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**SPECIFICATION OF MATERIALS PERTAINING TO**  
**WATER SECTOR**

## SUPPLY OF WATER DISTRIBUTION MATERIALS

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## TECHNICAL SPECIFICATION

### GENERAL

All materials and equipment supplied shall be suitable for use in U.A.E. and under conditions prevailing at the sites of the work.

All the materials are to be approved by the Federal Electricity & Water Authority before ordering. Samples of all items shall be submitted to FEWA without any cost charged to FEWA, which will remain FEWA's property. All samples submitted shall conform to the specification; any deviation from the specification shall be clearly mentioned. The samples submitted shall have a sticker showing tender no., tenderer name and main offer/alternative offer.

Unloading and stacking of the materials at FEWA stores/sites shall be carried out by the supplier. The stacking shall be done in FEWA stores as directed by Head of Stores.

All the items (2% or 2 Nos. whichever is more) shall be tested in **U.A.E** in the presence of FEWA Engineer without any extra charges, if requested.

Any failure in testing in presence of FEWA's representative at the time of delivery can be considered a cause of rejection for the entire consignment, and FEWA's decision shall be final and binding.

**This specification is for all materials, but you may choose the spec as per the B.O.Q.**

### **Important :**

- (i) Where the year is not mentioned in the specification of B.S., I.S.O. etc., the latest published edition shall be deemed applicable.
- (ii) After placing order, latest edition of relevant BS/ISO/DIN/AWWA etc. specification in English shall be submitted to FEWA at no extra cost.
- (iii) Non ISO 9000 certified manufacturers who have supplied similar items may be approved at FEWA's sole discretion.
- (iv) All catalogues and other documents enclosed with the offer must bear the stamp and signature of the supplier.
- (v) The supplier must submit the following documents in a proper file.
  - (1) All the original catalogues in which the proposed materials are highlighted.
  - (2) All schedules duly filled.
  - (3) FEWA's technical specification with suppliers stamp.
  - (4) Samples (if any).
  - (5) Quality assurance certified to conform ISO 9000 (or equivalent) series for the manufacturer.
  - (6) Details of past supply records for the last four years.
  - (7) Technical offer must have B.O.Q. with delivery period, make & country of origin (FOR TENDERS ONLY).**

FEWA will not be responsible for the loss of any documents if loose papers are submitted.

(v) **Failing to submit all the schedules will result in the rejection of the offer or assumption that all the materials are as per FEWA specifications. FEWA's decision is final and binding.**

(vi) The supplier shall give warranty for all the items against manufacturing defects, material failure and corrosion problems for 5 years from the date of supply.

(vii) Suppliers must supply bolts, nuts & gaskets for each flange. All the bolts must be stainless steel AISI 316 **fully threaded** and the threads must be BSP threads in accordance with the requirements of BS 21-1975

(viii) **Sizes of the bolt are given on page 75**

(ix) **The suppliers must submit country of origin certificate, bill of lading, packing list at the time of delivery.**

(x) Marking

Body of the D.I. Gate Valves/Air Valves/Butterfly Valves/Non-Return Valves shall be marked by cast on or stamped figures as follows:

- Letters "FEWA".
- Contract No.
- Size of Valve.
- Year of manufacturing.
- Manufacturer's trademark or name.
- Working pressure.

(xi) The supplier shall furnish FEWA with Certificate that all materials quoted for and supplied against his offer, comply in all respects with FEWA specifications and are as per relevant Standards approved by FEWA. **If there is any deviation from FEWA specification please indicate clearly item by item in schedule 'H'. If the supplier fails to do so FEWA may or may not approve those materials and FEWA's decision will be final and binding.**

(xii) **Testing and Inspection at the Manufacturing Factory**

FEWA Engineers may inspect the materials in the factory. The contractor/supplier shall give FEWA at least 15 days notice of availability of the materials for testing. The Engineer shall have the right to inspect all the material at manufacturer's premises. The manufacturer shall provide FEWA's Engineer free access to inspect the manufacturing process at works and supply the necessary labour and facilities for carrying out the tests.

The inspection Engineer shall select about 2- 5% of the number of materials for testing. The duration of each test shall be as per the relevant standards and as approved by FEWA.

**ALL THE ITEMS MUST BE SUPPLIED ON PALLETS/BOXES EXCEPT PIPES**

## **1.0 FIBRE (ASBESTOS) CEMENT PIPES & SOCKETS**

### **1.1 Scope of Work**

This specification defines the requirements of fibre-cement (Asbestos Cement) pipes and joints for use under pressure for conveying potable water.

### **1.2 General**

Pipes shall be made from a close and homogeneous mixture essentially consisting of Chrysotile Asbestos Fibres, Cement and Water excluding any materials liable to cause ultimate deterioration in the quality of the Pipes. Pipes shall be from manufactures having previous successful experience in pipe supply within the U.A.E. and approved by FEWA. All the pipes shall be supplied with joints.

### **1.3 Class/Design of Pipes**

Pipe shall conform to the requirements of BS-EN 512:1995 Class 20, i.e. test pressure in the factory 20 bar as per BSEN 512, unless otherwise stated in the quantities schedules. The finished product shall be entirely seamless and capable of being cut, drilled and tapped.

### **1.4 References**

The selection of material, design, manufacturing and testing of pipes and joints covered by this specification shall be in compliance with the latest edition of the reference listed below and shall include all revisions and amendments, unless otherwise noted :

#### **A) British Standards Institution**

- BS-EN 512 : Fibre-cement products-pressure pipes and joints.
- BS 2494 : Specification for elastomeric seals for joints, pipe
- BS-EN 681-1 works, and pipelines.
- BS4027 : Sulphate resisting Portland cement.

#### **B) International Organization for Standardization**

- ISO 160 : Asbestos Cement Pressure Pipes & Joints.
- ISO 2785 : Guide to the selection of asbestos cement pipes  
subject to external load with or without internal  
pressure.
- ISO 390 : Asbestos cement products sampling and inspection.

### **1.5 Dimensions**

Asbestos cement pipe shall be manufactured and supplied in 5/3-meter lengths for all diameters. All joints and pipe ends shall have the following principal dimensions:

**CLASS - 20**

Nominal Diameter mm	Wall thickness at the pipe machined end - mm	Outside Diameter at the Pipe machined end - mm	Calibration Length At the End of Pipe mm	Length of A.C. Joint mm
100	13	126	125	120
150	14	178	125	120
200	17	234	155	150
250	19	288	155	150
300	22	344	155	150
400	28	456	210	200
500	30	560	210	200
600	34	668	250	240
700	40	780	250	240
800	44	888	280	270
900	50	1000	280	270
1000	55	1110	310	300
1200	60	1320	310	300

**TOLERANCE ON EXTERNAL DIAMETER OF THE CALIBRATED END :**

Nominal diameter mm	Maximum tolerance mm
Up to 300	± 0.6
400 & 500	± 0.8
Over 600 up to 1200	± 1.0

**1.6 Cement**

All cement used in the manufacture of asbestos cement pipe and joints shall be high sulphate resisting cement conforming to BS 4027:1996 type LA with strength class 42.5 N/mm<sup>2</sup>. Copies of cement mill certificates shall be submitted with each consignment of pipe delivered upon request.

**1.7 Joints**

Asbestos cement pipe shall be provided with spigot ends to be joined with 'Reka' type couplings using two rubber rings. Each pipe shall be supplied with one joint and two rubber rings. Rubber rings shall conform to the requirements of BS 2494. The joints shall be capable of withstanding a test pressure of 20 bars without any leak when deflected to the angle specified below:

Nominal Diameter Mm	Joint Deflection Angle Degrees
Up to 200	5
250 & 300	4
400 & 500	3
600 to 1000	2
1200	1

Copies of test reports showing compliance to these requirements shall be submitted to FEWA for approval if requested. REKA rubber rings for couplings shall be supplied in closed bags/containers shielded from sunlight. Each bag/container shall contain only one size of rubber rings according to the pipe diameter and shall be marked with a clear print indicating the diameter and the number of rings in the bag.

### **1.8 Design Calculations**

Pipe design calculation, as per ISO 2785 shall be submitted to FEWA for review, showing maximum safe burial depth for each diameter and class of pipe.

### **1.9 Coating**

All the pipes, joints etc. shall be thoroughly cleaned and coated externally with a solution of Black Bitumen paint complying to the BS:3416 Type I class A or Type II or equivalent standard.

### **1.10 Testing**

Asbestos cement pipes shall be factory tested in accordance with section 4.6 of BS-EN 512 - 1995. Copies of test certificate shall be submitted for each consignment delivered. Inspection, sampling and lot size shall be in accordance with Annexure 'A' of BS-EN 512:1995. Lot size for diameter larger than 1000 mm shall be 200 pipes. The inspection lot size, for sampling and testing to be carried out in the presence of FEWA's representative, will be at FEWA discretion limited within minimum and maximum lot specified in Section of ISO-390, taking into consideration quality of past supplies.

All the tests including the destructive type tests shall be carried out by the manufacturer in the presence of FEWA's representative/consultant before delivery. Testing and related activities shall be carried out at no additional cost. Pipes, which are destroyed in testing, shall be replaced at no additional cost as well. In addition to the above, if requested by FEWA, the contractor/supplier shall carryout tests on pipes/joints delivered to site at contractor/supplier's expense including transportation.

For outside U.A.E. manufacturer, all tests including destructive tests shall be carried out at manufacturer's place in the same procedure as the UAE's manufacturer. The manufacturer/supplier shall give 14 days advance notice. Pipes, which are destroyed in testing, shall be replaced at no extra cost by the manufacturer. The cost of transport of pipes and joints for testing and delivery once again, shall be borne by the supplier/contactor.

The pipes shall pass the result obtained from both formulae mentioned in BS 512 or ISO 160.

In addition to the above, a sufficient number of quality control tests, based on the total production of pipes and joints, shall be made at regular intervals by the manufacturer to ensure that his products comply with the requirements of FEWA and certified records of all such tests shall be kept for inspection by FEWA.

The manufacturer shall, on request, furnish FEWA with a certificate confirming that all the pipes supplied by him under this contract comply with the requirements of FEWA.

The following acceptance tests shall be carried out at the manufacturer's works on pipes:

- a) Works hydraulic pressure test on all pipes.
- b) Hydraulic pressure test of pipes with joints to the maximum deflection, as recommended by the manufacturer.
- c) Bursting (tensile tangential) strength test (number of tests as specified in ISO 390) on specimen 0.5 m to 1.0 m long, or on ring sections cut from the pipe barrel.
- d) Transverse crushing strength test (number of test as specified in ISO 390) on test specimen cut from the pipe barrel.
- e) Longitudinal bending test for pipes up to and including diameter 150 mm (number of tests as specified in ISO-390) on specimen at least 2.2 m long.
- f) Straightness – The straightness shall be assessed by visual inspection. If there is a doubt on this assessment, then it shall be verified according to the BS EN 512 (number of tests as specified in ISO 390).
- g) Absorption tests shall be carried for the AC pipes in the presence of FEWA's representative complying to ISO 4483.
- h) **Failure of Pipes and Joints at the time of Testing at Site**

During hydro-pressure testing at site after delivery to stores/site and, if pipes/ joints failed, shall be replaced at no extra cost including transport expenses. The reason of the failure shall be investigated by FEWA and FEWA decision shall be final and binding to the tenderer/supplier.

#### **1.11 Sampling and Inspection of delivered Pipes and Joints**

FEWA shall also have the right to select up to 1% (maximum 20 pipes) of the pipes and joints, delivered to the store to be subjected to hydro-testing at the manufacturer's works in the presence of the FEWA's Engineer. In the case of imported pipes the re-testing must be arranged at local test facilities in the U.A.E. The Contractor/supplier shall provide such labour, material and transport as the FEWA's representative may require to assist him in carrying out the sampling, inspection and testing of pipes and joints. No additional payment shall be made for the above number of tests conducted by the supplier/contractor.

#### **1.12 Acceptability of Inspection Lots**

The acceptability of inspection lots shall be in accordance with Section 7 of ISO 390.

### **1.13 Submittals:**

The tenderer/supplier shall submit along with his tender, all catalogues giving the detailed specifications of the pipe, he proposes to supply for the contract along with detailed specification of Bitumen paint, to be used for external coating.

### **1.14 Marking**

The pipes and joints shall be marked legibly and indelibly with the following:

- Manufacturer's name or trademark.
- Date of manufacture Month-Day-Year (for pipes only)
- Class of pipe
- Nominal diameter
- BS-EN 512.
- Home line positions at pipe ends.
- Client's name, i.e. 'FEWA'
- Contract No. ....../Lot No.

### **1.15 Transportation of Pipes**

- a) A.C. Pipe and Joints shall be properly and securely transported from the place of manufacture to the FEWA Stores at Sharjah or other place. No nesting of AC Pipe shall be allowed at anytime at the manufacturer's yard, during transport or on site.

Where pipes are transported by truck, the pipes shall be transported on wooden cradles or skids and shall be properly protected from contact with metal surfaces by rubber or wooden spacers or wedges.

- b) Where any part of the transport is done by ocean freight or barge, or if AC Pipe is imported from outside the U.A.E., then the following packing procedures shall be applicable and followed:

All AC Pipes and Joints shall be transported in full wooden crates. Crates shall be provided with transverse wooden spacers such that the unsupported span of AC pipe does not exceed 2 meters inside the crates. Crates shall be provided with skids to allow lifting by forklift. Pipes inside the crates shall be provided with rubber or polystyrene end protectors around the spigot surface of the pipe. Crates shall be marked with the manufacturer's name, the contract number and details of contents. Pipes shall be individually crated.

### **1.16 Unloading**

Unloading at stores/sites must be carried out carefully under the control and responsibility of the contractor/supplier. Care should be taken to avoid severe impact with any solid object (i.e. other pipes, ground etc.). All packing and transportation expenses shall be deemed to be included in the supply rates, and no extra payment shall be made by FEWA for the same.



ASTM D 3567	Dimensions of Reinforced Thermosetting Resin Pipe and Fittings
ASTM D 4024	Reinforced Thermosetting Resin Flanges
ASTM D 4161	Bell and Spigot Reinforced Thermosetting Resin pipe joint Using Flexible Elastomeric Seals
ASTM D 638	Test Method for Tensile Properties of Plastics
ASTM D 695	Compressive Properties of Rigid Plastics
ASTM D 696	Coefficient of liner Thermal Expansion of plastics.

2.2.3 American Petroleum Institute:

API 15 LR	Low Pressure Fibreglass Line Pipe.
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2.2.4 British Standards Institution:

BS 5480	Glass Fibre Reinforced Plastics (GRP) Pipes and Fittings for use for Water Supply or Sewerage
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2.2.5 International Organization for Standardization (ISO)

ISO 62	Plastics – Determination of Water Absorption.
ISO 1172	Textile glass Reinforced Plastics – Determination of Loss on Ignition.

**2.3 Submittals**

Prior to start of production, the manufacturer shall submit to FEWA dimensional drawings and design calculations of pipes and fittings for approval of FEWA.

**2.4 Material and Fabrication**

GRP pipes and fittings shall have the following principal of construction:

2.4.1 **General**

All materials and the manner and degree to which they are used shall be selected so that:

- They will resist the corrosive effects of both the contained and surrounding environments.
- They will withstand strains expected to be produced in both the interior and exterior surfaces.

GRP pipes shall be machine-made continuous glass filament wound consisting of a liner, a structural wall and a resin rich exterior layer.

#### 2.4.2 **Resin – rich inner liner (corrosion barrier)**

Pipe shall have an inner corrosion resistant, thermosetting resin rich liner reinforced with 'C' glass mat or veil and impregnated with Vinyl Ester or epoxy resin. This liner thickness shall not be less than 0.50 mm. No sand fillers may be present in the inner corrosion resistant layer. The liner shall be continuous along the circumference of the pipe and shall be of uniform thickness and composition and shall contain approximately 90 % of resin material.

#### 2.4.3 **Structural Wall**

The structural wall consists of continuous glass filament windings and/or woven roving and chopped glass reinforcement, which may include fillers, all impregnated with isophthalic, vinyl ester or epoxy resins.

Structural filament reinforcing shall be provided with minimum 65% by weight of continuous glass filaments for helical filament wound pipes and not less than 60% for continuous filament wound pipe.

#### 2.4.4 **Exterior Layer**

All piping system shall have a 0.25 mm minimum thickness resin rich exterior surface impregnated with vinylester or epoxy resin.

#### 2.4.5 **Materials**

##### Glass

Glass reinforcements shall be compatible with the impregnating resin used and shall be provided with especial finish to assure a good adhesion with the resin.

C – glass shall be used as reinforcing material for the chemical resistant inner. This type of glass shall appear in the form of a fleece with a surface weight of 25 –50 g / m<sup>2</sup>

E– glass shall be used as reinforcing material for the mechanical resistant layers. This type of glass shall appear in the form of roving or woven cloth.

##### Resins

The type of the resin selected (vinyl ester, polyester or epoxy resin) shall be based on its proven resistance to the transported medium at similar service conditions and environments. The final selection shall be subject to FEWA approval. Resins used shall be a commercial high-grade thermosetting resin.

No pigments shall be added to any resin used, for buried pipe work. No additives shall be used except for viscosity control.

All resins to be used shall be tested in accordance with ASTM C 581.

All resin systems shall be at least equal to the requirement of BS 3532 type B.

##### Fillers

Fine aggregates may be used as fillers for buried pipe only, and shall be high purity silica with a maximum size of 3 mm, with no deleterious matters.

#### 2.4.6 **Chemical Requirements**

GRP pipes and fittings shall not impart any taste, odour or colour to drinking water and they shall be certified for potable water use by WRC-UK or NSF-USA or such other reputed authority.

#### 2.4.7 **Pipes above Ground and Inside Pits**

Design and construction shall be in accordance with the requirements of ASME 1792. Exposed pipes above ground shall have protection against UV degradation.

### 2.5 **Joints**

#### 2.5.1 **Flexible Joints**

Standard buried pipe with unrestrained joint shall have filament wound GRP couplings, with confined rubber ring gaskets. Rubber rings shall be of natural or synthetic rubber conforming to BS 2494 or ASTM F477. Joints shall allow for at least 1.5 degree deviation while remaining water tight at 1.5 times the pipe operating pressure. The rubber rings shall be the sole element controlling the water tightness.

#### 2.5.2 **Flanged Joints**

GRP flanges where used shall be machine filament wound or hand lay up flanges. Flanges shall be manufactured with vinyl ester or epoxy type resins only. Flanges shall be fixed and flat faced with full or 'O' ring gaskets. Gasket material and design shall be as per the manufacturer's recommendations. The pipe manufacturer shall provide torquing sequence and maximum tightening torque as appropriate for each flange size and design. Washers shall be used under all nuts and bolt heads. Complete set of bolts, nuts, washers and gasket shall be supplied for each flange. Bolts and nuts shall be stainless steel, Grade 316, conforming to BS-970, Part-4. Gaskets shall be EPDM rubber reinforced with cotton of thickness not less than 3 mm. Flange washers shall be used under all nuts and bolt heads. Flange drilling and rating shall be in accordance with BS 4504 PN16 or approved equivalent. Flanged joints shall be tensile resistant and suitable for use above or under ground with no thrust blocks.

