastic Piping systems- Polyethylene (PE) materials for water supply. Moulding of pipe sections shall not be used as a pipe manufacturing procedure. After the extrusion process the hot pipe shall be immediately cooled in controlled stages by external flushing with water. HDPE fittings shall be made either by compression moulding or fabrication from pipe.
- 3.5.3. HDPE pipe Manufacturers shall purchase HDPE resin in bulk as granules from the resin manufacturer.
- 3.5.4. The pipe's physical properties shall be specified and classified for individual resin grades in accordance with either ASTM D 3350 or ISO 12162 as determined by the Supplier.
- 3.5.5. The resin manufacturer shall determine the long term hydrostatic design stress for the compound to be qualified which follows the specifications of ASTM 2837.
- 3.5.6. All Polyethylene pipe and fittings shall conform to ISO 4427 or equivalent.
- 3.5.7. Fusion Joining Qualification:

Due to the fact that fusion joining of HDPE is the method of joining pipe or piping components, the fusibility of HDPE material shall be tested by the Manufacturer. The compound manufacturer shall demonstrate that each compound conforming to ASTM D3350 or ISO 4427-1 is fusible by testing the tensile strength of a butt fusion joint of pipes manufactured from the compound. The testing shall be done to failure and the acceptance criteria are 100% ductile failure.

3.5.8. HDPE Resin Material

- 3.5.8.1. All materials supplied shall be manufactured from high density polyethylene material compounds with designation code PE 3608.
- 3.5.8.2. Polyethylene butt fusion fittings shall be manufactured in accordance with ASTM D3261. Polyethylene fabricated fittings shall be manufactured in accordance with ASTM F2206. Electro-fusion fittings shall be manufactured in accordance with ASTM F1055. For HDPE piping systems designed based on ISO standards, the fittings shall be manufactured in accordance with ISO 4427.
- 3.5.8.3. The HDPE resin material used to manufacture pipe or fittings shall be listed in PPI TR-4.

3.5.8.4. Where more than 25% of the pipe produced from a resin lot is rejected due to non-compliance to the manufacturing specification the BWA shall reserve the right to reject all pipe produced from that resin lot. The Manufacturer is responsible for obtaining the BWA's written authorisation prior to acceptance of any such pipe for application to the order.

3.5.8.5. The resin material shall be qualified for butt fusion welding capability by the Resin Manufacturer or the Manufacturer and the butt fusion welding parameters for the resin material shall be provided by the Manufacturer.

3.5.8.6. Use of Re-grind Resin

Use of HDPE resin obtained by the Manufacturer's grinding of the pipe Manufacturer's own pipe, fittings or tubing production shall be permitted. Reground resin shall be of the same grade, type, colour and class of resin that is being used for the manufacturing of pipe or fittings production covered by this specification. Mixing of reground resin material with any different type or colour of reground resin shall be prohibited.

3.5.9. Pipe and Fittings Quality Assurance

3.5.9.1. The manufacturing quality assurance programmes shall be in accordance with the requirements of the relevant manufacturing standard.

3.5.9.2. The HDPE pipe and fittings shall be made to be homogeneous throughout and uniform in colour, density and physical properties. The Manufacturer shall have suitable process controls and monitoring to ensure that pipe extrusion process variables are maintained within the Manufacturer's and the Resin Manufacturer's requirements.

3.5.9.3. The HDPE pipe and fittings shall be free of cracks (splitting of material evident on the surface of the pipe or fittings), holes, blisters (voids that have either deformed the pipe or have broken the surface), voids, inclusions of foreign material, or any other visible defect that could affect the liner pipe wall integrity.

3.5.9.4. The manufactured HDPE pipe and fittings shall be tested by the Manufacturer in accordance with their approved manufacturing plan and quality assurance programme.

3.5.9.5. Blisters, chatter marks (rough surface such as washboard effect on the interior or exterior surface of the pipe), drag marks (deformity in the exterior surface of the pipe caused by excessive friction at the sizing box) shall be cause for rejection.

3.5.9.6. Die lines (longitudinal lines on the internal surface of the pipe and are the result of molten resin being drawn over imperfections on the surface of the die

mandrel) and spider lines shall be cause for rejection if the minimum wall thickness of the HDPE pipe or fitting at the defects is not maintained.

3.5.9.7. Pock marks (smooth depressions on the interior or exterior surface of the pipe or fitting) shall be cause for rejection if the minimum wall thickness of the HDPE pipe or fittings has been violated or the depth exceeds 5% of the minimum wall thickness.