Flanged branch tees used for air valves shall be provided with additional reinforcement support under the branch flange to withstand safely the air valve assembly weight.

#### 2.5.3 **Spigot Joints**

Spigot joints, where specified, shall have the same outside diameter as the asbestos cement pipe class 20 to which it is to be jointed. The joint dimensions and tolerances shall be equal to AC pipe spigots such that the joint remains watertight under all normal operating and surge conditions. The spigot ends shall be clearly marked with a "home line" indicating the proper insertion limit for the AC couplings. The spigot width shall not be less than half the AC coupling joint width. Spigot ends shall have bevelled edges.

#### 2.5.4 **Reinforced Overlay Joints (Butt & Wrap)**

Butt & Wrap pipe joints where used shall consist of layers of glass fiber reinforcement impregnated with vinyl ester or epoxy resin. The wall thickness, tensile and axial strength of the reinforced overlay shall meet or exceed the design strength of the adjoining pipe section. Butt & Wrap joints made on site shall be performed only by qualified persons employed by the pipe manufacturer. The joints shall be tensile resistant and suitable for use above or under ground with no thrust blocks. All hand laminations or windings shall utilize only one type of resin throughout.

#### 2.5.5 **Tensile Resistant Joints**

For design qualification of tensile joints, the joints when assembled in accordance with manufacturer's written instruction shall withstand a hydraulic works tests pressure of 2 times the working pressure with no weepage or leak for 60 seconds. This test is to be performed at the factory. End enclosures shall apply the full end load due to pressure on the pipe (or fitting) specimen being tested.

### 2.6 **Fittings**

GRP fittings such as bends, tees, junctions and reducers shall be equal to or superior in performance to the GRP pipe of the same diameter and pressure. All fittings shall be finished smoothly internally.

All standard fittings up to and including 300 mm diameter shall be filament wound on precision steel moulds. Standard 45 and 90 degree elbows shall be of the smooth short radius type.

Larger diameter fittings may be filament wound or of mitred construction (maximum 3 segments for bend or tee). All internal surfaces shall be finished smooth.

For GRP fittings, the deviation from the stated value of the angle of change of direction of a bend, tee or junction, shall not exceed  $\pm 1$  degree.

The tolerance on the manufacturer's declared length of fitting, shall be  $\pm 10$  mm taken from the point of intersection to the end of the fitting or  $\pm 10$  mm on straight fittings.

The fittings with spigots shall be suitable for making connections with asbestos cement pipes as specified in technical specifications.

All GRP fittings shall be fabricated by the pipe manufacturer in the pipe factory. Under no circumstance shall fabrication of fittings be allowed at the site by contractor. Complex fittings arrangements may be pre-assembled by the pipe manufacturer in the factory such that field joints are kept to a minimum.

### 2.7 **Design Requirements**

The following are the minimum design requirements which the manufacturer will conform based on his design and application for each system

<u>Service Fluid</u>	<u>Brackish &amp; chlorinated water/Drinking water</u>
Maximum operating pressure	10 bars
Maximum site test pressure	15 bars
Maximum allowable vacuum	-1 bar
Minimum depth of cover	1.0 m
Maximum depth of cover	4.0 m
Truck loading (wheel load)	90 KN
Maximum service temperature	50 <sup>0</sup> C
Stiffness( EI / D <sup>3</sup> )	- for DN 50 – 300 10,000 N/M <sup>2</sup>
	- for DN350 -1200 5,000 N/M <sup>2</sup>

## 2.8 Safety Factors

Pressure rating	>=	2.0
Ring bending strain (stress)	>=	1.5
Combined strain (stress)	>=	1.5
Buckling	>=	2.5

Design calculations shall be submitted to FEWA for review and approval and shall include hydraulic design study and calculation.

The pressure rating for GRP pipe or fittings shall be based on the long term hydrostatic design pressure of this specification with a design factor of 2.0.

Flanged fittings where called for shall be designed for installation above ground or in chambers, without thrust blocks; and to resist end thrust from closed valves.

## 2.9 Hydrostatic Leak Test

All pipe, fittings and spools shall be hydrostatically leak tested at the factory in accordance with AWWA C950, to a test pressure equal to twice the pressure rating.

## 2.10 Physical Requirements

### 2.10.1 Wall Thickness

GRP pipe shall be of the solid wall type (unribbed). The wall thickness required for each size/pressure class shall be established by the manufacturer to meet the design requirements.

### 2.10.2 Diameters

Pipe shall be manufactured in standard metric sizes based on the pipe nominal inside diameter in sizes 25 mm and larger. The actual inside diameter shall not vary from the nominal inside diameter by more than the tolerances allowed in related ISO or BS standards.

### 2.10.3 **Stiffness**

The pipe stiffness shall be determined by the manufacturer to meet the design requirements with particular regard to installation method, burial depths, deflection limits, buckling and vacuum requirements. However, the pipe initial specific stiffness ( $EI/D^3$ ) shall in no case be less than  $5000 \text{ N/M}^2$ , when tested in accordance with AWWA C950 or BS 5480 (tested as ASTM D 2412) for larger than 300 mm. dia. and  $10,000 \text{ N/M}^2$  for less than 300 mm. dia.

### 2.10.4 **Beam Strength**

GRP pipe shall meet the minimum longitudinal tensile strength requirements specified in AWWA C950 for the appropriate operating pressure class.

The above requirements are intended to provide adequate strength for normal handling and under ground laying conditions. They are not to be used for design purposes. Pipes intended to withstand the end load resulting from internal pressure at changes of direction, or the beam load resulting from above ground installation, will normally require higher longitudinal strengths and a suitably designed restrained jointing system.

### 2.10.5 **Hoop Tensile Strength**

The pipe shall be sampled and tested for hoop tensile strength in accordance with AWWA C950. The test results shall meet or exceed the minimum axial tensile strength requirements listed in Table 10 of AWWA C950

### 2.10.6 **Axial Tensile Strength**

The pipe shall be sampled and tested for axial tensile strength in accordance with AWWA C950. The test results shall meet or exceed the minimum axial tensile strength requirements listed in Table 11 of AWWA C950 or one – half of hoop tensile strength whichever is greater.

Axial tensile strength for flange/flanged fittings shall be 70 M Pa.

### 2.10.7 **Workmanship**

GRP pipe and joints shall be free from de laminations, cracks, bubbles, pinholes, pits, blisters, foreign inclusions and resin-starved areas that due to their nature, degree or extent detrimentally affect the strength and serviceability of the pipe. No glass fibre reinforcements shall penetrate the interior surface of the pipe wall.

Joint sealing surfaces shall be free of dents, gouges, de laminations, or other surface irregularities that will affect the integrity of the joints.

GRP pipe shall be as uniform as commercially practicable in colour, opacity, density and other physical properties.

### 2.10.8 **Ignition Loss**

A minimum of one pipe for every 30 pipes manufactured shall be tested in accordance with ASTM – D 2583 "standard Method pf Test for Ignition Loss of Cured Reinforced Resins"

### 2.10.9 Visual Requirements

GRP pipes and fittings shall be free from delamination, crazing, dry areas or cracks. Spigot ends shall be free from end delamination, torn edges and gouges and shall be finished smooth to ensure water tightness. All laminate surfaces internally and externally shall be fully cured with a minimum Barcol hardness of 30 when tested in accordance with ASTM 2583. The inside liner of the GRP fittings shall be free of cracks.

### 2.10.10 Ultra-Violet Resistant

All above ground pipes shall be resistant to ultra-violet light at the design operating characteristics for 25 years.

### 2.11 Inspection and Factory Testing

As a minimum, the following tests shall be carried out by the pipe manufacturer at the frequency specified, and shall form part of the manufacturer's overall quality control programme. Test results and certificates shall be submitted to FEWA for each consignment delivered. Witnessing of factory testing by FEWA may be required. 2% of the material or 2 pieces of each material whichever is more shall be tested in the factory and the testing shall be witnessed by FEWA Engineer without any additional cost. Test methods shall be in accordance with AWWA C950 BS5480. All the pipes must be tested in accordance with the relevant specification.

<u>Test</u>	<u>Frequency</u>
Visual inspection	Every item
Dimensions	Every item
Barcol hardness (resin cure)	Every item
Hydraulic pressure @ 20 bar	Every item
Stiffness	Once per 100 items
Axial and hoop tensile stress	Once per 100 items
Loss on ignition (composition)	Once per 100 items

Copies of all test reports shall be submitted to FEWA for each lot delivered to site.

### 2.12 Dimensions

- a) The wall thickness and the thickness of flange shall be determined by the manufacturer to meet the design requirements of this specification.
- b) Dimension of outer diameter at calibrated end

Nominal bore of pipe	Outer diameter at calibrated end
dia. 80 mm	106 mm
dia. 100 mm	126 mm
dia. 150 mm	178 mm
dia. 200 mm	234 mm
dia. 250 mm	288 mm
dia. 300 mm	344 mm
dia. 400 mm	456 mm
dia. 500 mm	560 mm
dia. 600 mm	668 mm

c) Flange thickness

<u>Nominal diameter (mm)</u>	<u>Minimum GRP flange thickness (mm)</u>
50	35
80-100	40
150-200	45
250-300	55
350	60
400	65
450	70
500	75
600	80
800	95

Contractor/supplier shall submit dimensional drawing for all the items along with quotation.

**2.13 Bolts, Nuts, Washers and Gaskets**

Complete set of bolts (**full threaded**) nuts, washers and one gasket shall be supplied to each flange. Bolt and nut shall be conforming to BS 970 Part 4 - Stainless Steel Grade 316 and gasket shall be EPDM rubber reinforced with cotton of thickness not less than 3 mm. Length of the Bolt must be suitable to connect with G.R.P. Flanges.

**2.14 G.R.P. Tail Piece (with bolt & gasket)**

G.R.P. Pipe of 1/2 metre length with both sides flanged. Flanges shall be flat faced and drilled to BS 4504. Stainless steel AISI 316 bolt, nut and gasket shall be supplied as per FEWA Specifications.

**2.15 GRP Tee For Air Release Valve**

GRP Tee for Air release valve shall be spigot with flanged branch, which shall be tee reducer of 400 mm length, (for pipes of diameter more than 150mm) with additional reinforcement support, under the flange branch, to withstand safely the air valve assembly weight.

**2.16 GRP. Tee For Washout**

GRP Tee for washout shall be all flanged invert level Tee with tangential flanged branch.

**2.17 Double spigot adaptor**

Double spigot adaptor is a piece of pipe with double spigot ends, one shall be suitable to make connection with asbestos cement pipe socket class 20, and the other end shall be suitable to make connection with ductile iron socket.

DN.	Outer side diameter	
	DI. PIPE	AC. PIPE
80 mm	98 mm	106 mm
100 mm	118 mm	126 mm
150 mm	170 mm	178 mm
200 mm	222 mm	234 mm
250 mm	274 mm	288 mm
300 mm	326 mm	344 mm
400 mm	429 mm	456 mm
500 mm	532 mm	560 mm
600 mm	635 mm	668 mm
800 mm	842 mm	888 mm
1000mm	1048 mm	1110 mm

## 2.18 Markings

Each pipe and joint shall be indelibly marked with the following information :

- Standard Number including type, liner, grade and class.
- Stiffness
- Manufacturer's name or trademark
- Manufacturing date
- Nominal diameter in mm
- Operating pressure in kg/cm<sup>2</sup>
- Coupling "home line" position on spigot ends
- Drawing and spool numbers - where applicable
- Client's name, i.e. "FEWA".
- Contract No.
- Lot No.

## 2.19 Rejection

The results of any QC test which do not conform to the requirements of this specification, the test shall be repeated on two additional samples from the same lot of pipe. Each of the two samples shall conform to the requirements of this specification and If either of the two additional samples fail, the lot shall be rejected.

## 2.20 Handling, Storage and Transportation

GRP pipes shall be handled, stored, transported in strict accordance to the manufacturer's written instructions.

No nesting during storage or transport shall be allowed.

For flanged fittings, the manufacturer shall submit before delivery, the recommended gasket details, the bolt torquing sequence and maximum recommended torque for each flange size supplied.

The following initial information shall be submitted to FEWA for approval.

- i) GRP pipe data sheet(s).
- ii) Detailed resin data
- iii) Detailed glass reinforcement data
- iv) Detailed joint and gasket data
- v) Detailed manufacturing process for pipe, joints and fittings

### **2.21 Warranty**

The manufacturer must give warranty for 5 years for all G.R.P. Pipes & Fittings.

**Delivery period for G.R.P. Fittings shall be one period. Priority list of the fittings will be given after issuing the contract.**

### **3.0 BULK WATER METERS (2" and above) SUITABLE FOR A.M.R. SYSTEM**

#### **3.1 General**

Water Meters should conform to the requirements stipulated in B.S. 5728, ISO 4064, 75/33/EEC or any other equivalent international standards approved by FEWA. All Water Meters shall be manufactured in **West Europe/U.S.A./Japan**.

Water meters to be supplied are to be suitable for measuring water flow in closed conduits to domestic consumers. They must give continuous hassle-free service and long working life under rigorous climatic condition prevailing in U.A.E. ambient temperature up to 50°C is very common during summer months, below 10°C is experienced during winter months. Humidity also undergoes sharp changes with 100% humidity a common phenomenon. Violent sand storms are a common feature and fine dust is carried in suspension in the atmosphere. T.D.S. range of the water is 500 to 3000 mg/l.

Price quoted for water meters should include all accessories need for connection (bolt, nut, gasket etc.).

Tenderer shall state the name and address of the factories at which the meters will be manufactured. All offers must be accompanied by complete technical specifications, catalogues, all in English for the meters offered.

As a proof for the quality of the offered water meters, a comprehensive reference list of clientele as well as a programme of tests carried out on each water meter must be included. In addition to the above certificate from any international inspection body authenticating the conformity of the water meters should be produced, if available.

#### **3.2 Technical Requirements**

- (1) All water meters must be Class 'B'.
- (2) All water meters must be suitable for A.M.R. System.
- (3) All water meters must be flanged in accordance with B.S. 4504 PN 16.
- (4) Length of the water meter must be in accordance with I.S.O. 4064.
- (5) All meter parts must be replaceable spare parts must be stocked and be available at all times.

- (6) Meter body shall be totally separate from the meter measuring mechanism.
- (7) All water meters must read in imperial gallons.
- (8) The body shall be made of cast iron material of grade 260 min. protected by a non-corrosive coating from inside and outside (such as pure epoxy of D.F.T. 300 microns).
- (9) Impeller can be acceptable in synthetic material, provided the thermoplast substance used are approved for continuous operating temperature of 50°C.
- (10) The counter must be encapsulated type (evacuated and vacuumized).
- (11) Reading display window shall not be susceptible to condensation and should be protected by hinged flap.
- (12) All materials should comply with latest B.S. specification or equivalent.
- (13) **Marking**

All water meters shall be clearly and indelibly marked with the following information, either grouped or distributed on the casing, the indicating device dial or an identification plate. The water meter cover, being detachable, shall never be used for this purpose.

- (a) Name or trademark of the manufacturer.
- (b) Metrological class, nominal flow rate and pressure loss in bars.
- (c) Year of manufacture.
- (d) Serial number.
- (e) Arrow indicating the direction of flow.
- (f) Maximum working pressure.
- (g) Letter FEWA.
- (h) Mark of type approval.

(i) **Manuals**

The successful tenderer will supply five (5) sets (all in English) of maintenance manuals and fully illustrated spare parts books for each size and type of supplied water meters.

- (j) Complete set of bolts (full threaded), nuts, washers and one gasket shall be supplied to each flange. Bolt and nut shall be conforming to BS 970 Part 4 - stainless steel grade 316 and gasket shall be rubber reinforced with cotton of thickness not less than 3 mm.

(k) **Warranty**

All water meters should be under warranty for 3 years from the date of supply.

(l) **Test Certificates**

All water meters shall be tested at Qmax, Qt, Qmin, head loss, pressure test and all test results shall comply to ISO 4064 or BS 5728 and all test results shall be submitted to FEWA.

**(m) Delivery and Unloading**

The supplier is responsible for unloading all the water meters to FEWA Store, Sharjah. Unloading at Stores must be carried out under the control and responsibility of the supplier. Care should be taken to avoid severe impact with any solid object. All packing and transportation expenses shall be deemed included in the supply rates, and no extra payment shall be made by FEWA.

**4.0. ELECTROMAGNETIC FLOW METER**

**4.1 DETAILED SPECIFICATIONS**

Electromagnetic flow meters shall operate on electromagnetic induction principles and shall consist of a detector head and signal converter system. The flow metering system shall provide pulse and analogue current outputs proportional to volume and rate of flow respectively unless otherwise specified for Fieldbus output.

The detector head shall have a stainless steel metering tube and non-conductive, abrasion-resistant lining to suit the fluid being metered. Detector heads shall be flanged to BS 4504. The flanges shall be compatible with those specified for the associated pipe work. The detector head shall be IP67 certified minimum, and where there is possibility of flooding and in locations where the detector is in flow chamber the protection shall be IP 68. Detector heads shall be fitted with an anti-roll system to prevent damage during storage.

Power and signal cables to the detector head shall be factory sealed. Potted on site is not acceptable. Other measures shall be employed to ensure that no water or foreign matter enters the terminal enclosure during the interim period between installation and wiring.

Detector heads installed within a chamber shall have a degree of protection IP68 and shall be suitable for indefinite submersion under a head of water equal to the chamber depth or 3 meters whichever is the greater.

Detector heads shall be installed on steel cradle or concrete plinth with minimum 5 pipe diameters of straight pipe upstream and 3 diameters downstream. When fitted in lined, non-metallic or internally coated pipe work, the detector head shall have a grounding electrode with corrosion-resistant grounding rings.

The instrument and pipe work shall be designed and installed in such a way that air or other gases will not be trapped in or around the sensor. The flow meter body shall be bonded by tinned copper braid links at each end to the adjacent pipe work to ensure a good connection between the body and the metered liquid.

If the pipe work has cathodic protection the manufacturer's recommendations for bonding and protecting the instrument and its signals shall be adhered to.

For sewage and sludge and thick slurry type applications, automatic or self-cleaning of the electrodes shall be provided where required by the flow metering system. The flow measuring system shall have separate electrodes for measuring, grounding and empty pipe detection. The electrodes shall be of SS 316L material or Hastelloy for corrosive media.

The signal processing facilities of the converter shall ensure that the output signals are unaffected by interfering voltages, stratified flow, changes in fluid electrical conductivity within the limit stated, non-homogeneity of the fluid or the presence of ferrous particles.