3.5.9.8. Gouges or cuts to the outside surface of the HDPE pipe or fittings shall be rejected if they exceed 10% of the wall thickness.

3.6. All High Density Polyethylene (PE) pipes shall be tested in accordance with ASTM 2737 – 12e1 – Standard Specification for Polyethylene (PE) Plastic Tubing or equivalent.

3.7. HDPE pipe and fittings dimensions

3.7.1. The HDPE pipe and fittings dimensions shall be as specified in the order and be in accordance with the specified manufacturing standard.

3.7.2. The HDPE pipe dimensions shall be measured by the Manufacturer as part of their quality assurance programme.

3.7.3. The measurement of HDPE pipe wall thickness shall be preferably tested by an online monitor which is the preferred method that determines the pipe wall thickness at a minimum of 8 locations around the pipe's circumference, on a continuous basis and over the entire pipe length.

3.7.4. For outside diameter and wall thickness the pipe shall meet ASTM D2122 or equivalent the pipe shall be tested by the continuous method at the start of each coil or reel and hourly or once per length for straight pipe.

3.7.5. For ovality the pipe shall meet the Manufacturer's standard and shall have a nominal value per ASTM D2513.

B. **Valves, Fire Hydrants and Ancillaries**

1. **Wedge Gate Valves**

1.1. Valves shall meet or exceed the latest revision of BS 5163 Wedge Gate Valve Standard.

1.2. The body of the valve shall meet or exceed the requirements of the latest revision of B.S. 1452 grade 220 minimum.

- 1.3. The body rings shall be gun metal to BS 1400-LG2 and shall be screwed into the body recess for diameters of 14 ins. (350 mm) and higher and pressed for smaller diameters.
- 1.4. The wedge shall be manufactured of cast iron to the latest revision of B.S. 1452 grade 220 minimum with gun metal rings.
- 1.5. The wedge rings shall be gun metal to BS 1400-LG2 and shall be screwed into the wedge recess for diameters of 14 ins. (350 mm) and higher and pressed for smaller diameters.
- 1.6. The stem shall have two O-rings and a wiper ring above the thrust collar and a third O-ring below the thrust collar. Stem seals shall be capable of being replaced with the valve under pressure.6.107. The stem shall be high tensile bronze to the latest revision of BS 2872, CZ116, CA104 screwed with thread of trapezoidal form – 12 mm pitch. Alternatively stainless steel to the latest revision of BS 970 431-S29 may be used. The stem shall not contain lead or zinc.
- 1.7. Valves shall close clockwise.
- 1.8. Valve Flanges shall be drilled to BS 4504, PN16.
- 1.9. Valve stems shall be fitted with a cast iron square cap made to BS 1452 grade 14, dimensions – 1 1/8 ins. Square at the top and 1 3/8 ins. Square at the bottom, the depth between the top and the bottom shall be 2 5/8 ins. The square cap shall have the capability of accommodating the Barbados Water Authority's standard valve opening tool.
- 1.10. The valve body and bonnet shall have an electrostatically applied fusion bonded epoxy coating both inside and outside with a minimum of 15 mils. All coatings shall meet or exceed the requirements of the British Water Industry Specification WIS 4-52-01. The coating is to be applied at the valve manufacturer's facilities.
- 1.11. O-ring style seals shall be used as the gasket on the bonnet and stuffing box to prevent the possibility of blow out.
- 1.12. All valves shall be tested by hydrostatic pressure equal to the requirements of BS 5163 and a certified copy of the pressure report shall be submitted prior to shipment from the manufacturer.
- 1.13. All valve manufacturers shall be listed and approved by the Water Research Council (WRC), United Kingdom.
- 1.14. The overall length of the valve shall be in accordance with BS 5163.
- 1.15. Valve Flanges shall be drilled to BS 4504, PN 16.

1.16. Bolts, nuts and washers shall be of steel to BS 4278 and BS 4190 minimum and all exposed bolts, nuts and washers shall be protected against corrosion as the valve body. All bolts, nuts and washers can also be of stainless steel.

1.17. Valves shall have a working pressure of 16 bar (236 psi) minimum.

2. Resilient Seated Gate Valves

2.1. Valves shall meet or exceed the latest revision of BS 5163:1986 Type B Resilient Seated Gate Valve Standard.

2.2. The wedge shall be ductile iron, **completely** rubber encapsulated inside and out, including the guides. The brass stem nut shall be an integral part of the wedge to maintain alignment. The wedge elastomer shall be bonded to the ductile iron wedge to prevent corrosion.