The instrument zero shall be set at the manufacturer's premises and thereafter this zero shall be maintained automatically without interruption of flow or output signals. The zero and output signals shall be unaffected by partly fouled electrodes. The transmitter material shall be powder coated die cast aluminium or of SS.

#### 4.2 **Flow Sensor**

The flow sensor shall be manufactured from AISI 304 stainless steel metering tube with a Neoprene or non-conductive hard rubber liner to withstand process temperatures upto 80° C or better material, subject to Authority approval. The liner material shall be abrasive resistant and approved for potable water use by WRC-UK or equivalent internationally recognized authority.

There shall be 2 Nos. of measuring electrodes with built in reference electrode and empty pipe detection electrode as a standard item. The reference electrode shall ensure potential equalization between the sensor and the fluid and proper grounding of the installation. Electrode material shall be SS316L.

The end connections of the flow tube shall be flanged to ISO 7005-2 PN10/PN16/PN25 as indicated in the data sheet to suit project piping specifications. The flange material shall be of carbon steel with Zinc/Aluminium alloy coating.

The input impedance shall be  $10^{15}$  ohms or greater so that electrode fouling does not affect signal and electrode seal integrity. The sensor data shall; be stored in a built-in EPROM module.

The flow sensor shall be provided with a robust powder coated die cast aluminium housing, certified to IP-68 of IEC 50529 for remote transmitter version only and IP-67 for integral transmitter version. The manufacturer shall provide necessary type test certificates for the enclosure. It shall be possible to validate the instrument on site without removal of the sensor for ease of fault diagnosis and maintenance.

Automatic cleaning of electrodes shall be possible through the transmitters. The electrical connections for cable entry for sensors with remote transmitters shall be M20 x 1.5 with appropriate cable glands.

A minimum of (10) meters, of interconnecting cable between sensor and the transmitter unit shall be included for remote versions. The interconnecting special cable shall be supplied from the manufacturer of the flow meter and the length shall be as per site requirements.

#### 4.3 **Transmitter Unit**

The following features shall be provided as a minimum;

- 1 Pulsed DC field excitation;
- 2 Scaled pulse output for integration counter drive;
- 3 Capability of bi-directional measurement with differing forward and reverse ranges and with local and remote indication of flow reversal;
- 4 Contact operation at a programmable measured value;
- 5 Integral display of current flow and integrated quantity;
- 6 Galvanic isolation between each output circuit and between the electrode circuit and output circuit;
- 7 Each output circuit to be isolated from earth within the instrument but suitable for grounding at any point in the external circuit;
- 8 Key entry for basic parameters, range etc;
- 9 Commissioning and rescaling to require no special programming knowledge;
- 10 An adjustable low flow cut-off;
- 11 Self-diagnosis;
- 12 Terminals to have a compartment separate from the electronic components;
- 13 Minimum fluid conductivity 20 micro-Siemens/cm or less;
- 14 Continuously adjustable velocity range setting 0.5 to 10 m/s or better.

The transmitter unit shall be either integral with the flow sensor or remotely mounted to suit the application requirements as indicated in the project data sheet.

The transmitter unit shall be microprocessor based, of modular design and shall be easily configurable through integral keypads. The electronics shall be of modular construction for ease of maintenance and future expandability. The operation shall be through optical touch control buttons.

The transmitter shall be provided with at least three (3) lines illuminated display for rate of flow and totalised flow indication. The data storage shall be EEPROM to preserve data on power failure without backup. The unit shall have high electromagnetic compatibility according to IEC 801/VDE 0843 and NAMUR recommendations. The unit shall also withstand an isolation Test upto 1800 DV for 2 secs.

The transmitter shall be housed in robust die-cast aluminium enclosure with IP67 protection for both compact and remote versions.

The unit should have good resistance to shock and vibrations and withstand acceleration upto 2g/2 h per day., 10-100 Hz (complete system).

The unit shall be able to operate on power supplies in the range of 85V to 260V AC. It should be possible to operate the meter without removing the front cover, and should have password security facility to avoid unauthorized operation.

All inputs and outputs shall be available and configurable by the user.

- 1) 2 nos. Analogue, 4-20 mA d.c. signal proportional / Profibus.
- 2) 1 nos. Active/passive (open collector) selectable to pulse/frequency output.
- 3) Status configurable for limit values, end value switching, empty pipe detection, flow direction over ranging or instrument fault.
- 4)

#### 4.4 **Performance**

The following performance shall be available as a minimum; superior standards shall be met where stated elsewhere in the Specification or where so required by the metering and/or control requirements.

Overall flow system accuracy for local and remote display (including pulse counter)

The unit shall have a rangeability of 1000:1 to measure fluid velocities from 10mm/sec to 10m/sec. with a specified accuracy.

Accuracy shall be better than  $\pm 0.25\%$  of reading (actual flow rate) at flow velocity  $> 1$  m/s with repeatability with  $\pm 0.1\%$  of flow rate. The measurement shall be insensitive to entrained solid particles. Each converter shall be completely interchangeable with any other electromagnetic flow meter converter of the same design.

Plant-mounted signal converter enclosures shall have a degree of protection of not less than IP67. Signal converters installed within an instrument panel located in a building may be of the rack-mounted type having a degree of protection not less than IP20.

Signal converters shall not be located in flow meter chambers or areas subject to flooding.

#### 4.5 **Calibration**

Each detector head and converter shall be wet-tested and calibrated with the velocity programmed to a value not exceeding that appropriate to the specified application in a permanent test rig having a valid Quality Assurance Certificate or Calibration Certificate issued by the National Standards or Calibration Authority of the country of origin of the flow meter. The certificate shall be of 5 pt. Calibration.

- 4.6 Complete set of bolts, nuts and one gasket shall be supplied to each flange. Bolt and nut shall be conforming to BS 970 Part 4 - Stainless Steel Grade 316 and Gasket for PN 16 shall be rubber reinforced with cotton of thickness not less than 3 mm. and the rating of the gasket shall be the same as that of the valve.

The Nuts and Bolts for equipment side flange shall also conform to the same requirements.

## **5.0 BUTTERFLY VALVES**

### **5.1 General**

All butterfly valves required under this clause shall be of West European origin and should conform to the requirements of the specification mentioned below:

Butterfly valves shall conform to BS 5155 or equivalent. Valves shall be suitable for flow in either directions and shall be designed to be used as a regulating and tight shut-off valves.

Supplier shall further warranty the valves against manufacturing defects, material failure and corrosion problems for **five years** from the date of supply.

### **5.2 Class**

The valves (unless otherwise specified) shall be suitable for a working pressure equivalent to 16 bars.

### **5.3 Performance**

The valves shall have flanged ends of appropriate design and drilling system to be capable of functioning with the specified working pressure.

### **5.4 Materials**

The valves components shall be manufactured from the following materials (unless otherwise specified).

#### **a) Body**

The body shall be made of Ductile Cast Iron to BS 2789 Grade 420/12 or 500/7.

#### **b) Shaft**

The shaft shall be made of Aluminium Bronze to BS 2874 CA104/Stainless Steel 316 L.

The design of the shaft shall be such that it will safely sustained maximum differential pressure across the closed valve, and it shall be capable of withstanding the max. torque required to operate the valve as specified in BS 5155 or equivalent.

#### **c) Complete set of bolt and nut, gasket shall be supplied to each flange. Bolt & nuts shall be conforming to BS 970 Part 4 - Stainless Steel Grade 316 and gasket shall be rubber reinforced with cotton of thickness not less than 3 mm.**

#### **d) The valve disc shall be **Aluminium Bronze** (conforming to BS 1400 AB 2) and Disc shall be coated with Rilson of 150 microns.**

## 5.5 Operation

Worm reducing gear enclosed in Ductile Iron (BS 2789 Grade 420) casing grease packed shall be supplied with hand wheel and position indicator.

## 5.6 Marking

Each body will be marked by Cast-on or stamped figures as follows:

- Size of Valve.
- Year of manufacturing.
- Manufacturer's trademark or name.
- Working pressure.
- Letters "FEWA".

## 5.7 Tests

One number of the valves of each size shall be tested according to the standard specification in the presence of FEWA Engineer. (Seat test, Body test & Disc strength test).

## 5.8 Technical Data

Catalogues, leaflets, comprehensive technical information, and detailed working drawings for the offered valves showing all parts, dimensions and material specifications should be submitted.

**Unless otherwise specified face to face dimensions for Butterfly Valves shall be as follows:**

<u>Size (mm)</u>	<u>FTE (mm)</u>
800	318
600	267
500	229
400	216
300	178
200	152
100	127
80	114
50	108

## 5.9 Protection

Inside shall be rubber lined made of EPDM or equivalent suitable for permanent contact with fresh/brackish water at permanent temp. of at least 60°C. Outside shall be fusion bonded/electrostatically epoxy coating not less than 300 microns (DFT).

## 6.0 D.I. GATE VALVES (Spigot/Flanged)

### 6.1 General

All Valves shall be of West European origin and should comply with B.S. 5163/86 or equivalent and the specification detailed below has to be followed.

All the valves shall be Resilient seated with non-rising stem suitable for potable water.

## 6.2 Class

Unless otherwise specified, the valves shall be designed for a working pressure of 16 Kg/sq.cm. and shall withstand in open position test pressure appropriate to the working pressure (1.5 times at least).

## 6.3 Materials

Unless otherwise specified, the valves components shall be manufactured from the following materials:

Body, Bonnet, Stuffing box & Cap	Ductile Cast Iron to B.S. 2789 Grade 420/12 or Grade 500/7
Stem	Stainless Steel AISI 316.
Wedge	Ductile Cast Iron to B.S. 2789 Grade 420/12 or Grade 500/7
Rubber	EPDM
Stem Nut	Gunmetal to BS 1400 LG2

## 6.4 Flanges

Flanges of the valves shall conform to BS 4504/1969 Part 1 - PN 16 and drilling system to be capable of functioning with the specified working pressure.

## 6.5 Stem

The valve stem shall be made in one piece and shall be able to withstand without permanent distortion all stresses, compressive, tensile and torsional, to which it could be subjected. The stem diameters above and below the Collar shall comply with the dimensions given in Table (4) of B.S. 5163/86.

## 6.6 Operation

Valves shall be manually operated (unless otherwise specified) supplied with **stem caps/hand wheel** and shall be closed clockwise.

Complete set of bolts, nuts and one gasket shall be supplied to each flange. Bolt and nut shall be conforming to BS 970 Part 4 - Stainless Steel Grade 316 and Gasket shall be rubber reinforced with cotton of thickness not less than 3 mm.

## 6.7 Protection

All valves shall be protected internally and externally by fusion bonded epoxy coating of thickness not less than 300 microns (DFT)

## 6.8 Dimensions

<b>NOMINAL DIA. OF VALVES (SPIGOT)</b>	<b>EXTERNAL DIA. AT FINISHED END</b>	<b>FACE TO FACE DIMENSIONS OF SPIGOT GATE VALVE</b>	<b>FACE TO FACE DIMENSIONS OF FLANGED GATE VALVE</b>
Dia. 80 mm	106 mm	280 mm	203 mm
Dia. 100 mm	126 mm	300 mm	229 mm
Dia. 150 mm	178 mm	350 mm	267 mm
Dia. 200 mm	234 mm	400 mm	292 mm
Dia. 250 mm	288 mm	450 mm	300 mm
Dia. 300 mm	344 mm	500 mm	356 mm
Dia. 350 mm	402 mm	--	381 mm
Dia. 400 mm	456 mm	600 mm	406 mm
Dia. 450 mm	--	--	432 mm
Dia. 500 mm	560 mm	--	457 mm
Dia. 600 mm	668 mm	--	508 mm

## 6.9 Test

2 Nos. of the valves of each size must be tested and the testing shall be witnessed by FEWA Engineer without any additional cost.

## 7.0 NON-RETURN VALVES/CHECK VALVES

### 7.1 General

Valves shall comply as far as possible with B.S.S. 5153/74 or equivalent and the specification detailed after has to be followed:

- (a) The valves shall be straight pattern for use with the axis of the body ends ports horizontal and antislam swing type.
- (b) The valves shall be suitable for velocities (3.5 - 5) m/sec.

### 7.2 Class

Unless otherwise specified, the valves shall be designed for a working pressure of 16 Kg/cm<sup>2</sup>.

### 7.3 Material

The valve components shall be manufactured from the following materials.

Body, Body Cover	Ductile Cast Iron to B.S. 2789 Grade 420/12 or Grade 500/7.
Disk	Ductile Cast Iron/Steel encapsulated with EPDM Rubber.
Hinge Pin	Stainless Steel Gr. 316-S16 to B.S. 970/4.
Hinge to Disc Connection	Gunmetal to B.S. 1400-LG2
Disk Facing Ring	Gunmetal to B.S. 1400-LG2
Body Seats	Gunmetal to B.S. 1400-LG2

#### **7.4 Type**

Valves, unless otherwise specified, shall be swing type for horizontal position.

#### **7.5 Performance**

Valves shall have flanged ends of appropriate design and drilling system (B.S. 4504 PN 16) to be capable of functioning with the specified working pressure.

#### **7.6 Dimensions**

The face to face, and centre to face dimensions, unless otherwise specified, shall be as detailed in Table No. 2 of B.S. 5153/74. The tolerance shall be as given in the same standard specification.

#### **7.7 Tests**

Each valve shall be hydraulically tested according to the standard B.S. 5153/74 and to the following pressure:

- a) Body Test : 24 Kg/cm<sup>2</sup>
- b) Seat Test : 16 Kg/cm<sup>2</sup>

#### **7.8 Protection**

Valves shall be protected internally and externally by fusion-bonded epoxy of thickness not less than 300 microns (D.F.T.)

#### **7.9 Marking**

Each valve shall be marked with cast or stamped lettering giving the following information:

- a) Class of Valve.
- b) Size of Valve.
- c) Manufacturer's Name or Trade Mark.
- d) Year of Manufacturing.
- e) Type of Casting.

#### **7.10 Technical Data**

Catalogues, leaflets, comprehensive technical information and detailed working drawings for the offered valves showing all parts, dimensions and material specifications, should be submitted.

#### **7.11 Accessories**

Each valve shall be supplied with all accessories such as:

Stainless Steel Grade 316 Bolts, nuts, washers and 3 mm cotton reinforced EPDM rubber gasket for each flange.

## **8.0 AIR VALVES MUST CONFORM TO THE SPECIFICATION EITHER (A) OR (B).**

### **(A) AIR VALVES**

#### **8.1 Design Requirements**

Air Valves shall be designed in accordance with the following requirements.

Rapid Filling of Pipeline

Uninterrupted high volume air discharge through the large orifice.

Pipeline draining or Column Separation.

Uninterrupted high volume air intake through the large orifice.

The valve must incorporate an integral surge alleviation mechanism which will automatically dampen surge pressures due to rapid air discharge or the subsequent rejoining of separated water columns.

#### **8.2 Construction And Design**

The air release & vacuum break valve shall be of a compact single chamber design with solid cylindrical High Density Polyethylene control floats housed in a tubular stainless steel and stainless steel ends secured by means of stainless steel tie rods conform to AISI 304. Bottom side should be flanged and flange must conform to BS 4504/1969 Part 1 - PN 16.

Body

2", 3" & 4" - Stainless Steel

The valve shall have an integral surge alleviation mechanism which shall operate automatically to limit transient pressure rise or shock induced by closure due to high velocity air discharge or the subsequent rejoining of separated water columns. The limitation of pressure rise must be achieved by deceleration of approaching water prior to valve closure. Relief mechanisms that act subsequent to valve closure cannot react in the low millisecond time span required and are therefore unacceptable.

Large orifice sealing shall be effected by the flat face of the control float seating against a nitrile rubber 'O' Ring housed in a dovetail groove circumferentially surrounding the large orifice. Discharge of pressurized air shall be controlled by the seating & unseating of a small orifice on a natural rubber seal affixed to the control float.

The intake/discharge orifice area shall be equal to the nominal size of the valve i.e., 100 mm (4") valve shall have a 100 mm (4") intake/discharge orifice.

The valve construction shall be proportioned with regard to material strength characteristics, so that deformation, leaking or damage of any kind does not occur by submission to twice the designed working pressure.

Complete set of bolts, nuts and one gasket shall be supplied to each flange. Bolt and nut shall be conforming to BS 970 Part 4 - Stainless Steel Grade 316 and Gasket shall be EPDM rubber reinforced with cotton of thickness not less than 3 mm.

#### **8.3 Protection**

All Stainless Steel Valves shall be protected internally with suitable anticorrosive coating.

#### **8.4 Test**

Minimum 2 Nos. of each size must be tested in the presence of FEWA Engineer.

- (1) Leakage test at 0.5 bars.
- (2) Leakage test at 16 bars.

#### **(B) D.I. FLANGED DOUBLE AIR VALVES**

All air valves required under this clause shall be of West European origin and should conform to the requirements of the specification mentioned below:

These ductile iron air release valves shall be with double chambers, having large orifices for high air flow capacities.

They shall be suitable for working pressure of 16 bar and body test pressure of 24 bar. Flanges shall conform to B.S. 4504 PN 16.

The valve body shall be internally and externally coated with fusion bonded epoxy paint of approved quality and standards not less than 300 microns (DFT) for long term protection against corrosion and suitable for contact with potable water, (non-toxic).

Valve body chambers (both) shall be fitted with Gunmetal guides (to BS 1400 LG2) for floating balls.

Body, Bonnet & Cover

- Σ Ductile Iron  
Conform to BS 2789  
Grade 420/12 or Grade 500/7.
- Σ Float - ABS (Acrylonitrile Butadiene styrene)

All other parts shall be made of approved corrosion resisting alloys. All air valves shall have flanged end of PN 16.

Complete set of bolts, nuts and one gasket shall be supplied to each flange. Bolt and nut shall be conforming to BS 970 Part 4 - Stainless Steel Grade 316 and Gasket shall be EPDM rubber reinforced with cotton of thickness not less than 3 mm.

#### **8.5 Tests**

2 Nos. of Valves of each size must be tested in the presence of FEWA Engineer as per relevant specification without any additional cost.

- (1) Leakage test at 0.5 bars.
- (2) Leakage test at 16 bars.

#### **8.6 Marking**

Each body will be marked by cast - on or stamped figures as follows:

- Size of Valve
- Year of manufacturing
- Manufacturer's trademark or name
- Working pressure
- Letters "FEWA"

## **8.7 GENERAL**

Supplier must furnish FEWA with detailed technical catalogues/information on his proposed valves, along with his offer. Further, a manufacturer's and/or supplier's certificate confirming that all valves supplied against this enquiry have been subjected to the necessary tests and comply in all respects to FEWA specifications must be furnished at the time of delivery.

Supplier shall further warranty the valves against manufacturing defects, material failure and corrosion problems for five year from the date of supply.