2.3. The wedge elastomer shall be EPDM and shall be of the type that inhibits bacterial growth and shall be resistant to residual chlorine. The EPDM rubber shall have sufficient “memory”, that will allow it to absorb impurities (e.g. small pebbles) when the valve is closed and regain its original shape when the valve is re-opened, thus allowing the impurities to be flushed away.

2.4. The stem shall have two O-rings and a wiper ring above the thrust collar and a third O-ring below the thrust collar. Stem seals shall be capable of being replaced with the valve under pressure.

2.5. The stem shall be stainless steel (AISI 42) or high tensile bronze to the latest revision of BS 2872, CZ116, CA104 screwed with thread of trapezoidal form – 12 mm pitch. A stainless stem is the preferred choice. The stem shall not contain lead or zinc.

2.6. Valves shall close clockwise.

2.7. Valve stems shall be fitted with a cast iron square cap made to BS 1452 grade 14, dimensions – 1 1/8 ins. Square at the top and 1 3/8 ins. Square at the bottom, the depth between the top and the bottom shall be 2 5/8 ins. The square cap shall have the capability of accommodating the Barbados Water Authority’s standard valve opening tool.

2.8. The valve body and bonnet shall have an electrostatically applied fusion bonded epoxy coating both inside and outside with a minimum of 15 mils. All coatings shall meet or exceed the requirements of the British Water Industry Specification WIS 4-52-01. The coating is to be applied at the valve manufacturer’s facilities.

- 2.9. The bonnet bolts shall not be exposed to the environment, or alternatively bolts, nuts & washers shall be of 316(A4) stainless steel with the grade casted on the bolt head.
- 2.9.1. O-ring style seals shall be used as the gasket on the bonnet and stuffing box to prevent the possibility of blow out.
- 2.10. All valves **shall** be tested by hydrostatic pressure equal to the requirements of BS 5163 (latest Revision) and a certified copy of the pressure report shall be submitted prior to shipment from the manufacturer.
- 2.11. All valves manufacturers **shall** be listed and approved by the Water Regulations Advisory Scheme (WRAS), United Kingdom.
- 2.12. All valve manufacturers shall be ISO 9001 certified. A certificate shall be presented with each offer.
- 2.13. The overall length of the valve **shall** be to BS 5163:1986.
- 2.14. Valve Flanges and drillings **shall** be to BS 4504, PN16 raised face.
- 2.15. Bolts on gland flange **shall** be of 316 Stainless Steel and the grade shall be casted on the bolt head.
- 2.16. Valves shall have a working pressure of 16 bar (236 psi) minimum.
- 2.17. Resilient seated gate valves shall be AVK Series 21, or approved equal.

3. Air Release Valves

3(a) Single Acting

- 3.1. The air valve shall be capable of releasing air bubbles from the distribution system when it is fully under pressure.
- 3.2. The valve body shall be of Cast Iron GG25 to BS EN 1452 grade 250 or Grey Cast Iron BS EN1561 GJL-HB-185.
 - 3.2.1. The air valve shall have electrostatically applied fusion bonded epoxy coating inside and outside with a minimum of 15 mils. All coatings shall meet or exceed the requirements of the British Water Industry Specification WIS 4-52-01. The coating is to be applied at the valve manufacturer's facilities.
- 3.3. The cover and nozzle shall be sealed to the body by an O-ring of NBR to BS 2494 type 3.

- 3.4. The air valve float shall be of rubber coated polycarbonate or foamed polypropylene.
- 3.5. Bolts, nuts and washers shall be of galvanized steel to BS 4278 and B.S. 4190 minimum and all exposed bolts, nuts and washers shall be protected against corrosion as is the valve body. Alternatively the body shall be screwed to a base assembly of DZR Brass BS 2784 CZ132 complete with EPDM O-Ring and 1" Male BSPT inlet.
- 3.6. The pressure test shall be in accordance with BS 5163.
- 3.7. The valve shall have a working pressure of 16 bar (235 psi) minimum.
- 3.8. The inlet shall be 1" male BSPT.
- 3.9. The air valve manufacturer **shall** be ISO 9001 certified, and a certificate shall be presented with each offer.
- 3.10. The air valve manufacturers **shall** be listed and approved by the Water Regulations Advisory Scheme (WRAS), United Kingdom.
- 3.11. The air valve shall be AVK Series 701-13 or approved equal.