## **9.0 PRESSURE REDUCING VALVES**

### **1 General:**

All Pressure Reducing valves required under this clause shall be manufactured and supplied from North American, EEC former Western European countries, Australia, or Japan only and should conform to the requirements of the specification mentioned below:

- 1.1 Pressure reducing valves shall be automatic operation and shall be manually adjustable.
- 1.2 The valves shall be capable of reducing a constant or variable inlet pressure to a constant outlet pressure of 30 to 40 meters head.
- 1.3 The valves shall be designed to provide the necessary loss of head and shall operate without hunting. It shall be of the globe valve type with main body of ductile iron or high grade cast iron and with bronze and gunmetal trims. The valve mechanism shall be piston operated , controlled from a servo diaphragm actuated by an adjustable spring balance relay comparing pressure generated across an integral orifice plate.
- 1.4 Each valve shall be fitted with a pressure gauge to facilitate checking of operation, each shall have the body rated to PN25 and shall be pressure tested to 40 bar. Each valve shall installed complete with all accessories to form a complete system.
- 1.5 Valves shall have flanged ends of appropriate design and drilling system (R.S. 5404 PN 16 unless otherwise specified)

### **1.6 Marking**

Each valve body shall be marked with cast-on or stamped lettering giving the following :

- 2 Size of valve
- 3 Year of manufacturing
- 4 Manufacturer's trading mark or name
- 5 Working pressure
- 6 Letters "FEWA"
- 7 Contract No.

- 1.7 Complete set of bolt and nut, gasket shall be supplied to each flange. Bolt & nuts shall be conforming to BS 970 Part 4 - Stainless Steel Grade 316 and gasket for PN16 shall be rubber reinforced with cotton of thickness not less than 3 mm. and the rating of the Gasket shall be same as that of the valve. For higher pressure, the gasket shall be in a range of high quality and high performance asbestos free material, that have been proven in service. It shall have an excellent creep resistance, good steam resistance, approved by WRA for use in potable water and subject to FEWA approval.

## **10.0 SPECIFICATIONS FOR PRESSURE SUSTAINING AND REDUCING VALVES**

- 10.1 The Pressure Sustaining and Pressure Reducing valves shall be of the globe type, piston or diaphragm operated to comply with the general requirements of specification.

The valve must be capable of bubble tight sealing against 16 bar operating pressure unless mentioned otherwise. The end flange shall be rated and drilled in accordance with the standard shown in the Data sheets.

The pressure sustaining valve shall be of the pressure compensated globe type complete with external hydraulic relay system and designed to automatically sustain a predetermined pressure immediately upstream its position.

The pressure reducing valve shall be of the pressure compensated globe type complete with external hydraulic relay system and designed to reduce a constant or variable inlet pressure to a predetermined constant outlet pressure at varying flows. The controlling pressure point can be either at the valve or at the point on the pipeline some distance from the valve.

The relay control system shall consist of a hydraulic relay valve unit, orifice and strainer block control valves and interconnecting small bore piping. The relay valve shall be manufactured completely in stainless steel 316, which shall consist of diaphragm, diaphragm guide, support piston, spindle, etc.

The office / strainer unit shall have a body and internals of stainless steel. The pressure setting control valves and control piping shall be constructed in 316 stainless steel.

The valves shall be designed such that the hydraulic relay system can be inspected, maintained or replaced without isolating the supply. All necessary repairs to the valve shall be possible without removing the valve from the line.

The pressure setting shall be capable of being adjusted on site by the use of an adjustment screw to alter the compression of the spring. The opening and closing speeds shall also be field adjustable by adjusting the flow regulation screw. The valves shall be capable of being fully opened or fully closed by respective opening and closing of upstream and down stream ground cooks.

The valves shall be designed to provide the necessary loss of head and shall operate without hunting. The valve mechanism shall be piston operated, controlled from a servo diaphragm actuated by an adjustable spring balance relay comparing pressure generated across an integral orifice plate.

The valve shall be coated internally with fusion bonded epoxy coating system to minimum 300 microns DFT at any point. The maximum dry film thickness shall be as per paint manufacturer recommendations. The internal coating material to be used shall be suitable for potable water and certification in this respect from a recognized international authority shall be submitted for FEWA's approval.

#### 10.2 **Material Specification:**

Body	: Ductile from GGG 40/50
Trims Ported Guide & Seating	: Gunmetal to BS 1400 LG 2C
Seating on plunger	: Rubber
Plunger	: Ductile iron GGG 40/50
Pilot Valves (control valves)	: Stainless steel 316
Pilot parts (fittings)	: Stainless steel 316
Indicating rod	: Stainless steel 316

## **11.0 SPECIFICATIONS FOR ACTUATOR & POSITIONER**

### 11.1 **Specification for Actuator & Positioner**

For motorised type actuators the following shall be considered as a guideline for selection of actuators.

The actuators shall be suitable for use on a nominal volt 3 phase Hz power supply and are to incorporate motor, integral reversing starter, local control facilities and terminals for remote control and indication connections. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel with either phase sequence or the 3-phase power supply connected to the actuator.

It shall be possible to carry out the setting of the torque and turns and configuration of the indication contacts without the necessity to remove any electrical compartment covers. Setting of the torque or turns by using the local controls is not acceptable. Infra- red setting is preferred.

The actuator shall be sized to guarantee valve closure at the specified differential pressure. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal. The operating speed shall be such as to give valve closing and opening at approximately 10-12 inches (250-300mm) per minute unless otherwise stated in the job specification.

The electric motor shall be Class F insulated, with a time rating of at least 15 minutes at 104°F(40°C) or twice the valve stroking time, whichever is the longer, at an average load of at least 33% of maximum valve torque. Electrical and mechanical disconnection of the motor should be possible without draining the lubricant from the actuator gear case. The motor shall be provided with high Torque protection device and thermal overload (embedded) protection device. The actuator gearing shall be totally enclosed in an oil-filled gear case suitable for operation at any angle. All main drive gearing must be of metal construction.

A hand wheel shall be provided to emergency operation, engaged when the motor is declutched by a lever or similar means, the drive being restored to power automatically by starting the motor. The hand/auto selection lever should be pad lockable in both hand and auto positions. It should be possible to select hand operation while the actuator is running or start the actuator motor while the hand/auto selection lever is locked in hand without damage to the drive train. The hand wheel drive must be mechanically independent of the motor drive and any gearing should be such as to permit emergency manual operation in a reasonable time. Clockwise operation of the hand wheel shall give closing movement of the valve.

The actuator shall be furnished with a drive bushing easily detachable for machining to suit the valve stem or gearbox input shaft. Normally the drive bush shall be positioned in a detachable base of the actuator. Thrust bearings, when housed in a separate thrust base should be of the sealed for life type.

The actuator shall be provided with remote valve position/actuator status indication. Four contact shall be provided which can be selected to indicate any position of the valve, with each contact selectable as normally-open or normally-closed. The contacts shall be rated at 5A, 250V AC, 30V DC.

The actuator shall include a digital local position indicator with a display from fully open to fully closed in 1% increments. Red, green and local yellow lights corresponding to Open, Closed and Intermediate position shall be included on the actuator. The digital display shall be maintained without any external supply being connected.

The reversing starter, control transformer and local controls shall be integral with the valve actuator suitably housed to prevent breathing and condensation build. The starter shall be suitable for 60 starts per hour and of rating appropriate to motor size. The controls supply transformer shall be fed from two of the incoming three phases. It shall have the necessary tapings and be adequately rated to provide power for the following functions:-

- 120V AC energisation of the contactor coils.
- 24V DC output where required for remote controls.
- Supply for all the internal electrical circuits.
- The primary and secondary winding shall be protected by easily replaceable fuses.

Integral to the actuator shall be local controls for Open, Close and Stop and a Local/Remote selector switch padlock able in any one of the following three positions: local control only, off (no electrical operation), remote control plus local stop only. It shall be possible to select maintained or non-maintained local control. The local controls shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.

The necessary wiring and terminals shall be provided in the actuator for the following control functions:

Removable links for substitution by external interlocks to inhibit valve opening and/or closing.

Connections for external remote controls fed from an internal 24V DC supply and/or from an external supply of (min. 12V, max. 120V) to be suitable for any one or more of the following methods of control:-

- (A) Open, Close and Stop.
- (B) Open and Close.
- (C) Overriding Emergency Shut-down to Close (or Open) valve from a "make" contact.
- (D) Two-wire control, energize to close (or open), de-energize to open (or close).

Selection of maintained or push-to-run control for modes (A) and (B) above shall be provided and it shall be possible to reverse valve travel without the necessity of stopping the actuator. The starter contactors shall be protected from excessive current surges during travel reversal by an automatic time delay on energisation of approximately 300ms.

The internal circuits associated with the remote control and monitoring functions are to be designed to withstand simulated lightning impulses of up to 1.1kV.

Facilities shall be provided for monitoring actuator operation and availability as follows:-

Monitor (availability) relay, having one SPDT changeover contact, the relay being energized from the control transformer only when the Local/Off/Remote selector is in the Remote position to indicate that the actuator is available for remote (control room) operation.

Where required, it shall be possible to provide indication of Thermostat trip and Remote selected as discreet signals.

Provision shall be made for the addition of a diagnostic module, which will store and enable download of historical actuator data to permit analysis of changes in actuator or valve performance.

Internal wiring shall be of tropical grade PVC insulated stranded cable of appropriate size for the control and 3-phase power. Each wire shall be clearly identified at each end.

The terminals shall be embedded in a terminal block of high tracking resistance compound.

The terminal compartment shall be separated from the inner electrical components of the actuator by means of a watertight seal.

The terminal compartment of the actuator shall be provided with a minimum of 3 threaded cable entries.

All winding supplied as part of the actuator to be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable.

A durable terminal identification card showing plan of terminals shall be provided attached to the inside of the terminal box cover indicating:-

- Serial number
- External voltage values
- Wiring diagram number
- Terminal layout

This must be suitable for the contractor to inscribe cable core identification alongside terminal numbers.

Actuators shall be O-ring sealed, watertight to NEMA5/IP68 and shall at the same time have an inner watertight and dustproof O-ring seal between the terminal compartment and the internal electrical elements of the actuator fully protecting the motor and all other internal electrical elements of the actuator from ingress of moisture and dust when the terminal cover is removed on site for cabling.

Enclosure must allow for temporary site storage without the need for electrical supply connection.

All external fasteners should be of stainless steel.

Actuators for explosion-hazardous applications shall in addition be certified Flameproof for Zones 1 and 2 (Divisions 1 and 2) Group gases.

Each actuator must be performance tested and individual test certificates shall be supplied free of charge. The test equipment should simulate a typical valve load, and the following parameters should be recorded.

Current at max. torque setting

Torque at max. torque setting

Flash test voltage

Actuator output speed or operating time.

Each valve body shall be marked with stamped lettering on an SS plate giving the following :

Size of valve

Year of manufacturing

Manufacturer's trading mark or name

Working pressure

Letters "FEWA"

Contract No.

## **12.0 LOW DENSITY POLYETHYLENE PIPE**

**12.1 SCOPE** : This specification applies to low density Polyethylene Pipe (Type 32) for cold water services. The outside diameters and nominal pressures are in accordance with BS-1972/67.

**12.2 CLASSIFICATION OF PIPES** : Pipes are classified by maximum sustained working pressure as follows:

Class - C : 9.1 Kgf/cm<sup>2</sup>

The maximum sustained working pressure given above is based on water at a temperature of 20 deg. C. This is the maximum sustained working pressure for which the pipes are suitable for use.

**12.3 DIMENSIONS** : Pipes shall conform to the outside diameters and wall thickness given in the following Table.

Nominal ND	Outside Diameter		Wall Thickness Class-C 9.1 Kgf/cm <sup>2</sup>		Coil Length Mtrs.
	Min. (mm)	Max. (mm)	Min. (mm)	Max. (mm)	
½"	21.2	21.5	2.7	3.0	200
1"	33.4	33.7	4.2	4.6	150
2"	60.1	60.6	7.6	8.4	150
3"	88.6	89.3	11.2	12.3	100

**12.4 MARKING** : All pipes shall be indelibly marked at intervals of not more than 3 m with the following :

- 1) Manufacturer's name.
- 2) The specification number.
- 3) The nominal size and class as shown in above Table.

**12.5** The pipes should be supplied in coils. The coil lengths should be in accordance with the above Table.

## **12.6 GENERAL**

In general the pipes shall conform to the British Standard 1972 : 1967 for material composition, physical characteristics, mechanical characteristics, sampling and testing.

## **12.7 ACCEPTANCE**

Each delivery to the stores shall be accompanied by a compliance certificate from the manufacturer. Any deviations found in random checks on coil lengths, pipe dimensions and any failure in hydrostatic pressure tests shall be considered a cause for rejection of the entire lot.

### **TEST**

1. Heat reversion
2. Resistance to hydraulic pressure
3. Tensile strength
4. Elongation at breaks

### **TEST METHOD**

- Appendix 'F' of BS 1972-1967  
Appendix 'G.2' of BS 1972-1967  
Appendix 'H' of BS 1972-1967  
Appendix 'H' of BS 1972-1967

## **13.0 GUNMETAL/BRONZE GATE VALVES**

Valves must be Gunmetal/Bronze(West European origin) conform to BS 1400LG2 with non-rising stem, female threaded and of the best quality suitable for use to BSP thread (G.I. Fittings/Pipes). They must conform to BS 5154/B-PN16 (or approved equivalent standards). They shall be suitable for working pressure of 16 bar and water temperature up to 60°C.

### **13.1 SADDLE STRAPS (COLLAR BRACES)**

All Saddle Straps shall be gunmetal free from manufacturing defects, and shall be complete with Stainless Steel AISI 316 bolts & nuts, rubber washers etc. They must be suitable for use with asbestos cement pressure pipes conforming to I.S.O.-160-1980, Class 20 and be capable of accommodating brass ferrules for drill sizes 1/2" Ø to 2" Ø. (Length of the bolt must be minimum 75 mm for 100 mm and 90 mm for 150 mm). All Saddle Straps must be drilled and threaded to suit 1" Ferrule.

### **13.2 GUNMETAL FERRULES**

All Ferrules shall be of Gunmetal, swivel balancing, screw-down and compression/ push-fit type or approved equivalent and shall be suitable for use with polythene pipes conforming to B.S. 1972/67 Class 'C' with stopcock combine with ferrule for closing and opening purposes and conform generally with B.S. 864. Ferrule shall withstand hydraulic pressure of minimum 16 bar and temperature up to 60°C.

### **14.0 GALVANIZED IRON TUBES, TUBULARS AND FITTINGS**

14.1 Tubes and tubulars shall conform to the requirements of BS 1387, Class-Heavy, and marked with RED bands for class Heavy identification, screwed with sockets and shall have BSP threads in accordance with the requirement of BS 21 to suit fittings.

The fittings(West Europe origin) shall conform to the requirements of BSEN 12041:2000, All male female fittings shall be chamfered to assist assembling and to avoid the crossing of threads

All the tubes and fittings shall be capable of withstanding internal hydraulic pressure of 50 kg/sq.cm without showing any sign of leakage.

A certificate from the manufacturers of tubes, and fittings as regarding their conformity with respective standards shall be submitted to FEWA.

All tubes, tubulars and fittings covered under this project shall be hot dip galvanized. Galvanizing shall be done by dipping thoroughly descaled and cleaned tubes, tubulars and fittings in a bath of molten zinc, containing not less than 98.5% of zinc by weight, at a temperature suitable to produce a complete and uniformly adherent coating of zinc. The nominal consumption of zinc should be 550 grams per square meter area (equivalent to 77 microns). Minimum consumption of zinc shall not be less than 490 grams per square meter area (equivalent to 67 microns).

Flanged connections of tubes, tubulars and fittings shall conform to BSEN 1092-1 2002

The tenderer shall submit catalogues of proposed material giving detailed technical information and specification along with his tender.

## **15.0 PLASTIC COMPRESSION FITTINGS**

Plastic Fittings must be suitable for use with polyethylene pipe conform to BS 1972/67 Class C.

Fittings must be suitable for use in continuous exposure to bright sunlight.

It must be suitable for contact with potable water.

The fittings shall withstand a hydraulic working pressure of minimum 10 bar.

The materials of the fittings must conform to relevant International Standard.

The Supplier shall submit Catalogues (Stamped and Signed) giving detailed specification for fittings, which he proposes to supply.

All ends of Plastic Connectors, Tees and Reducers must be suitable to polyethylene pipe conforming to BS 1972/67 Class 'C'.

## **16.0 PLASTIC ADAPTER (Male Threaded)**

Adapter shall be plastic compression fitting or push fit. One end shall be suitable to fit with polythene pipes conforming to B.S. 1972/67 Class 'C' and the other end shall be suitable to fit G.I. Pipes conforming to B.S. 1387.

## **17.0 STOP COCK ½", 1" & STOP COCK 1x½"**

Stopcocks must be made of Brass (Zinc must be minimized) with nickel plated inside and outside or gunmetal conforms to B.S 1400 LG2. One end (1" & 1/2" side) shall be female threaded (B.S.P. thread) swivel nut suitable to fit with G.I. Fittings and the other end (1" & ½" side) shall be suitable to fix low density polyethylene pipe conforming to B.S 1972/67 Class 'C' (compression fitting/push fit). Stopcock shall be of ball type with full bore and lock shield type suitable to be operated only with special key. Minimum of 10 % of keys must be supplied without any extra charges. These stopcocks shall have one-piece integral joints.

## **18.0 FLOAT VALVES**

Float Valves must be either Bronze or Gunmetal and of the best quality suitable for use to BSP thread (G.I. Fittings/Pipes). They must conform to the relevant International Standard and be complete with all accessories. Ball must be made of Copper. They shall be suitable for working pressure of 10/16 Bar.

## **19.0 BRONZE NON-RETURN VALVE**

Non-return Valve must be made of Bronze/Gunmetal conform to BS 1400 LG2, swing type, female threaded, best quality, West Europe/Japan origin, suitable to use with G.I. Pipe/Fittings having BSP thread. Working pressure must be minimum 10/16 bar. Valves generally must conform to BS 5154.

## **20.0 STRAINER**

Steel Schedule 80/Ductile Iron Basket type Strainer with both ends flanged and fitted with Stainless Steel 316 basket/screen. The basket should be removable from the top for maintenance purpose and drain plug should be provided. The strainer should be suitable for potable water up to 50°C. Fusion bonded epoxy coated to a minimum of 250 microns internally and externally.

Body	:	DI GGG40/Steel Schedule 80
Basket/Screen	:	SS 316
Plug	:	SS 316
Bolts/Nuts	:	SS 316
Perforations	:	DN 50 & DN 80 : Standard Screen 3/64 perforated SS 316. DN 100 to DN 900 : 1/8" perforated.

The strainers selection should be based on flow characteristics to ensure minimum pressure drop and for easy maintenance and cleaning. Flanges must conform to PN 16 BS4504. Minimum flow area should be 30% up to DN 80 and 40% for PN 100 and above. Typical head loss curve and screen size to be provided along with offer.

## **21.0 PLASTIC AIR VALVES**

Plastic Air Valves shall suitable for use under rigorous climatic conditions prevailing in U.A.E. It shall be suitable for use with potable water of temperature up to 60° C and 10 bar pressure. Air Valves must not leak at low pressure around 0.5 bar.

## **22.0 DETECTABLE WARNING TAPE**

Detectable Warning Tape shall be of high quality, strong, non-corroding, acid and alkali resistant, tear resistant and resistant to other destructive elements found in the sand/ soil. Detectable warning tape shall have long durability to maintain its installed width and message. It shall be free of surface area distortion normally. The width of tape shall be 150mm. Aluminums foil shall be minimum 12 ,corps micron thick and 300mm width and laid between the layers of polyester. The total thickness shall be minimum 250 microns.

The tape shall be Blue in colour and printed with minimum 50mm high black lettering alternatively in Arabic and English. The tape shall be imprinted with FEDERAL ELECTRICITY AND WATER AUTHORITY WITH LOGO – CAUTION – WATER MAINS BELOW" in Arabic and English . The tape shall have printed message in reverse type printing ( i.e. on back side of transparent polyester sheet). The manufacturer name shall be printed at every LM or less distance. The complete working shall be accommodated in I, or lesser length of tape in English and Arabic. This will continue for the complete length. The colours shall be vivid, glossy and permanent . The aluminium foil shall be incorporated so that it can be detected from ground surface using a buried cable locator such as RD 400 locator manufactured by Radio Detection Corporation. If requested by Engineer, the demonstration shall be given for delectability of tape by cable location at site

## **23.0 G.R.P. TANK**

### **GENERAL**

The Supplier must submit along with his quotation relevant catalogues/descriptive literature, copies of relevant specification and drawings giving detailed specifications of the materials used for the manufacturing of the tank quoted for. All such catalogues and other documents enclosed with his offer must bear his stamp and signature.

The supplier shall furnish FEWA with a Certificate that the tank quoted for and supplied against his offer, comply in all respects with FEWA Specifications and are as per relevant international standards approved by FEWA prior to delivery.

Prior approval for the design of the tank and all the materials used for the tank must be obtained from FEWA. The FEWA shall have the right to inspect the manufacturing of the tank.

Tanks must be made of Fiber Glass (G.R.P.) suitable for 100% humidity and 60°C temperature, corrosion proof, U.V. stabilized, non-toxic, non-staining, algae resistant, suitable for potable water and conform to B.S. 4994-1987 or equivalent International Standards. Tanks must be **cylindrical shape** with uniform thickness.

**Contractor must manufacture G.R.P. Tanks as per attached drawing.**

### **23.1 TANK SHELL**

The tank shall be manufactured by a **machine filament winding process** and shall include a chemical resistant liner, a structural wall and an exterior surface as follows:

The liner shall be approximately 1 mm thick. The liner surface shall be reinforced with 'C' glass mat backed by chopped 'E' glass, all impregnated with high Vinyl ester resin.

The structural wall shall consist of 'E' glass reinforcement, all impregnated with a high grade Isophthalic polyester resin.

The shell shall have a resin rich exterior surface reinforced with 'C' glass mat.

The shell shall be of uniform thickness and composition and shall have a minimum thickness of 14 mm.

No dark pigments or dyes shall be used in the shell construction.

External surface must have black-pigmented resin to prevent sunlight and topcoat of white polyester.

### **23.2 TANK RIBS**

The tank construction shall include stiffener ribs to provide sufficient stiffness and rigidity to the tank. The rib forms shall be moulded polyurethane foam, mechanically laminated over by machine to the tank shell. The tank shell shall be properly grounded at rib locations prior to placing the ribs to provide good bonding. Normal rib dimensions shall be as follows:

Rib width at bottom	:	180 mm. minimum
Rib height	:	30 mm. minimum
Rib reinforcement thickness	:	5 mm. minimum
Diameter of the tank	:	Around 3 metre.

### **23.3 CRADLE SUPPORTS**

**Cradle supports must be provided as per the drawing.** Detailed drawing of the same must be submitted along with the quotation. Minimum thickness of the shell at the cradle shall be 18 mm.

### **23.4 END CAPS**

Tank end caps shall be fabricated by a combination of hand and spray application of 'E' type glass fibre reinforcements and a high grade Isophthalic polyester resin moulded on precision made steel moulds. The minimum thickness of the end caps shall be 15 mm.

The tank shell and the end caps shall be jointed together using alternate layers of chopped strand mat (450 gm/m<sup>2</sup>) and woven roving (630 gm/m<sup>2</sup>) impregnated with resin, ensuring that all surfaces to be bonded have been well grounded.

The lay up joint shall be applied externally and shall have a minimum thickness of 10 mm. The width of the joint shall be 250 mm minimum. Internal lamination shall consist of 3 layers of chopped strand mat, and final resin coat.

### **23.5 POTABLE WATER CERTIFICATION**

The tank manufacturer shall be certified to meet the requirements of BS 6920 for products approved for potable water usage.

### **23.6 INLET, OUTLET, DRAIN & OVERFLOW PIPE**

G.R.P. Pipe 4" with Flange of PN 16

### **23.7 LADDER**

Stainless Steel ladder should be provided outside and inside the tank. Necessary dust proof air vents must be provided.

### **23.8 MANHOLE COVERS**

2 Nos. of 600 mm. built in G.R.P. Manhole frame with dust proof Manhole covers.

### **23.9 TESTING**

Following tests are to be done in the presence of FEWA Engineer prior to delivery.

### **23.9 AIR TEST**

Each tank must be tested for air pressure at 5 P.S.I. for 5 minutes with no pressure loss.

### **23.10 VACUUM TEST**

Each tank must be tested using a vacuum pump for a negative pressure of 2.5 P.S.I. for 5 minutes without pressure increase or collapse of the tank.

### **23.11 LEVEL TEST**

Suitable test must be arranged to confirm that all Cradle supports after fixing to the Tank are at the same level.

Any other test deemed necessary is to be done by the supplier without any additional cost.

### **23.12 TRANSPORTATION, LOADING AND UNLOADING**

The supplier shall be responsible for loading of these tanks at his factory, transportation and unloading of the tanks to FEWA Store, Sharjah.

### **23.13 MAINTENANCE**

The supplier shall maintain the tank **for 5 years** from the date of supply. During the period, the supplier shall attend to all repairs within 48 hours. In case of the repairs are not attended by the supplier, the same will be attended by the FEWA and cost will be recovered from the supplier. No additional payment shall be made for this type of work.

*Note : Attached drawing is for 10,000 Gallons. If the size of the tank is 5000 Gallons contractor must design and submit the drawing for approval.*

### **24.0 DUCT U.P.V.C. PIPES - SOLVENT WELD SOCKET TYPE**

#### **(a) Standards**

All material supplied and all works carried out, shall comply in all respects with the requirements of this specification and such regulations, which may be in force. Except where modified by this specification, materials shall be in accordance with BS (British Standard) 3506 (1969) : Unplasticized PVC Pipe.

As an alternative to BS Standard indicated above, the tenderer may quote for materials in accordance with his National or International Standards covering UPVC Pipes. In such case difference between BS Standard and that of the National or International Standard shall be clearly indicated by the tenderer in his offer and one copy of the National Standard in English language shall be attached with his offer.

When BS National/International Standard are refer to, the edition shall be that of current at the date of tender, together with any amendment issued to that date. The tender shall specify when tendering, the standards with which his offer complies. UPVC Pipes shall be of **Class 'C'** and the manufacturer shall be certified to ISO 9000 series. Non ISO 9000 certified manufacturers with previous successful direct supply experience to FEWA may be approved at FEWA's sole discretion for similar sizes supplied earlier.

#### **(b) Construction**

All details, dimensions and instruction shown on any drawings, diagrams and specifications quoted herein shall be taken as forming part of this specification. The PVC Pipes shall be made from unplasticised polyvinyl chloride (UPVC) generally to the requirements of nominal size of BS 3506. The extruded pipe shall be capable of being flattened completely between the plates of a hydraulic press without cracking or splitting. The pipes shall be corrosion resistant and tough.

The external and internal surface of pipes shall be clean, smooth and virtually free from grooves or other indentations or projections. The smoothness of the internal surface of the pipe shall be such that the pulling through of the cables in long lengths shall be facilitated without risk of damage to the exterior surface of the cable.

Each pipe shall have a tapered socket formed at one end. The socket shall be reasonable concentric with the axis of the pipe. The spigot end of the pipe and the socket shall be sufficiently tight interference fit.

Set of end caps and end plugs if included in the scope of supply shall be made of the same material as shown above for UPVC Pipes. The caps are to be used at the spigot end and plugs are to be used at socket end for sealing of respective UPVC pipes when the pipes are not in use.

*Note : Tenderer shall submit representative samples for the UPVC pipes.*

**(c) Markings**

All pipes shall be indelibly marked. The marking shall shown the following legend:

- ς Manufacturer's name.
- ς Year of manufacture
- ς FEWA Contract No.

Height of the markings shall not less than 6.5 mm.

Markings along the length of the pipes shall be provided at least at two different locations spaced equally around the periphery of the pipe.

**(d) Drawings & Samples**

The tenderer shall provide drawings, samples and catalogues for the UPVC pipes and accessories offered.

**(e) Testing**

Testing of the pipe shall be done in the presence of FEWA Engineer as per specification.

**(f) Delivery**

All the pipes shall be delivered to FEWA Stores or Areas (Ras-Al-Khaimah, Fujairah and Dibba).

**25.0 MANHOLE COVER ,FRAME AND SURFACE BOX**

**25.1 SCOPE**

This standard applies to manhole tops with a clear opening upto and including 600mm, for installation within areas subjected to pedestrian and of vehicular traffic

**25.2 NORMATIVE REFERENCES**

The following standards contain provisions, which, through reference in this text, constitute provisions of this standard:

BS EN 124	Gully tops and manhole tops for vehicular and pedestrian areas.
BS EN 1563	Specification for founding spheroidal graphite Cast Iron.
BS 3416	Specification for Bitumen based coatings for cold application, suitable for use in contact with potable water.
BS 4164	Coal-tar based hot applied coating materials for protecting iron and steel including a suitable primer.

**25.3 STANDARD**

Manhole top shall be manufactured generally comply with requirement of BSEN 124.

**25.4 MATERIALS**

The metal used for the manufacture of castings the manhole top shall be spheroidal or nodular graphite iron (Ductile Iron) complying with the requirements specified in BS EN 1563.

All cast units shall be cleanly cast and shall be free from air holes, sand holes, cold shuts and chill. They shall be neatly dressed and carefully fettled.

All casting shall be free from voids, whether due to shrinkage, gas inclusion or other causes.

**25.5 CLASSIFICATION**

Manhole top shall be of class D 400.

**25.6 SHAPE AND DIMENSION**

Shape and Dimension of manhole tops used in GCC countries are stated in Table 1. The depth of manhole frame shall be at least 150mm.

**Table 1**

Country	Shape	Clear opening area	Usage
UAE	Square	600 x 600 mm	Gate & Butterfly valves $\geq$ 300mm Bulk Water meter, Air valve washout valve.

**6.0 WEIGHT OF LIDS**

**6.1 Square manhole cover:**

For easy handling the manhole cover shall be with **double triangular lids** and weight of a single lid shall not be more than 32 Kg.

**.6.2 SEATING**

The manufacture of manhole tops shall be such as to ensure the compatibility of their seating. Those seating shall be manufactured in such a way as to ensure stability and quietness in use.

### **6.3 SECURING OF THE COVER WITHIN THE FRAME**

The cover shall be secure within its frame to meet the required traffic conditions relevant to the place of installation. This may be achieved by one of the following arrangements.

- a) A locking device
- b) A sufficient mass per unit area
- c) A specific design feature

These arrangements shall be designed so as to allow opening of the covers by means of usual tools.

### **25.7 DIRT PANS**

The manhole top shall be supplied with Dirt Pans, made of Glass Reinforced Plastic (sand trap).

The GRP sand trap shall rest on the lip of the frame, underneath the lids, but without any possibility of imposition of loads from externally or self load of lid/frame. There should be a handle to lift sand trap to access manhole chamber.

GRP material shall have a minimum thickness of 4.5mm and the sand trap shall be capable of withstanding static load of 150kg. applied centrally over 150mm square surface area, with a deflection measured at the center not exceeding 25mm.

### **25.8 SURFACE CONDITION**

The upper surface of the cover shall be flat within a tolerance of 1% of the clear opening with a maximum of 6mm.

The upper surface shall have a raised pattern to provide a skid-resisting surface. The height of raised pattern shall be between 3 to 8mm and the surface area of the raised pattern shall be between 10 to 70% of the total upper surface area.

### **25.9 FRAME BEARING AREA**

The bearing area shall be designed in such a way that;

- a) The bearing pressure in relation to the test load shall not exceed  $7.5 \text{ N/mm}^2$  and
- b) It provides an adequate contribution to stability under working conditions.

### **25.10 PROTECTIVE COATING**

All units shall be supplied coated internally and externally by dipping or other equivalent means using a hot applied coal – tar – based materials complying with the requirements specified in BS 4164 or a cold applied black bitumen material complying with the requirements specified in BS 3416 or heavy duty abrasion resistance epoxy paint with minimum DFT 400 microns.

No coating shall be applied to any casting unless the surface of the casting are clean dry and free from rust.

### **25.11 TESTING**

Manhole tops shall be tested as complete units in their condition of service. The test load shall be 400 KN and testing method shall be in accordance with clause 8 of BS EN 124.

## **25.12 MARKING**

All covers and frame shall be casted with the following markings:

1. FEWA – WATER (in English)
2. Class
3. Name or identification mark of the manufacturer

The above mentioned markings shall be clear and durable.

## **26.0 STAINLESS STEEL REPAIR CLAMP (WEST EUROPEAN ORIGIN)**

Clamp must be S.S. 304 and the rubber lining must be EPDM Rubber, length of each clamp shall be minimum 500 mm. All bolts must be S.S. 304.

## **27.0 DUCTILE IRON PIPES, FITTINGS AND ACCESSORIES**

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## 27.1 **SCOPE**

This specification covers the general requirements for Ductile Iron (D.I.) pipes, fittings and accessories including material specifications, internal lining, external coating, joints, polyethylene sleeves etc. This specification sets the minimum acceptable requirements. In case of difference between this specification and the specified international standards then the most stringent requirements shall prevail.

## 27.2 **APPLICABLE STANDARDS AND CODES**

D.I. pipes, fittings and accessories including coating and polyethylene sleeve shall comply with the latest issue of the following standards and other relevant standards noted elsewhere in this specification:

ISO 527	Plastics-Determination of tensile properties.
ISO 887	Plain washers for metric bolts screws and nuts.
ISO 974	Plastics-Determination of the brittleness temperature by impact.
ISO 2230	Vulcanized rubber-guide to storage.
ISO 2531/EN 545	Ductile iron pipes, fittings, accessories and their joints for water or gas applications.
ISO 3506	Corrosion - resistant stainless steel fasteners.
ISO 4014	Hexagon head bolts – Product grades A and B.
ISO 4032	Hexagon nuts, style 1 – Product grades A and B.
ISO 4179	Ductile iron pipes for pressure and non-pressure pipeline – Centrifugal cement mortar lining – General requirements.
ISO 4587	Adhesives – Determination of tensile lap-shear strength of rigid-to-rigid bonded assemblies.
ISO 4633	Rubber seals – Joint rings for water supply, drainage and sewerage pipeline – Specification for materials.
ISO 6600	Ductile iron pipes, centrifugal cement mortar lining – composition controls of freshly applied mortar.
ISO 6506-1	Metallic materials – Hardness testing – Brinell test – Part 1: Test method.
ISO 6708	Pipe works components – Definition and selection of DN
ISO 7005-2	Metallic flanges – Part 2: Cast iron flanges.
ISO 7268	Pipe components – Definition of nominal pressure.
ISO 7483	Dimensions of gaskets for use with flanges to ISO 7005.

ISO 8179-1	Ductile iron pipes – External coating – Part 1: Metallic zinc with finishing layer.
ISO 8179-2	Ductile iron pipes – External coating – Part 2: Zinc rich paint with finishing layer.
ISO 8180	Ductile iron pipes – Polyethylene sleeving.
ISO 8501-1	Preparation of Steel Substrates.
ISO 10804	Restrained joint systems for ductile iron pipelines – Part 1: Design rules and type testing.
EN 1092-2	Circular flanges for pipes, valves, fittings and accessories, PN designated – Part 2: Cast iron flanges.
BS 146	Specification for Portland blast furnace cements.
BS 3416	Specification for bitumen - based coatings.
BS 7079	Specification for surface finish of blast-cleaned steel for painting.
BSEN 681	Elastomeric Seals
BSEN 1563	Founding Spheroidal graphite Cast iron
BSEN 10025	Hot rolled products of non-alloy Structural Steels
DIN 30671	Thermo set plastics coatings for buried steel pipes
DIN 30672	Coatings of corrosion protection tapes and heat Shrinkable material.
DIN 4226	Aggregates for concrete.

### 27.3 D.I. MATERIAL CHARACTERISTICS

Ductile iron pipes, fittings and accessories shall meet the following requirements :  
Material Characteristics:

Material	Pipes Centrifugally Cast	Pipes not Centrifugally Cast, Fittings and Accessories
Minimum tensile strength (MPa)	420	420
Minimum yield strength (MPa)	300	300
Minimum elongation after fracture (%)		
DN 40 to DN 1000	10	5
DN 1100 to DN 2600	7	5
Maximum Brinell hardness, (HB)	230	250

## 27.4 D.I. PIPES

All D.I. pipes supplied shall be truly circular, of uniform thickness and supplied in the longest practicable length so as to minimize the number of joints.

Unless otherwise specified in the drawings or in the Particular Specification all pipes, joints and fittings shall be suitable for the maximum pressure under which they will operate (normal service pressure + surge pressure or the maximum site test pressure whichever is greater) and shall sustain without damage or substantial leakage the specified site hydrostatic test pressure.

The nominal iron wall thickness of pipes and fittings shall be in accordance with ISO 2531/EN 545 and calculated as a function of the nominal size, DN, by the following formula, with a minimum of 6 mm for pipes and 7 mm for fittings

$$e = K(0.5 + 0.001 \text{ DN})$$

Where :

e is the nominal wall thickness, in millimeters;

DN is the nominal size in millimeters;

K is a coefficient used for thickness class designation. It is selected from a series of whole numbers :.....8, 9, 10, 11, 12.....

Unless otherwise specified in the Particular Specification all pipes used shall be class K9 (K = 9).

All Pipes shall be subject to Third Party Inspection during manufacturing.

Dimensions and nominal iron wall thickness of fittings shall be in accordance with the ISO 2531/EN 545.

Name of manufacturer, standard, nominal diameter (DN), type of socket, class and date of manufacturing (month + year) shall be cast inside the socket or on the barrel of the fittings. The CONTRACT number shall be painted on the pipe/fittings.