3(b) Double Acting

- 3.12. The air valve shall be capable of releasing large volumes of air from the distribution system when filling the system and allowing large volumes of air to enter the system when the system is being emptied. The valve shall also be capable of releasing air bubbles when the system is fully under pressure.
- 3.13. The valve body shall be of Cast Iron GG25 to BS EN 1452 grade 250.
- 3.14. The air valve shall have electrostatically applied fusion bonded epoxy coating inside and outside shall have electrostatically applied fusion bonded epoxy coating inside and outside with a minimum of 15 mils. All coatings shall meet or exceed the requirements of the British Water Industry Specification WIS 4-52-01. The coating is to be applied at the valve manufacturer's facilities.
- 3.15. The cover and nozzle shall be sealed to the body by an O-ring of NBR to BS 2494 type 3.
- 3.16. The air valve float shall be of rubber coated polycarbonate or foamed polypropylene.
- 3.17. Bolts, nuts and washers shall be of galvanized steel to BS 4278 and B.S. 4190 minimum and all exposed bolts, nuts and washers shall be protected against corrosion as the valve body.
- 3.18. The air valve shall carry a single acting valve (see specs in 3(a)) screwed to the bonnet.

- 3.19. The pressure test shall be in accordance with BS 5163.
- 3.20. The valve shall have a working pressure of 16 bar (235 psi) minimum.
- 3.21. The air valve manufacturer **shall** be ISO 9001 certified, and a certificate shall be presented with each offer.
- 3.22. The air valve manufacturers **shall** be listed and approved by the Water Regulations Advisory Scheme (WRAS), United Kingdom, or approved equal.
- 3.23. The inlet shall be flanged to BS 4504 PN16.
- 3.24. The Air Valve shall be combined with a butterfly valve (to BS EN 593:1998 or equivalent) with lever operation or a resilient seat gate valve with hand-wheel (see Section B - Valves, Fire Hydrants and Ancillaries- Section 2 – Resilient Seated Gate Valve).

4. Fire Hydrants

- 4.1. Hydrants shall meet or exceed BS 750 Type 2 **Underground** Fire Hydrant standard.
- 4.2. Hydrant body, bonnet, gland flange, shall be of Ductile Iron BS EN 1563 EN GJS 500-7.
- 4.3. Hydrants shall have a 3" flanged inlet drilled to BS 4504 and a bayonet joint outlet suitable for a 2 1/8 ins. bayonet joint outlet connection. The bayonet joint outlet **shall be capable of connecting to the Barbados Fire Service's standard connecting tool** (available for inspection at the Barbados Water Authority).
- 4.4. Hydrant stem shall be of stainless steel BS EN 10088 No. 1.4104.
- 4.5. Valve stems shall be fitted with a cast iron square cap made to BS 1452 grade 220 min. (with the capability of accommodating the Barbados Water Authority's standard valve opening tool).
- 4.6. All bonnet & gland bolts shall be of stainless steel Grade A2.
- 4.7. Hydrants shall have electrostatically applied fusion bonded epoxy coating inside and outside with a minimum of 15 mils. All coatings shall meet or exceed the requirements of the British Water Industry Specification WIS 4-52-01 Class B. The coating is to be applied at the valve manufacturer's facilities.
- 4.8. Rated working pressure shall be 16 bar (236 psi); test pressure shall be 24 bar (353 psi).
- 4.9. Hydrant main valve shall be of the fixed stopper type and shall be of ductile iron BS EN 1563 EN GJS 500-7, completely encapsulated with EPDM rubber and with a DZR wedge nut

embedded to ensure alignment during operation of the valve. The EPDM rubber shall be of the type that inhibits bacterial growth and is resistant to residual chlorine.

- 4.10. Hydrant main valve closure shall be clockwise.
- 4.11. All operating parts, including the valve seat shall be removable through the barrel without digging.
- 4.12. Hydrant shall withstand a working pressure of 16 bar (236 psi) minimum.
- 4.13. The hydrant manufacturer **shall** be ISO 9001 certified, and a certificate shall be presented with each offer.
- 4.14. The hydrant manufacturers **shall** be listed and approved by the Water Regulations Advisory Scheme (WRAS), United Kingdom, or approved equal.
- 4.15. Hydrant shall be AVK Series 29-288 type or approved equal.

5. Fire Hydrant "Duck Foot" Bend

- 5.1. The fire hydrant duck foot bend (also called base bend) shall have a mechanical joint at the inlet end, capable of connecting to a 4 inch ductile iron pipe (external diameter of pipe 4.80 ins.).
- 5.2. The outlet shall be 3 ins. Flanged and drilled to BS 4504 and shall be capable of being connected to the fire hydrant at 6.4 above.
- 5.3. The fire hydrant duck foot bend shall have a working pressure of 16 bar (236 psi) minimum.