Pipes shall be hydrostatically pressure tested for leak tightness and certified at the manufacturer's plant prior to coating or lining for at least 10 seconds at the following minimum internal test pressures:

- 1 50 bar for pipes DN 300 and smaller
- 2 40 bar for pipes DN 350 through DN 600
- 3 32 bar for pipes DN 700 through DN 1000
- 4 25 bar for pipes DN 1100 through DN 2000
- 5 18 bar for pipes DN 2200 through DN 2600

Unless otherwise stated in the Particular Specification all D.I. pipes supplied shall be of socket and spigot end. It shall be the CONTRACTOR's sole responsibility to order a percentage (minimum 2%) of the total length per diameter of pipes as calibrated pipes, for the purpose of cutting etc. These pipes shall be clearly marked and shall not be used for normal pipe laying unless it becomes clear that they are not required for the purpose of cutting any more. The percentage to be ordered shall give due regard to any changes in route which may occur during the course of the work for whatever reason.

## **27.5 D.I. FITTINGS**

All D.I. fittings supplied shall be truly circular of uniform thickness according to ISO 2531 and EN 545.

All fittings shall be subject to Third Party Inspection during manufacturing.

Dimensions and nominal iron wall thickness of fittings shall be in accordance with the ISO 2531/EN 545 (Series A).

For fittings the thickness  $e$  is the nominal thickness corresponding to the main part of the body. The actual thickness at any particular point shall be increased where necessary to meet localized high stresses depending on the shape of the casting (e.g. at internal radius of bends, at the branch body junction of tees, etc).

Name of manufacturer, standard, nominal diameter (DN), type of socket, class and date of manufacturing (month + year) shall be cast inside the socket or on the barrel of the fittings. The contract number shall be painted on the fitting.

Fittings shall be pressure tested for leak tightness and certified at the manufacturer's plant prior to coating or lining. The test pressure shall be carried out for at least 10 seconds either with air at a pressure of 1 bar or with water at the pressure indicated below:

- 1 25 bar for fittings DN 300 and smaller (for fittings with PN 10 flanges test pressure shall be 16 bar)
- 2 16 bar for fittings DN 350 through DN 600
- 3 10 bar for fittings DN 700 and larger

## **27.6 JOINTS**

### **27.6.1 Flexible Joints**

Flexible joints shall be of spigot and socket "push-on" type suitable for angular deflection in any direction and capable of axial movement to compensate for thermal expansion or contraction and ground movement. All flexible joints for D.I. pipes and fittings shall be designed in compliance with ISO 2531.

Joints may permit angular deflection to accommodate ground movements and to negotiate large radius bends. All joints shall be designed to be fully flexible. Consequently, the allowable angular deflection declared by the manufacturer shall not be less than (See BS 545):

- 1 3.5° for DN 40 to DN 300
- 2 2.5° for DN 350 to DN 600
- 3 1.5° for DN 700 to DN 2000

Allowable deflection with respect to Nominal Diameter DN shall be as per BS EN 545 latest edition.

Rubber ring joints shall be of a type that will not deteriorate under local conditions either during storage or during operation. The rubber gasket shall be of EPDM elastomer or equivalent in accordance with ISO 4633 suitable for drinking water supply.

Where mechanical type joints are specified, proposed and approved they shall be supplied complete with approved gaskets, glands, hot dipped galvanized or cadmium plated bolts, nuts and all other necessary accessories. Where retainer glands are specified they shall be supplied with bolts and/or other necessary accessories.

### **27.6.2 Flanged Joints**

Flange ended pipes and fittings shall only be used when connecting to valves or other special fittings as approved by FEWA.

The flanges shall be raised faced and integrally cast or welded on. Screwed on flanges or glued on flanges are not acceptable. Rotatable flanges may be used for pipes and fittings up to DN 600.

The dimensions and drilling of the flanges shall be to ISO 7005-2 or EN 1092-2. The pressure rating of the flanges shall be as given in the Data Sheet or Particular Specification. Flanged joints shall be supplied complete with gaskets, hot dipped galvanized or cadmium plated nuts, bolts and washers.

Rubber gaskets shall be EPDM elastomer or equivalent approved in accordance with ISO 4633 suitable for drinking water supply. The gasket shall be minimum 3 mm thick and shall be metal reinforced for pressure rating of 16 bar and higher. The dimensions of the flange gaskets shall be to ISO 7483.

The nuts, bolts, washers shall be of stainless steel grade 316. Nuts and bolts shall be suitable for the pressure rating specified in the Particular Specification. Nuts and bolts shall be to ISO 4014 and 4032 and washers to ISO 887.

### **27.6.3 Restrained Joints**

D.I. pipes and fittings with restrained coupling shall be utilized where pipelines have to cross roads through existing ducts or in areas with restricted accessibility where the use of concrete anchor blocks is prohibited, or as directed by FEWA. The CONTRACTOR shall submit with his bid full details of the type of restrained coupling he proposes to use.

Whenever in the course of work the CONTRACTOR intends to utilize restrained couplings he shall obtain prior approval from FEWA.

Calculation of the number of pipe lengths with restrained coupling required, shall follow the manufacturer's recommendation and shall be subject to FEWA approval.

Restrained joints shall be designed to resist the axial thrust forces but maintaining flexibility and angular deflection. Restrained joints shall be designed in accordance with ISO 10804-1. The joint shall be capable of withstanding the greater of the test pressure or the service pressure + the surge pressure.

The type of restrained joint shall be subject to FEWA approval.

The thrust resisting mechanism shall be separated from the sealing action of the gasket and shall not be in contact with potable water in the pipeline.

## **27.7 Internal Lining to D.I. Pipes and Fittings**

### **27.7.1 General**

Unless otherwise specified in the Data Sheet or Particular Specification all D.I. pipes and fittings shall be internally lined with Sulphate resisting blast furnace slag cement mortar in accordance with the following specification and shall be certified as suitable for use with potable water by an internationally accepted organization such as UK's WRC (Water Research Centre).

The cement mortar lining for D.I. pipes and fittings shall be in accordance with ISO 4179.

The internal surface of the socket bell of all zinc/bitumen coated D.I. pipes and fittings shall be painted with a non-toxic solvent-free two part epoxy coating applied to a minimum dry film thickness (DFT) of 100 microns or equivalent corrosion protection system to be approved by FEWA. The thickness of the coating may be reduced only at the gasket locating ring to conform to manufacturer's recommended tolerances.

### **27.7.2 Surface Preparation**

Prior to cement lining application the inner surfaces of pipes and fittings shall be cleaned of dirt, loose rust particles, grease, oil or any other material which could be detrimental to good contact between the metal and the lining.

### **27.7.3 Cement**

Cement to be used shall be of the sulphate resisting blast furnace slag cement type complying with the requirement of BS 146, obtained by grinding a mixture of 70 percent by weight of granulated blast furnace slag, to be completed with portland clinker and a maximum of 3.5 percent calcium sulphate.

### **27.7.4 Aggregates**

Only clean, rounded or crushed natural mineral materials aggregates shall be used in accordance with the requirement of the latest issue of the German DIN 4226 standards.

The distribution of grain sizes shall be:

- a) the amount of particles passing through a standard sieve with an aperture size of 0.125 mm shall not be more than 10% by mass.
- b) the amount of particles with a diameter up to 1/3 of the normal lining thickness shall not be less than 50% by mass.
- c) the maximum particle diameter shall not be greater than 1/2 of the normal lining thickness. The amount of shall not exceed 5% by mass.

#### **27.7.5 Additives**

The use of cement additives is allowed, subject to FEWA approval, provided that they do not adversely affect the quality of the lining, and that of the transported water.

Additives shall not contain any elements which impart potable change in colour, taste or odor or present a health hazard. Certificates of non toxicity prepared and signed by recognized, independent laboratories, shall be made available to FEWA.

#### **27.7.6 Water**

Water used for the mortar shall be of potable quality and shall not contain elements which influence the hardening of the lining or the quality of the water flowing through the finished pipes.

#### **27.7.7 Mortar**

Mortar for the lining shall be composed of cement, sand and water. The mortar shall be well mixed and of proper consistency to produce a dense homogenous lining that will adhere firmly to the DI pipe or fitting surface.

Weight of cement and sand shall be accurate to + 3%.  
The water/cement ratio shall not be more than 0.40.

The cement mortar shall not contain less than one part of cement to 3.5 parts of aggregates by weight as per ISO 4179.

#### **27.7.8 Method of Lining**

Lining application and quality for finished surface shall be in accordance with ISO 4179.

All pipes shall be lined by a centrifugal process. The consistency of the mortar and the time and speed of spinning the pipe shall be so adjusted to minimize the segregation of aggregates from the cement.

Fittings shall be lined by a spray method.

In all cases a smooth finish of the lining shall be obtained, entirely free from cavities or visible air bubbles.

The lining shall be uniform and extend from the spigot end up to the beginning of the socket cavity on the other side. The socket shall be left free of mortar.

No seal coat shall be applied to the cement lining unless otherwise instructed and approved by FEWA.

### 27.7.9 Curing

After application to pipes and fittings, the cement mortar shall be cured under controlled conditions (minimum 48 hours at more than 15°C and 75% relative humidity).

Alternative methods of curing are subject to approval of FEWA.

### 27.7.10 Repair of Defective or Damaged Areas of Lining

Defective or damaged areas of lining may, at FEWA's discretion, be patched by cutting out the defective or damaged lining to the metal so that the edges of the lining not removed are perpendicular or slightly undercut. The cut out area shall then be trowled with fresh mortar in the following composition :

- 1 One part cement (by weight).
- 2 One part sand.
- 3 Water of potable quality, with non toxic additive dispense of synthetic materials subject to FEWA's approval.

### 27.7.11 Thickness of the Lining

Thickness of the cement mortar lining shall be as follows:

	Lining Thickness (mm)		
	Normal	Minimum Mean Value	Minimum Value at One Point
80 – 600	5.0	4.5	3.5
700 – 1200	6.0	5.5	4.5
1400 – 2000	9.0	8.0	7.0
2200 – 2600	12.0	10.0	7.0

N.B.: The above figures differ from ISO 4179.

### 27.7.12 Mechanical Properties

The cement mortar lining shall have adequate resistance against compression and bending action. Representative test pieces shall have the following minimum properties after 28 days.

Water Cement Ratio of Test Piece	Compression Strength N/mm <sup>2</sup>	Bending Strength N/mm <sup>2</sup>
0.45	40	5.0
0.40	45	5.5
0.35	50	6.0

### 27.7.13 Quality of the Lining, Tests and Records

The lining shall be free from voids, ridges or corrugations that reduce the thickness of the lining to less than the specified minimum thickness.

Lining shall have a smooth surface. There shall be no cavities or entrapped air, similarly there shall be no evidence of differences between portions of lining.

Linings shall be placed so that there is no gap between the pipe barrel and the lining.

In some circumstances thicker linings may be required and these shall be stated in the appropriate specification.

If a lining is damaged it may be repaired on site using a one to one cement/sand mortar mix. (proportions by weight). Repairs shall cure for at least 72 hours.

Mortar lining may show evidence of cracking, crazing or debonding after delivery to site. The following conditions may be accepted.

- a) Cracking - provided that the longitudinal length of a crack is not more than 600 mm, width of crack not more than 0.8 mm, circumferential cracks are not more than 50% of the circumference.
- b) Crazing - provided that individual cracks are less than the limits given in a), crazing over an area not exceeding 25% of the lining area may be acceptable.
- c) Debonding - area of disbondment and radial displacement shall not exceed the values given in BSEN 545.

The following tests and measurements shall be conducted, recorded and filed with frequencies according to ISO 4179 and ISO 6600.

- 1 Determination of lining thickness.
- 2 Cross sectional sample.
- 3 Water cement ratio.
- 4 Aggregates.
- 5 Bonding and compression strength.

## **27.8 External Coating To D.I. Pipes And Fittings**

### **27.8.1 General**

Depending on the existing local conditions the external coating of D.I pipes and fittings shall be one of the following as given in the Data Sheets or Particular Specifications.

1. Metallic zinc with bituminous coating layer. (Standard coating for pipes)
2. Zinc rich paint with bituminous coating layer. (Standard coating for fittings)
3. Polyurethane coatings. (Pipes in Subkha areas)
4. Fusion bonded epoxy coating. (Flanged fittings)

All coatings are subject to the prior approval of FEWA.

Where non-toxic coating is specified, certification shall be required from an internationally recognized independent laboratory certifying that the material is safe for potable water service. At the discretion of FEWA all special coatings on pipes and fittings shall be subjected to thickness checks and for holiday testing on SITE in order to satisfy FEWA that the coatings are within the specified limits and that no pin holes are present.

The thickness of the coatings may be reduced only at the gasket locating ring to conform to manufacturer's recommended fitting tolerance.

### **27.8.2 Metallic Zinc with Bituminous Coating to D.I. Pipes**

The system consists of a factory applied metallic zinc layer to ISO 8179-1 and a finishing layer of black bituminous coating of tropical standard to BS 3416 with a minimum dry film thickness (DFT) of 100 micron.

The zinc content shall be minimum 99% and the mean mass of the zinc coating shall not be less than 200 g/m<sup>2</sup> applied on the bare metal of the external surface of the pipe.

The external surface of the D.I. pipe spigot end at a minimum length of 250mm shall have non-toxic bituminous paint applied to a minimum DFT of 100 microns.

The internal surface of the socket end shall be painted with a layer of zinc rich paint 150 g/m<sup>2</sup> (zinc content not less than 85%) plus a layer of non-toxic bituminous paint to a minimum DFT of 100 microns and a total average DFT of 120 microns.

### **27.8.3 Zinc Rich Paint with Bituminous Coating to D.I. Fittings**

The system consists of factory applied zinc rich paint layer to ISO 8179-2 and a finishing layer of black bituminous coating of tropical standard to BS 3416 with a minimum DFT of 100 micron.

The thickness of the zinc rich coating shall be minimum 150 g/m<sup>2</sup> and shall contain minimum 85% zinc in the dry film.

The external surface of the D.I. fitting spigot end at a minimum length of 250mm and the internal surface of the socket end, which may have direct contact with potable water, shall have a non-toxic bituminous paint applied to a minimum dry film thickness of 100 microns, and a total average DFT of 120 micron.

### **27.8.4 Polyurethane Coating**

#### **27.8.4.1 General**

This section covers the factory application of solvent free polyurethane coating to D.I. pipes and fittings by airless, hot -spray techniques. The coating application shall conform with DIN 30671 or equivalent standard.

For polyurethane coated D.I. pipes and fittings the external surface of the spigot end at a minimum length of 250mm and the internal surface of the socket end which may have direct contact with potable water shall have non-toxic solvent free two part epoxy coating applied to a minimum dry film thickness of 300 microns.

27.8.4.2 Materials

The coating shall be a high build, 100% solids urethane consisting of two components, one component based on polyurethane resin, which may or may not be modified with coal tar, and a second component based on an isocyanate resin.

The coating shall be capable of being airless sprayed to provide an average of 2.0 mm dry film thickness in a continuous application if an unmodified polyurethane is used or 2.5 mm dry film thickness if coal tar modified polyurethane is used. Whichever coating is used it shall meet all the requirements for mechanical properties as specified in DIN 30671.

The CONTRACTOR shall provide FEWA with test certificates for the coating system to be employed. No materials shall be used unless FEWA has accepted the results of the test specified.

Notwithstanding the requirements of DIN 30671 the coating shall be guaranteed to preserve its integrity and maintain storage, handling, installation, testing and operation in the ambient conditions prevailing in the country of manufacture and in UAE.

The test certificate shall state the properties of the coating and shall specify the test method used.

The polyurethane coating system shall comply with the data included in Table 1 below:

**Table 1**

Materials		
	nominal thickness	2000 microns
	minimum thickness	1500 microns
	nominal thickness	2500 microns
	minimum thickness	1800 microns
Holidays test (voltage)		10Kv
Impact Test		10 J (1 pipe per day)
Adhesion test		Incision knife edge (1 pipe per day)

27.8.4.3 Surface Preparation

All slag shall be removed and all sharp edges shall be ground down. Prior to blasting, all oil, grease, etc. shall be removed. All surfaces to be coated shall be blast cleaned to BS 7079 2<sup>nd</sup> quality or to ISO 8501-1. The photographic standard of surface preparation shall be to SIS 05 5900 Grade SA 2½. The amplitude of surface roughness shall be 75+ 15 microns as measured using a surface profile gauge. In cases of dispute a sample plate shall be prepared and the profile shall be measured using a traveling microscope.

The CONTRACTOR shall ensure that the type of abrasive used, its particle size and the blasting pressure used are suitable for achieving the required profile. The compressed air used in blasting shall be clean, dry and oil free.

After blast cleaning all dust shall be removed by vacuum or a clean, oil free, dry air blast.

The application of the coating shall follow with the least possible delay.

Any pipe not coated within 4 hours after blast cleaning shall be completely reblasted before coating.

The surface to be coated shall be maintained at a temperature of at least 5° C above the dew point of the surrounding atmosphere at all times during the coating procedure.

#### 27.8.4.4 Application

The polyurethane coating shall be applied using airless spray painting equipment strictly in accordance with the paint manufacturer's recommendations.

The paint shall be applied in a continuous process to achieve a covering film free from misses, tears, runs, sags, etc. and the minimum dry film thickness at any point as stated in Table 1 above.

All painted area shall be thoroughly dried before being overcoated and be free of all loose particles, dust, debris and atmospheric contamination.

The external surface of the D.I. pipe spigot end at a minimum length of 250mm and the internal surface of the socket end which may have direct contact with potable wall shall have non-toxic solvent free two part epoxy coating applied to a minimum dry film thickness of 300 microns.

#### 27.8.4.5 Inspection

The pipe coating shall be completely continuous and free from all holidays, voids, pinholes or other defects. The thickness of the coating, the degree of adhesion to the pipe and the standard of workmanship generally shall be regularly checked in accordance with DIN 30671 and FEWA's requirements.

Impact and adhesion tests shall be carried out on each day of production and the damage so caused shall be made good by the CONTRACTOR at his own cost.

The CONTRACTOR shall provide and operate an approved holiday detector with a loud alarm operating at the voltage specified. Holiday detection shall be carried out over 100% of surface area.

The maximum number of holiday repairs allowed shall be six per nine meter length. The allowable number shall be reduced pro-rata for shorter pipe lengths.

If, in the opinion of FEWA holidays and other imperfections such as lifting edges, lack of adhesion, etc. are so frequent as to indicate poor application, the coating shall be stripped, the pipe cleaned and recoated at the CONTRACTOR's expense.

The pipe shall be repaired to pass the holiday detection test so that no holiday are present on the finally released coated pipe.

#### 27.8.4.6 Repairs

In the event that problems are detected or repairs are needed, the CONTRACTOR shall take immediate steps to correct the situation.

All repairs to the coated pipe shall be at the CONTRACTOR own expense.

Scars, dents, damaged areas and holidays shall be cleaned by removing all rust, scale, dirt or foreign materials or loose coating using a small file.

Repairs either in the factory or subsequently on site are to be made by means of a repair procedure approved by FEWA prior to commencement of work. Any pipe subject to a coating repair procedure shall be fully re-examined in accordance with above inspection requirements.

If cathodic protection is provided for the coated pipeline, coating at electrical connections shall be repaired according to the approved repair procedure.

#### 27.8.4.7 Joint Protection

All joints of polyurethane ductile iron coating coated pipes shall be protected by heat shrinkable pipe sleeves or collars. The heat-shrinkable sleeves or collars shall have a high shrink ratio as well as high penetration resistant thick walled structure which together with an internally coated adhesive mastic sealant shall ensure a reliable vacuum-tight anti corrosion coating over the bare pipe joint and the polyurethane coated pipe ends. The heat-shrinkable sleeve shall be manufactured from a radiation cross linked, thermally stabilized, UV-resistant modified polyolefin sheet material with an inner surface of a controlled thickness visco-elastic sealant which shall be in accordance with the following minimal requirements :

##### Heat -Shrinkable Sleeve Material

PROPERTY	TEST METHOD	CONDITION	REQUIREMENT	TYPICAL VALUE
Tensile strength	ISO 527	23°C, CHS* 50 mm/min	17 MPa (min.)	24 Mpa
Ultimate elongation	ISO 527	23°C, CHS* 50 mm/min	500% (min.)	750%
Impact brittleness	ISO 974	Below -40°C		Pass
Thermal ageing	DIN 30672	100°C, 100 days		
Followed by test for				
Ultimate elongation	ISO 527	23°, CHS* 50 mm/min	-25% loss of elongation	4%
Water absorption	ISO 62	23°C, 24 hrs	0.1 % (max.)	0.05%

6 CHS = cross head speed

Sealant Material

PROPERTY	TEST METHOD	CONDITION	REQUIREMENT	TYPICAL VALUE
Softening Point	ASTM E28		85°C (min.)	92°C
Peel strength to steel, PE and epoxy	DIN 30672	23°C, CHS* 100 mm/min	15 N/cm (min.)	25 N/cm
Peel strength to steel After conditioning for 100 days at 50°C	DIN 30672	23°C, CHS* 100 mm/min	12 N/cm (min.)	25 N/cm
Shear strength	ISO 4587	23°C, 1 mm thickness CHS*50 mm/min	10N/cm <sup>2</sup> (min)	15N/cm <sup>2</sup>

7 CHS = cross head speed

Dimensions

Backing thickness as supplied : 0.9 mm nominal

Sealant thickness as supplied : 1.5 mm nominal

Sleeve width as supplied : 300, 450 or 600 mm nominal.

**27.8.4.8 Fusion Bonded Epoxy Coating**

The system consist of factory applied fusion bonded powder epoxy coating externally and internally. The minimum dry film thickness of the coating shall be 300 microns.

The powder epoxy resin shall be applied by electrostatic spray and shall be non toxic suitable for use in contact with drinking water. The powder material and method of application shall be subject to FEWA approval.

The D.I. pipe or fitting shall be blast cleaned to SIS 05 5900 Grade SA 2½. Rust, grease and other foreign maters shall be removed prior to coating application.

The temperature of the metal shall be adjusted to ensure complete polymerisation of the powder material.

After coating application the coating shall be allowed to cure before being cooled with water to permit handling and inspection.

The coating shall be free from blisters, pinholes, runs, sags or any other irregularities and shall have uniform color, gloss and thickness.

The coating shall be free from holidays. Every D.I. pipe or fitting shall be inspected for holidays over 100% of its coated surface. The holiday detector shall be set at 2.2 kV with a rate of travel of the probe over the surface shall not exceed 300 mm/s.

The minimum impact resistance of the coating when tested in accordance with ASTM G14 shall be 18J without causing holidays.

The coating shall not show any tendency for disbondment or blistering. Cathodic disbondment test shall be carried out in accordance with ASTM G42. The maximum coating disbondment shall be 5mm radius from the edge of the artificial holiday.

#### **27.9 Flange Adaptors**

Flange adaptors shall be installed as shown on the drawings to facilitate removal of valves and other items for servicing/replacement.

The material of the body end ring and sleeve shall be ductile iron grade 420/12 to BSEN 1563 or steel grade S275 to BSEN 10025 as approved by FEWA. The studs, nuts, bolts shall be stainless steel grade 316. The gasket shall be EPDM to ISO 4633 or BSEN 681-1 suitable for drinking water.

The flange pressure rating shall be as given in the Data Sheet or Particular Specification.

The coating shall be factory applied non toxic fusion bonded epoxy powder or Rilsan Nylon II with normal dry film thickness of 300 microns and minimum DFT of 250 microns.

#### **27.10 Stepped Couplings**

Stepped couplings shall be used to connect the spigot ends of two pipes of different nominal diameters.

The material of the body ring and sleeve shall be ductile iron grade 420/12 to BSEN 1563 or steel grade S275 to BSEN 10025. The nuts, bolts and washers shall be stainless steel 316. The gaskets shall be EPDM to ISO 4633 or BSEN 681-1 suitable for drinking water. The coating shall be factory applied non toxic fusion bonded epoxy powder or Rilsan Nylon II with normal dry film thickness of 300 microns and minimum DFT of 250 microns.

#### **27.11. Dismantling Joints**

Dismantling joints shall be installed as shown on the drawings to facilitate removal of valves and other equipment for servicing/replacement. The dismantling joints shall be of the tied/restrained type.

The material of the body, ring and sleeve shall be ductile iron grade 420/12 to BSEN 1563 or steel grade S275 to BSEN 10025 as approved by FEWA. The nuts, bolts, studs, tie rods, washer shall be stainless steel 316. The gaskets shall be EPDM to ISO 4633 or BSEN 681-1 suitable for drinking water.

The pressure rating of the flanges shall be as given in the Particular Specification. The coating shall be factory applied non toxic fusion boded epoxy powder or Rilsan Nylon II with normal dry film thickness of 300 microns and minimum DFT of 250 microns.

### **27.12 Split Tees For Under Pressure Connections**

Split tees shall be ductile iron grade 420/12 to BSEN 1563. The sealing mechanism shall be by rubber ring set in a locating groove around the branch opening and held firmly against the mainline pipe by the pressure of the opposite bolted half or alternatively by full length rubber gaskets along the mating halves and at the separate end flanges.

The rubber gaskets shall be EPDM to ISO 4633 or BSEN 681-1 suitable for drinking water. The bolts, nuts, washers shall be stainless steel 316.

The split tees shall be coated with non toxic fusion bonded epoxy powder or Rilsan

Nylon II with normal dry film thickness of 300 microns and a minimum DFT of 250 microns.

### **27.13 Ductile Cast Iron Collar**

DI. Collar shall be movable on the Pipe barrel (slide type) with mechanical joint on both sides.

### **27.14 Puddle Flanges or Sealing Flanges**

Puddle flanges or sealing flanges shall be used in all situation where a ductile iron pipe is cast into a chamber wall where restraint is not required. The sealing should be water tight between the pipe and the opening through which it will pass. If the seal is made of two parts jointed by nuts and bolts they should be galvanized.

### **27.15 Thrust / Anchor Flanges**

Thrust/anchor flanges shall be used where D.I. pipes or fittings are cast into the chamber wall and shall be designed to restrain the connecting valves or other equipment installed inside the chamber.

Thrust/anchor flanges shall be integrally cast or factory welded on to the pipe piece as approved by FEWA. Bolted or screwed on thrust flanges shall are not acceptable.

The coating to the thrust/anchor flange shall be similar to that of the pipe/fitting.

The position of the thrust/anchor flange shall be as shown on the drawings or determined on site.

### **27.16 Polyethylene Sleeves**

Protective polyethylene sleeves shall be used with all D.I. pipes and fittings to be installed in buried condition and shall be in accordance with ISO 8180. The polyethylene sleeve manufacturer shall have the ISO 9001/9002 quality control certificate.

The polyethylene sleeve shall be black, resistant to the effect of ultra violet light, tubular film in accordance with the latest issue of ASTM D-1248 or approved equivalent standard. The minimum nominal thickness of the sleeve shall be 0.010 inch (250 microns) with a maximum minus tolerance of 10%.

The material shall be made from a polymer with a melt flow index as measured according to BS 2782, of 10 or less and a density in the range of 0.915 to 0.925 g/ml. The sleeve shall be free from pinholes, gels, undispersed raw materials and particles of foreign matter. The film may not contain more than 5% by weight of material other than polyethylene.

Polyethylene sleeving shall be stored in cool dry store away from direct sunlight or excessive heat. Rolls shall be supplied individually packed in black polyethylene sacks and clearly labeled with the date of manufacture, the length of the roll, the pipe size for which it is intended, the name of the manufacturer and the country of manufacture. The stock of the polyethylene sleeve shall be rotated on the first in/first out basis.

#### **27.17 Vendor Documentation**

The CONTRACTOR shall furnish the following vendor data as a minimum, with his bid:

- Catalogues/Brochures of the proposed manufacturer's.
- Dimensional details of pipes and fittings.
- Detailed material specifications.
- Manufacturer's drawings, showing fittings dimensions.
- Complete details of testing facilities available at manufacturer's works.
- Local (UAE) agent name and address.
- Outline of Quality Assurance Procedures in use.

Bids not accompanied by any of above-mentioned information/data shall be considered incomplete, and liable to be rejected.

#### **27.18. Marking**

All items shall bear the following distinct marks :

- Number of standard
- Manufacturer's identification mark
- Indication that the item is made of ductile iron
- Nominal diameter
- Class of pipes and flanges
- Year of manufacture
- Home line positions at pipe ends
- Client's name, i.e. "FEWA"
- Contract No.

#### **27.19 Transportation of Pipes**

DI pipes and fittings shall be properly and securely transported from the place of manufacture to the site/ stores. No nesting of DI pipe shall be allowed at any time during the transport.

Where pipes are transported by truck, the pipes shall be transported on wooden cradles or skids and shall be properly protected from contact with metal surfaces by rubber or wooden spacers or wedges.

## 27.20 Handling & Storage

Pipes DN100 to DN400 should be supplied in bundles. Larger diameter pipes will be supplied as singles. Delivering pipes in bundles rather than single pipes provides a number of benefits viz during transportation, for pipe laying contractors, stack ground personnel and site operatives. Care should be taken not to lift the bundles by their retaining straps.

The composition of bundles for various diameters of pipes are as follows:

DN	No. of Layers x No. of pipes
100	3X5
150	3X5
200	2X3
250	2X2
300	2X2
350	2X2
400	2X2
500	2X2
600	2X2

The fittings and glands should be delivered in non-returnable pallets, covered with plastic film.

For lifting single pipes, use appropriately shaped hooks coated with a polyamide type protection. Use wide flat slings maintained sufficiently widely opened to prevent accidental slippage.

For storing of gaskets, the temperature should not exceed 25<sup>0</sup>C. They must be stored under clean and moderately humid conditions.

Also the pipes and fittings stacked in the stores or on site must permit correct inventory control and facilitate any repair work.

Each pipe bundle should be secured to two base timbers which can be laid directly onto a hard standing surface. The bundles may be stacked one on top of the other with the axes of the pipes parallel and thus the maximum stack height should not exceed three bundles.

Where individual pipes are to be stacked, it is recommended that the parallel method is used using wooden battens between rows. The maximum recommended number of layers in a stack is given below:

DN	Max. recommended No. of layers in a stack
100	16
150	14
200	12
250	10
300	8
400	7
500	6
600	4

## **28.0 SPECIFICATION FOR CARBON STEEL PIPING MATERIALS**

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28.1 **SCOPE**

This specification defines the technical requirements for Carbon Steel Piping materials such as Carbon steel pipes, fittings, flanges and gaskets, bolts, nuts, etc. for the flanges.

This covers carbon steel piping materials from DN 80mm (3" NB) and above upto DN 1800 mm (72").

28.2 **APPLICABLE STANDARDS AND CODES**

2.1 All materials and workmanship shall comply with the latest editions of applicable standards and codes, which shall include but not be limited to the following:

ASME B31.3	Process Piping.
ASME B16.9	Factory made, Wrought Steel Butt Welded Fittings.
ASME B 36.10	Dimensions and Weights of Seamless and Welded Steel Pipes.
ASME B.1.1	Unified Inch Screw Threads.
BS 4504 Sect 3.1	Circular Flanges for Pipes, Valves and Fittings (PN Designated). Specification for Steel Flanges
BS EN ISO 1461	Hot Dip Galvanising (Supercedes BS 729).
BS 6956	Rubber Gaskets
ASTM A105/A105M	Standard Specification for Forgings, Carbon Steel for Piping Components.
ASTM A106	Seamless Carbon Steel Pipe for High Temperature Service.
ASTM A193	Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service.
ASTM A 194	Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service.
API 5L	Specification for Line Pipe.
API 1104	Welding of pipelines and related facilities.
ISO 7005 Part 1	Steel Flanges
ISO 10474	Steel and Steel Products – Inspection Documents.
ISO 9000	Quality Management and Quality Assurance Standards – Guidelines for Selection and Use.
ISO 8501-1 and	Preparation of steel substrates before application of paints and related products – surface roughness.

**28.3 SITE CONDITIONS**

For site and climatic conditions refer General Technical Requirements Document.

**28.4 DESIGN CONSIDERATIONS****28.4.1 General**

The wall thickness of piping components shall be determined by the Design Engineer considering the applicable design conditions, accordance with ASME B 31.3 code, considering 3 mm corrosion allowance.

The piping shall be capable of withstanding satisfactorily all resultant forces exerted by normal pressures and any surge pressures which may arise from sudden reversal of flow during starting up or shutting down of any portions of the system.

Material grades, wall thickness, branch connections, etc. shall be as per applicable drawings.

**28.4.2 Steel for Pipe**

The material shall be open hearth furnace, electric furnace or basic oxygen steel. The steel shall be fully killed and of fine grain. The strips and plates shall be normalized or rolled under controlled temperature condition.

The particular treatment condition shall be specified in the quality certificate for plates and stripes.

The steel used for production of the pipes shall meet the quality requirements of API 5L. The mechanical properties shall meet the quality requirements of API 5L as summarized below.

Steel grade	Yield strength minimum (N/mm <sup>2</sup> )	Ultimate tensile strength minimum (N/mm <sup>2</sup> )	Elongation minimum percent in 2 inches
B	241	413	As appendix of API 5L
X42	289	413	
X46	317	434	

A heat analysis of the steel used for the pipes shall be provided with clause 3.3 of API 5L check analysis on the finished pipe shall be taken in accordance with clause 3.3 and 3.4 of API 5L. The chemical analysis shall be in accordance with ASTM 751.

The chemical composition of the steel shall meet the requirements of API 5L as summarized below.

Steel grade	Carbon Maximum	Magnesium Maximum	Phosphorous Maximum	Sulfur Maximum
B	0.26	1.15	0.04	0.05
X42	0.28	1.25	0.04	0.05
X46	0.30	1.35	0.04	0.05

In grade X42 through X65, for each reduction of 0.01 percent below the maximum carbon content, an increase of 0.05 percent manganese above the specified maximum is permissible, upto maximum of 1.45 percent for Grades X52 and lower and upto a maximum of 1.60 percent for Grades higher than X52.

### 28.4.3 Pipes

Pipes shall be conforming to API 5L Grade B, unless specifically mentioned otherwise. The pipe shall be formed by automatic submerged arc welding with either longitudinal seams or spiral seams or manual arc welding. Pipe manufactured to ASTM A 106 Grade B shall be considered an acceptable substitute for API 5L Gr B.

The quality of the weld shall be such as to produce a joint efficiency factor of 1.0

Pipes shall be seamless up to and including size DN 400 mm. Above DN 400 mm, they shall be Electrically Fusion Welded (EFW), unless specified otherwise.

All pipe sizes are designated as nominal pipe sizes (NPS) only. The following range of nominal pipe sizes shall be used. Dimensions (Outside diameter, out of roundness, wall thickness, straightness, weight etc.) of pipe shall meet the requirements of ASME B 36.10 or API 5L as applicable.

NOMINAL PIPE SIZE	
METRIC (mm)	Equivalent to INCH
DN 80	3
DN 100	4
DN 150	6
DN 200	8
DN 250	10
DN 300	12
DN 350	14
DN 400	16
DN 450	18
DN 500	20
DN 600	24
DN 700	28
DN 800	32
DN 900	36
DN1000	40
DN1100	44
DN1200	48
DN1400	56
DN1500	60
DN1800	72

#### **28.4.4 Fittings**

Fittings shall be to ASME B16.9 for sizes 24" and below. Fittings for size 24" and below shall be seamless. Elbows with butt welded ends shall be long radius type (radius equals 1.5 times the nominal pipe size). Short radius elbows shall not be used.

If miter elbows are economically justified in accordance with the ASME B31.3 requirements, they may be substituted for bends or wrought fittings as follows:

Three weld (90 degree) and two weld (45 degree) miter elbows may be used in sizes larger than 24 inches. The nominal radius of the miter elbow shall not be less than 1½ times the diameter of the pipes.

Bends may be substituted for welded elbows provided they are made of seamless pipe. Cold bends shall be limited to 6" size or smaller, subject to satisfying code requirements.

Elbowlets shall not be used for branch connections, instrument taps or vent and drain connections unless space considerations dictate. Drain and vent connections shall not be installed in elbows. Thermowells installed at other than 90 degrees to the pipe header or vessel wall are not allowed.

Reducing tees and reducers shall be supplied with butt weld end schedules to match the pipe, the allowable size combinations are as shown in ASME B16.9.

Branch connections shall be made from equal tees or reducing tees, integral reinforced branch fittings as approved by FEWA. In case reducing tee of required combinations is not available a combination of reducing tee and reducer shall be used.

#### **28.4.5 Flanges**

Flange dimensions shall be conforming to BS 4504 Sect 3.1 / ISO 7005 Part 1 and the rating of the flanges shall be as per the applicable data sheet.

All the flanges shall be welding neck raised face type. Slip on raised face flanges shall be accepted in place of welding neck flanges to suit the project requirements and as approved by FEWA.

For the gasket contact surface of DN 600 (24") and smaller flanges, the surface roughness shall be made between Ra 6.3 and 12.5 µm. For nominal sizes above DN 600 (24"), the surface roughness shall be between Ra 12.5 and 25 µm. Serrations may be either spiral or concentric.

#### **28.4.6 Gaskets and Bolting**

Material of gaskets shall be EPDM rubber, having 3mm thickness, suiting flange dimensions of the applicable standards. The gasket shall extend from the inside diameter of the flange to at least the inside edge of the bolt holes or may be laid beyond the bolt circle to the outside diameter of the flange.

Bolts and nuts shall be alloy steel conforming to ASTM A 193 Gr B7/A 194 Gr 2H and have regular square and hexagonal dimensions. Bolts and nuts shall be galvanised or cadmium plated and supplied with necessary washers.