6. Valve Boxes

- 6.1. Valve boxes shall be heavy duty ductile cast iron surface boxes.
- 6.2. Boxes shall have a square top of dimensions 6 ins. Square.
- 6.3. There shall be a clear opening of around 3 ¾ ins. Diameter or 4 ins. Square.
- 6.4. The base area shall be 9 ins. Square.
- 6.5. The depth of the box shall be 9 ins. to 12 ins.

7. Fire Hydrant Boxes

- 7.1. Fire hydrant boxes shall be heavy duty ductile/cast iron surface boxes.
- 7.2. The overall dimensions of the box (including bottom flange) shall be approximately 19.5 ins. x 13.5 ins.
- 7.3. There shall be a clear opening of approximately 15 ins. x 9 ins.
- 7.4. The depth of the box shall be approximately 4.5 ins.
- 7.5. "F.H." shall be inscribed on the chained lid.

8. Air Valve Boxes

- 8.1. Boxes for air release valves shall be heavy duty ductile cast iron, black coated.
- 8.2. Boxes shall have a double triangular cover.
- 8.3. There shall be a clear opening of 24 ins. x 18 ins, clear opening over base 30 ins x 24 ins.
- 8.4. The depth of the box shall be 6 ins.
- 8.5. "A.V." shall be inscribed on the chained lid.

9. Manhole Access Covers

- 9.1. Manhole access covers shall be heavy duty ductile iron and black coated, Class D400 (group 4 according to EN 124).
- 9.2. Access covers shall have a non-rock, double triangular design and it shall be capable of withstanding a 400kN (~ 40 tonnes) load test.
- 9.3. The following references **shall** be presented with each offer;
 - ISO 9001 manufacturers' certificate
 - BS EN 124 certified and product schedule
- 9.4. The access cover manufacturer **shall** be approved by the following certification bodies or approved equal;
 - BS EN 45001
 - BS EN 45011
 - BS EN 45012

- 9.5. There shall be a clear opening of approximately 600 mm x 600 mm.
- 9.6. The maximum depth of the box shall be no more than 150 mm.
- 9.7. **“WATER”** shall be inscribed on the access lid and it shall carry the British Standard ‘Kitemark’ or be similarly approved.

10. Underground Warning Tape for Water Pipes (Tracer Tape)

- 10.1. The underground warning tape shall be a laminate consisting of a minimum 10.0 mil thickness, inert polyethylene plastic and a layer which is minimum 2-mil aluminium foil and shall conform to BS EN 12613:2009 or equivalent.
- 10.2. This laminate shall be impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil and prevailing weather conditions of Barbados with respect to humidity (76-90%) and temperature (21-31 degrees Celsius).
- 10.3. The underground warning tape shall be BLUE in colour.
- 10.4. The tape shall be of width 100mm or 4 inches, and shall read – “CAUTION – WATER PIPE BURIED BELOW” in capital letters of minimum height two inches (2”) in the colour black in standard Arial font – Microsoft Word®. This lettering shall be continuous for the entire length of the tape and the spacing between these phrases shall be no greater than four inches (4”).

These letters shall also be encased to prevent removal from the tape during installation or maintenance works.
- 10.5. The underground warning tape shall be capable of detection using any of the standard cable locator or signal generator sets.

C. Pipe Fittings

1. Ductile Iron Pipe Fittings

- 1.1. Fittings shall be of ductile iron to AWWA standard C153 with mechanical joints to ANSI/AWWA C111o/A21.10 (or ANSI/AWWA C153/A21.53) with the flanges drilled to B.S. 4504.
- 1.2. Fittings shall be cement-mortar lined to ANSI/AWWA C104/A21.4 and have asphaltic seal coat.

- 1.3. Fittings shall be coated on the exterior with tropical grade asphaltic coating to ANSI A21.51 (AWWA C151) 5 mils nominal dry film thickness. The coating is to be applied at the valve manufacturer's facilities
- 1.4. All flange faces shall be machined prior to coating.
- 1.5. Joints shall be to ANSI/AWWA C111/A21.11 and joint lubricant shall be included.
- 1.6. All joint accessories shall be included.
- 1.7. Fitting shall have a working pressure of 16 bar (236 psi) minimum

2. Couplings and Flange Adaptors

(See Appendix A for outside diameter ranges for universal couplings and universal flange adaptors).

2(a) Universal Couplings

3. The Universal Coupling shall be capable of fitting cast iron, ductile iron, steel, PVC, HDPE, and asbestos cement pipes for each nominal diameter in one unit.
 - 2.1. The gland rings and center sleeve shall be ductile iron, GGG40/50 DIN 1693.
 - 2.2. Bolts and nuts shall be of mild steel grade 8 with rilsan nylon 11 coating, washers shall be of hardened steel zinc plated and passivated. The bolts **shall** carry a square in the head that fits in the groove of the gland so as to prevent turning while tightening the nut during installation.
 - 2.3. Coating on gland rings and council sleeve shall be electrostatically applied fusion bonded coating both inside and outside with a minimum of 15 mils. All coatings shall meet or exceed the requirements of the British Water Industry Specification WIS 4-52-01. The coating is to be applied at the valve manufacturer's facilities.
 - 2.4. The coating shall be applied during manufacture.
 - 2.5. The coupling shall allow for an angular deflection of up to 8 degrees within the center sleeve so as to ensure relief of stresses associated with non-alignment of water mains under repair.
 - 2.6. The rubber seals shall be EPDM to BS 2494 type W and shall be of the type that inhibits bacterial growth, and **shall** be resistant to residual chlorine.
 - 2.7. Couplings shall have a working pressure of 16 bar (236 psi) minimum.

- 2.8. The coupling manufacturer **shall** be ISO 9001 certified, and a certificate shall be presented with each offer.
- 2.9. The coupling manufacturer **shall** be listed and approved by the Water Regulations Advisory Scheme (WRAS), United Kingdom or approved equal.
- 2.10. The Universal Coupling shall be AVK Series 601 type or approved equal.

2(b) Universal Flange Adaptors

- 2.11. The flange adaptor shall be capable of fitting cast iron, ductile iron, steel, PVC, HDPE and asbestos cement pipes for each nominal diameter in one unit.
- 2.12. The gland rings and center sleeve shall be ductile iron, GGG40/50 DIN 1693.
- 2.13. Bolts and nuts shall be of mild steel grade 8 with rilsan nylon 11 coating, washers shall be of hardened steel zinc plated and passivated. The bolts **shall** carry a square in the head that fits in the groove of the gland so as to prevent turning while tightening the nut during installation.
- 2.14. Coating on gland rings and council sleeve shall be electrostatically applied fusion bonded coating both inside and outside with a minimum of 15 mils. All coatings shall meet or exceed the requirements of the British Water Industry Specification WIS 4-52-01. The coating is to be applied at the valve manufacturer's facilities.
- 2.15. The coating shall be applied during manufacture.
- 2.16. The rubber seals shall be EPDM to BS 2494 type W and shall be of the type that inhibits bacterial growth, and **shall** be resistant to residual chlorine.
- 2.17. Flange adaptors shall have a working pressure of 16 bar (236 psi) minimum.
- 2.18. Each adaptor shall be supplied complete with a gasket bolt set, clearly marked, indicating nominal size of adaptor, comprising of mild steel bolts, nuts, & washers, zinc plated passivated plus Rilsan nylon 11 coated, and with an EPDM full face gasket drilled to BS4504, PN16..
- 2.19. The flange adaptor manufacturer **shall** be listed and approved by the Water Regulations Advisory Scheme (WRAS), United Kingdom.
- 2.20. The flange adaptor shall be AVK Series 603 type or approved equal.

2(c) HPDE Transition Fittings

- 2.21. All transition fittings for HDPE pipe to ductile iron or PVC pipes shall be made per the HDPE pipe manufacturer's recommendations and specifications.
- 2.22. A moulded flange adapter within a carbon steel back-up ring assembly shall be used for pipe type transitions where a steel back-up ring shall mate with a 316 stainless steel flange per ANSI B16.1.
- 2.23. Ductile iron back-up rings shall mate with cast iron flanges per ANSI B16.1
- 2.24. All back-up rings shall be drilled to BS4504, PN16.
- 2.25. Bolts and nuts shall be of mild steel grade 8 with rilsan nylon 11 coating, washers shall be of hardened steel zinc plated and passivated. The bolts **shall** carry a square in the head that fits in the groove of the gland so as to prevent turning while tightening the nut during installation.

D. **Pipe Restraints**

General

- The working pressure of **ALL** pipes, fittings, valves and hydrants is 16 bar (236 psi).
- All pipe restraint devices shall be capable of working at the above pressure plus an additional surge pressure of 40 psi.
- Notarized certification from the manufacturer of all restraint devices shall be provided with the bid submission.
- For PVC pipe all restraint devices shall have a water working pressure rating equivalent to the full rated pressure of the PVC pipe they are installed on (see clause 5.2 PVC Pipe), with a minimum 2:1 safety factor in any nominal pipe size.
- In addition to the above, all PVC pipe shall meet or exceed the requirements of Uni-B13-94. "Recommended Performance Specification for Joint Restraint Devices for Use with Polyvinyl Chloride (PVC) Pipe".

1. Pipe Restraints for Mechanical Joints

- 1.1. Mechanical joint restraints shall be of heavy duty design, manufactured of high strength ductile iron, ASTM A536, Grade 65-45-12.

- 1.2. Set screws are to be of high strength low alloy steel, AISI 4140, heat treated to Rockwell 42-48, with knurled cup joints.
- 1.3. Drilling for set screws is to be on a 10 degree angle.
- 1.4. All joint restraints are to be Underwriters Laboratories Listed and meet ANSI/AWWA, 111/A21.11, where applicable.

2. Pipe Restraints for Ductile Iron Pipe.

3. Joint restraints for ductile iron pipe, fittings, valves and hydrants, shall be manufactured of high strength ductile iron, ASTM A536, Grade 65-45-12.
 - 2.1. Joint restraints shall incorporate machined serrations on the inside surface to provide 360 degree contact and support of the pipe barrel.
 - 2.2. Joint restraints shall not incorporate set screws or wedges that bear against the pipe wall.

3. Pipe Restraints for PVC Pipe

- 3.1. Pipe restraints for PVC pipe spigot and socket joints shall consist of split restraint rings, one ring installed on the spigot and connected to the other ring installed on the pipe barrel behind the socket.
- 3.2. The Pipe restraints shall incorporate a series of machined serrations (not "as cast") on the inside diameter to provide positive restraint, exact fit, 360 degree contact and support of the pipe wall.
- 3.3. Pipe restraints shall be of ductile iron, ASTM A536, Grade 65-45-12.
- 3.4. Connecting bolts shall be of high strength, low alloy material in accordance with ANSI/AWWA C111/A21.11 or equivalent.

E. **Polyethylene Pipe And Fittings (For Sizes ½" To 2" In Diameter)**

1. Polyethylene Pipe

- 1.1 Polyethylene pipe shall be manufactured to AWWA C901, ASTM D2239 for sizes ½" to 1" dia. and BS 6572 for sizes 1 ½" to 2" dia.
- 1.2 The pipe shall be class D and be High Density Polyethylene pipe.
- 1.3 The pipe shall be capable of operating under a sustained water pressure at (200 psi) 23 deg. Celsius.
- 1.4 The pipe shall be blue in colour.
- 1.5 The pipe shall have sufficient protection to enable an operational life of a minimum of 10 years with significant exposure to ultra violet while installed and in operation.

2. Corporation Stop

2. The material of the corporation stop shall be certified waterworks red brass meeting the latest revision of AWWA C-800 standard, ASTM B62. The alloy described by this standard should contain no lead.

2.1 The corporation stop shall be manufactured to ANSI/AWWA C800-89 with an AWWA/CC taper thread\ inlet and a pack joint outlet for polyethylene pipe.

3. Pack Joint Couplings

3. The material of the pack joint coupling shall be certified waterworks red brass meeting the latest revision of AWWA C-800 standard, ASTM B62. The alloy described by this standard should contain no lead.

3.1. The pack joint coupling shall be manufactured to ANSI/AWWA C800-89 with a pack joint inlet and a male iron pipe thread outlet for connection to galvanized iron pipe fittings.

4. Ball Curb Valves with Lockable Wing

4. The ball valve with lock wing shall be designed for quick operation in the control of water flow to domestic services and shall meet or exceed AWWA C-800 standard, latest revision, for "Underground Service Line Valves and Fittings"

4.1. The ball valve shall carry two lock wings one being an integral part of the stem and the other an integral part of the valve body. Each lock wing shall carry a hole not less than 7/16 inch diameter and that line up when the valve is closed.

4.2. The ball valve shall be designed so as to maintain a low turning torque and bubble tight closure at 300 psi. in both directions.

4.3. All cast components shall be certified waterworks red brass meeting the latest revision of AWWA C-800 standard, ASTM B62. The alloy described by this standard should contain no lead.

- 4.4. The ball shall be of red brass with a fluorocarbon coating approved for use in potable water, and shall be supported by two Buna-N or EPDM rubber seats.
- 4.5. The stem that operates the ball shall be of solid one piece construction and shall exert no other force on it except to turn the ball. The stem shall carry two Buna-N or EPDM O-ring seals. A “pop-in” retaining ring or a large brass nut shall be screwed and secured on to the bottom of the stem to hold the stem securely in place and eliminate blowout.
- 4.6. The ball valve shall have a brass cap which is integral with the stem. The stops and lugs for controlling the tee head rotation shall be enclosed by the tee head shirt.
- 4.7. The ball valve shall have female BSP (or equivalent) threads on inlet and outlet.
- 4.8. The Ball Valve shall be **Model 6101W** as manufactured by A.Y. McDonald Mfg. Co. or approved equal.

5. Saddles

5.1. For PVC Pipe Service Connections

- 5.1.1. A saddle which shall be suitable for C900 PVC pipe with a ¾” tap size threaded to BSP – AWWA catalog No. S90-403.
- 5.1.2. The saddle shall be manufactured from a metal alloy (red brass: 85-5-5-5) as per ASTM B-62 and AWWA C800 or equivalent. All hinge pins and bolts shall be manufactured from silicon bronze.
- 5.1.3. All bolts shall be 5/16” slotted hexagonal head used with silicon bronze nuts or screwed down into the bottom strap of the saddle, which shall be suitably tapped to receive the bolt. The alloy described by this standard should contain no lead.
- 5.1.4. The gasket for sealing the saddle to the PVC pipe shall be Buna – N rubber manufactured to ASTM – D2000 “O” ring design.

5.2. For HDPE Pipe Service Connections

- 5.2.1. A self –tapping ferrule shall be used which shall be suitable for AWWA C906 Pressure Class 254, DR 7.3 HDPE pipe with a ¾” tap size threaded to BSP – AWWA catalog No. S90-403.

- 5.2.2. The self-tapping ferrule shall be made with top and bottom straps which secure the device to the main to be manufactured from a Gunmetal Bronze to BS1400 grade LG2. All hinge pins and bolts shall be manufactured from silicon bronze.
- 5.2.3. All bolts shall be 5/16" slotted hexagonal head used with silicon bronze nuts or screwed down into the bottom strap of the saddle, which shall be suitably tapped to receive the bolt.
- 5.2.4. The gasket for sealing the saddle to the PVC pipe shall be Buna – N rubber manufactured to ASTM – D2000 "O" ring design.

APPENDIX A

OUTSIDE DIAMETER RANGES FOR UNIVERSAL COUPLINGS & UNIVERSAL FLANGE ADAPTORS

1.0. Universal Stepped Coupling OD's (mm)

3x4	- 84/106 – 109/133
5x6	- 136/153 – 159/179
7x8	- 193/215 – 218/242
9x10	- 242/268 – 266/292
11x12	- 301/327 – 324/350
15x16	- 410/436 – 436/462

2.0. Universal Straight Coupling & Universal Flange Adaptors OD's (mm)

4"	- 109/133
6"	- 157/183
8"	- 218/242
10"	- 266/292
12"	- 324/350
14"	- 372/396
16"	- 436/462
18"	- 495.3
20"	- 548.64

APPENDIX B

REQUIREMENTS

REQUIRED SUPPLY OF PIPES AND FITTINGS #041021						
Item	Description	Qty	Brand	Unit Cost CIP	Total Cost CIP	Lead Time
1	PUSHFIT FERRULE BRASS - 2"	134				
2	RESTRAINT PIPE 8" for PVC pipe	50				
3	TEE 4" HDPE DR 9	120				
4	TEE 6" HDPE DR 9	60				
5	TEE 8" HDPE DR 9	100				
6	FLANGE ADAPTERS 4"	562				
7	FLANGE ADAPTERS 6"	216				
8	FLANGE ADAPTERS 8"	59				
9	BACKING RINGS 4"	562				
10	BACKING RINGS 6"	216				
11	BACKING RINGS 8"	59				
12	SADDLE STAINLESS STEEL 4" - (for HDPE pipe) - A saddle which shall be suitable for C900 PVC pipe with a ¾" tap size threaded to BSP – AWWA catalog No. S90-403	1,508				
13	SADDLE STAINLESS STEEL 6" - (for HDPE pipe) - A saddle which shall be suitable for C900 PVC pipe with a ¾" tap size threaded to BSP – AWWA catalog No. S90-403	576				
14	SADDLE STAINLESS STEEL 8" - (for HDPE pipe) - A saddle which shall be suitable for C900 PVC pipe with a ¾" tap size threaded to BSP – AWWA catalog No. S90-403	382				
15	PIPE 4" HDPE DR 9 - 40ft Length	669				
16	PIPE 6" HDPE DR 9 - 40ft Length	243				
17	PIPE 8" HDPE DR 9 - 40ft Length	136				