The galvanising shall conform to hot dip galvanising as per BS 729 code to give a minimum average coating of 305 g/m<sup>2</sup> and a zinc thickness of not less than 43 microns.

Screw threads shall be UNC for 1 inch and smaller bolt diameters and 8-UN for larger diameters, Class 2 fit, in accordance with ASME B1.1.

Machine bolts shall only be used for jackscrews. Jackscrews shall be threaded full length. The length shall be measured from the bearing surface of the head and shall include the end point.

## **28.5 INTERNAL AND EXTERNAL COATING**

### **28.5.1 Internal Coating**

Internal surface of the pipes and fittings shall be blast cleaned to SA 2.5 in accordance with ISO 8501-01/SIS 05 59 00 standards and lined as specified in the data sheet.

### **28.5.2 External Coating**

External surface of the pipes and fittings shall be blast cleaned to SA 2.5 in accordance with ISO 8501-01/SIS 05 59 00 standards and epoxy coated/painted to a total dry film thickness of 275 microns, unless otherwise specified in the data sheet.

## **28.6. INSPECTION AND TESTING**

### **28.6.1 Shop Inspection / Testing**

Inspection and testing of all pipes, fittings and flanges shall be in accordance with applicable API, ASME, ASTM, ANSI, ISO, BS, Specification. All material test certificate shall indicate conformity to the requirements.

The FEWA reserves the right to stage inspect the material, manufacturing process, testing, etc. Such inspection does not relieve the Vendor of the responsibility of suitable design and workmanship.

CONTRACTOR shall submit a detailed Inspection and Test Plan (ITP) or Quality Control Plan (QCP) for approval showing manufacturing, inspection and testing activities, its acceptance criteria prior to commencement of manufacturing. All Certification shall be 3.1.B as per ISO 10474. The mechanical test, ultrasonic examination and hydrotest shall be witnessed by FEWA.

The radiography examination reports shall be reviewed by FEWA.

The CONTRACTOR/MANUFACTURER shall make suitable provisions for testing and inform FEWA sufficiently (atleast one month) in advance to enable their representatives to witness the test. If witnessing of any tests is not satisfactory and a retest is required, the cost of the witnessed retest shall their be borne by the CONTRACTOR.

MANUFACTURER shall ensure that all the applicable codes and standards available at their works for FEWA's reference during their visit to manufacturer's works for shop inspection/test.

The test and material certificates for all the items shall be entered in the manufacturing data/project record books. These shall include the witnessed tests and the documents shall be submitted to FEWA prior to the dispatch of the materials.

## **28.7 PACKING AND SHIPMENT**

Pipes shall be provided with adequate cushioned support during all stages of handling, transport and storage in order to prevent damage to the pipe, its wrapping or lining. Steel pipes with concrete lining shall not be moved by rolling. If stacked in tiers, each pipe of the bottom tier shall be supported on at least two purpose made cradles each giving continuous 120° support and cushioned with bags of sand, sawdust or other approved material. Each pipe of the upper tier and of any intermediate tier shall be similarly cushioned at all points of contact. The pipe manufacturer's recommendations as to stacking shall be strictly observed.

The period between completion of the external protection of a pipe and the completion of its installation shall be kept to a minimum and this period shall not generally exceed six months.

Each pipe and fittings shall be indelibly marked over any factory applied coating with the diameter, nominal pipe thickness, class, grade of steel, length of pipe and works test pressure and shall in addition carry a unique reference number to enable items to be correlated to works fabrication records, works test certificates, delivery notes and the like. It shall be marked with wall thickness and steel grade. Wherever possible, the marks shall be painted on the outside of pipes and fittings close to one end.

Where there is insufficient smooth surface area to accommodate the above information the marking shall be put on rust proofed metal tags secured to the item with galvanised wire.

The flanges of pipes and fittings shall be protected by wooden discs attached by means of service bolts or by other approved means. These bolts shall not be used in the actual job.

## **29.0 TECHNICAL SPECIFICATIONS FOR VELOCITY (TURBINE) WATER METER 1/2"**

### **29.1 General**

Water Meters should conform to the requirements stipulated in B.S. 5728, ISO 4064, 75/33/EEC or any other equivalent international standards approved by FEWA.

Water meters to be supplied are to be suitable for measuring water flow in closed conduits to domestic consumers. They must give continuous hassle-free service and long working life under rigorous climatic condition prevailing in U.A.E. ambient temperature up to 50°C is very common during summer months, below 10°C is experienced during winter months. Humidity also undergoes sharp changes with 100% humidity a common phenomenon. Violent sand storms are a common feature and fine dust is carried in suspension in the atmosphere.

Price quoted for water meters should include all accessories need for connection (connectors, nut, gasket etc.).

Tenderer shall state the name and address of the factories at which the meters will be manufactured. All offers must be accompanied by complete technical specifications, catalogues, all in English for the meters offered.

Minimum 10 Nos. of ½" water meters shall be supplied as samples to FEWA for inspection prior to approval without any extra charges.

As a proof for the quality of the offered water meters, a comprehensive reference list of clientele as well as a programme of tests carried out on each water meter must be included. In addition to the above, certificate from any international inspection body authenticating the conformity of the water meters should be produced, if available.

## 29.2 **Technical Requirements**

The domestic water meters with '**pulse output**' shall be suitable for use with water of temperatures up to 50°C (preferably 60°C) and 16 bar working pressure. The water meters required shall be of the velocity (turbine) type, multi jet with **straight reading counter registering imperial gallons** and shall have following requirements:

- a) Each water meter shall be tested at works to a pressure of 24 bar (1.5 times of working pressure).
- b) The water meter shall have threaded ends and shall be provided with two connectors (tail pieces, nut, gaskets).
- c) The threading system shall be according to B.S. 21 (Taper Male Ends).
- d) The water meters offered are to have metrological characteristics to the following minimum requirements:

### ½" Water Meter

Qmin : 5 Gallons/hour or less.  
Qmax : 600 Gallons/hour.  
Dial Registration : Minimum 10 million Imperial Gallons.  
Dial : Dry Type.  
Suitable for : Automatic Meter Reading (AMR) System

- e) The meters shall have a **metallic lid** hinged with spring to the counter box cover to prevent accumulation of dust and foreign matter on the counter top glass. The top glass shall be made of glass material, thick & tempered type to resist breakage, scratching & abrasion.
- f) The water meters shall have a sealing wire to prevent access to the counter mechanism and inlet and outlet couplings shall be drilled for seal wire holes.
- g) The water meters shall have an internal strainer or strainer placed upstream of the measuring element. Perforation size should be provided along with details of materials
- h) The water meters shall be of class 'C' type as mentioned in Clause 5.2 of ISO 4064/11, and with permissible errors according to Clause 5.1 of the same specification.

- i) Water meters must have check valve to prevent reverse flow.
- j) The manufacturer of the water meters must provide proof that they have obtained the International Quality Assurance Certificate, category ISO 9001/9002.
- k) The water meter must be easily serviceable and maintenance with interchangeable parts available from the manufacturer.
- l) The register shall be direct reading and without use of multiplying factors.
- m) The counter shall rest automatically to zero at least ten million imperial gallons. The register chamber shall always be free of moisture condensation.
- n) The water meters shall operate properly in horizontal position/vertical position/ inclined position.

### 29.3 **Material**

The water meters shall be made of suitable non-corroding, non-toxic, temperature resistant materials in accordance with BS 5728 and suitable for use in water supply in U.A.E., in compliance with clause 1.0 and 2.4 of this specification.

The water meter body shall be of brass (zinc must be minimized) with suitable surface treatment and resistant to corrosion. The components inside meters in contact with water, including the strainer shall be sufficiently resistant to any deterioration due to chlorinated water.

Internal rotary components shall be of injection-moulded plastic, non-tainting and which inhibit any scale formation.

The stainless steel parts shall be of high grade. All materials should comply with the latest relevant British standard specification or equivalent.

### 29.4 **Marking**

All water meters shall be clearly and indelibly marked with the following information, either grouped or distributed on the casing, the indicating device dial or an identification plate. The water meter cover, being detachable, shall never be used for this purpose.

- (a) Name or trademark of the manufacturer.
- (b) Metrological class, nominal flow rate in Imp. Gallon/min. and pressure loss in bars.
- (c) Year of manufacture.
- (d) Serial number.
- (e) One or two arrow/s indicating the direction of flow.
- (f) Maximum working pressure (16 bars).
- (g) The letters FEWA which represents Federal Electricity & Water Authority.
- (h) Mark of type approval.

29.5 **Spare Parts**

A separate price list of all different spare parts (not including the body) of each size must be submitted with the tender. This price list is important in studying and judging the tender, however, the total cost of spare parts will not be included in the schedule of prices and the total amount of tender.

27.6 **Manuals**

The successful tenderer will have to supply five (5) sets (all in English) of maintenance manuals and fully illustrated spare parts books for each size and type of supplied water meters.

29.7 **Warranty**

All water meters should be under warranty for 5 years from the date of supply.

This warranty shall be comprehensive and against any defects arising from defective design, materials or workmanship. Such warranty must be supported by proofs that the material used does not age during the lifetime of the meter, nor will it be negatively affected by the water quality and temperatures prevailing in U.A.E.

29.8 **Type Approval**

On request, the manufacturer must provide Type Approval Certificates from the country where he is based.

29.9 **Tools**

5 sets of tools for servicing/repairing the ½" water meters must be supplied without any extra charges.

29.10 **Inspection**

Supplier should intimate FEWA prior to the shipment to enable the FEWA officials to inspect the water meters in the factory. Minimum 2% or 10 Nos. whichever is more of water meter must be tested in the presence of FEWA representative. Test and test procedures shall be in accordance with the specification. All test certificates, including the one certifying that water meters would withstand 50°C/60°C must be submitted to FEWA Office, Dubai.

All these tests must be done without any extra charges.

29.11 **Delivery and Unloading**

The supplier is responsible for unloading all the water meters to FEWA Store, Sharjah. Unloading at Stores must be carried out under the control and responsibility of the supplier. Care should be taken to avoid severe impact with any solid object. All packing and transportation expenses shall be deemed included in the supply rates, and no extra payment shall be made by FEWA.

## 30.0 TECHNICAL SPECIFICATIONS FOR ELECTRONIC WATER METERS ½" & 1"

### 30.1 General

**Electronic** Water Meters should conform in general to the requirements stipulated in B.S. 5728 Class 'C', ISO 4064, 75/33/EEC, OIML R49-1 or any other equivalent international standards approved by FEWA.

Water meters to be supplied are to be suitable for measuring water flow in closed conduits to domestic consumers. They must give continuous hassle-free service and long working life under rigorous climatic condition prevailing in U.A.E. ambient temperature up to 50°C is very common during summer months, below 10°C is experienced during winter months. Humidity also undergoes sharp changes with 100% humidity a common phenomenon. Violent sand storms are a common feature and fine dust is carried in suspension in the atmosphere.

Price quoted for water meters should include all accessories need for connection (connectors, nut, gasket etc.).

Tenderer shall state the name and address of the factories at which the meters will be manufactured. All offers must be accompanied by complete technical specifications, catalogues, all in English for the meters offered.

Minimum 10 Nos. of ½" water meters and 2 Nos. of 1" water meters shall be supplied as samples to FEWA for inspection prior to approval without any extra charges.

As a proof for the quality of the offered water meters, a comprehensive reference list of clientele as well as a programme of tests carried out on each water meter must be included. In addition to the above, certificate from any international inspection body authenticating the conformity of the water meters should be produced, if available.

### 30.2 Technical Requirements

These meters are to be designed and manufactured for use with potable water but must have the capability of allowing particles up to 2.5 mm in diameter and air to pass through them without damaging the meters. The domestic water meters shall be suitable for use with water of temperatures up to 50°C (preferably 60°C) and 16 bar working pressure. The water meters required shall be of the **Electronic** type with **straight** reading counter registering **imperial gallons** and shall have following requirements:

- a) Each water meter shall be tested at works to a pressure of 20 bar.
- b) The water meter shall have threaded ends and shall be provided with two connectors (tail pieces, nut, gaskets).
- c) The threading system shall be according to B.S. 21 (Taper Male Ends).
- d) The water meters offered are to have metrological characteristics to the following minimum requirements:

½" Water Meter

Qmin	:	5 Gallons/hour or less
Qmax	:	600 Gallons/hour
Dial Registration	:	Minimum 10 million Imperial Gallons.
Meter Register	:	Electronic, fully encoded.
Accuracy	:	± 2%

1" Water Meter

Qmin	:	7 Gallons/hour or less
Qmax	:	1000 Gallons/hour
Dial Registration	:	Minimum 10 million Imperial Gallons.
Meter Register	:	Electronic, fully encoded.
Accuracy	:	± 2%.

- e) The meters shall have a lockable **metallic** lid hinged to the counter box cover to prevent accumulation of dust and foreign matter on the counter top glass. The top glass shall be made of glass material, thick & tempered type to resist breakage, scratching & abrasion.
- f) The water meters shall have a sealing wire to prevent access to the counter mechanism and inlet and outlet couplings shall be drilled for seal wire holes.
- g) The water meters shall have a strainer placed upstream of the measuring element. Perforation size should be provided along with details of materials
- h) The water meters shall be of class 'C' type as mentioned in Clause 5.2 of ISO 4064/11, and with permissible errors according to Clause 5.1 of the same specification.
- i) Water meters must have check valve to prevent reverse flow or it should not read reverse flow.
- j) The manufacturer of the water meters must provide proof that they have obtained the International Quality Assurance Certificate, category ISO 9001/9002.
- k) Water meter shall be of dry type, **no moving parts** and maintenance free.
- l) The register shall be digital display and direct reading without use of multiplying factors and reading should be in imperial gallons.
- m) The counter shall rest automatically to zero at least ten million imperial gallons. The register chamber shall always be free of moisture condensation.
- n) The water meters shall operate properly in horizontal position/vertical position/inclined position and it should not read **air**.
- o) All meters shall be equipped with the capacity of being interfaced with all types of **AMR devices**.
- p) Pressure loss should be minimised.

### 30.3 **Material**

The water meters shall be made of suitable non-corroding, non-toxic, temperature resistant materials in accordance with BS 5728 and suitable for use in water supply in U.A.E., in compliance with clause 1.0 and 2.4 of this specification.

The water meter body shall be of brass (zinc must be minimised) or injection moulded plastic material which should be resistant to deterioration by ultra violet radiation or any other metal (cast iron is not acceptable) suitable for using in aggressive water conditions and resistant to corrosion. The components inside meters in contact with water, including the strainer shall be sufficiently resistant to any deterioration due to chlorinated water.

The stainless steel parts if any, shall be of high grade. All materials should comply with the latest relevant British standard specification or equivalent.

### 30.4 **Marking**

All water meters shall be clearly and indelibly marked with the following information, either grouped or distributed on the casing, the indicating device dial or an identification plate. The water meter cover, being detachable, shall never be used for this purpose (**Sticker is not acceptable**).

- (a) Name or trademark of the manufacturer.
- (b) Metrological class, nominal flow rate in Imp. Gallon/min. and pressure loss in bars.
- (c) Year of manufacture.
- (d) Serial number.
- (e) One or two arrow/s indicating the direction of flow.
- (f) Maximum working pressure (16 bars).
- (g) The letters FEWA which represents Federal Electricity & Water Authority.
- (h) Mark of type approval.

### 30.5 **Manuals**

The successful tenderer will have to supply five (5) sets (all in English) of maintenance manuals and fully illustrated spare parts books for each size and type of supplied water meters.

### 30.6 **Warranty**

All water meters should be under warranty for **5 years** from the date of supply and **10 years** for the **battery** and **counter display**.

This warranty shall be comprehensive and against any defects/accuracy arising from defective design, materials or workmanship. Such warranty must be supported by proofs that the material used does not age during the lifetime of the meter, nor will it be negatively affected by the water quality and temperatures prevailing in U.A.E.

30.7 **Type Approval**

On request, the manufacturer must provide Type Approval Certificates from the country where he is based.

30.8 **Inspection**

Supplier should intimate FEWA prior to the shipment to enable the FEWA officials to inspect the water meters in the factory. Minimum 2% or 50 Nos. whichever is more of water meter must be tested in the presence of FEWA representative. Test and test procedures shall be in accordance with the specification. All test certificates, including the one certifying that water meters would withstand 50°C/60°C must be submitted to FEWA Office, Dubai.

All these tests must be done without any extra charges.

30.9 **Delivery and Unloading**

The supplier is responsible for unloading all the water meters to FEWA Store, Sharjah. Unloading at Stores must be carried out under the control and responsibility of the supplier. Care should be taken to avoid severe impact with any solid object. All packing and transportation expenses shall be deemed included in the supply rates, and no extra payment shall be made by FEWA.

**31.0 VOLUMETRIC/ROTARY PISTON WATER METER 1" SUITABLE FOR A.M.R. SYSTEM**

31.1 **TECHNICAL SPECIFICATIONS FOR WATER METERS 1"**

31.2 **General**

Water Meters should conform to the requirements stipulated in B.S. 5728, ISO 4064, 75/33/EEC or any other equivalent international standards approved by FEWA.

Water meters to be supplied are to be suitable for measuring water flow in closed conduits to domestic consumers. They must give continuous hassle-free service and long working life under rigorous climatic condition prevailing in U.A.E. ambient temperature up to 50°C is very common during summer months, below 10°C is experienced during winter months. Humidity also undergoes sharp changes with 100% humidity a common phenomenon. Violent sand storms are a common feature and fine dust is carried in suspension in the atmosphere.

Price quoted for water meters should include all accessories need for connection (connectors, nut, gasket etc.).

Tenderer shall state the name and address of the factories at which the meters will be manufactured. All offers must be accompanied by complete technical specifications, catalogues, all in English for the meters offered.

Minimum 2 Nos. of 1" water meters shall be supplied as samples to FEWA for inspection prior to approval without any extra charges.

As a proof for the quality of the offered water meters, a comprehensive reference list of clientele as well as a programme of tests carried out on each water meter must be included. In addition to the above, certificate from any international inspection body authenticating the conformity of the water meters should be produced, if available.

### 31.3 Technical Requirements

The domestic water meters with **pulse output** shall be suitable for use with water of temperatures up to 50°C (preferably 60°C) and 16 bar working pressure. The water meters required shall be of the volumetric type with straight reading counter registering **imperial gallons**, suitable for all types of **A.M.R. System** and shall have following requirements:

- (a) Each water meter shall be tested at works to a pressure of 24 bar (1.5 times of working pressure).
- (b) The water meter shall have threaded ends and shall be provided with two connectors (tail pieces, nut, gaskets).
- (c) The threading system shall be according to B.S. 21 (Taper Male Ends).
- (d) The water meters offered are to have metrological characteristics to the following minimum requirements:

#### 1" Water Meter

Qmin : 7 Gallons/hour or less  
Qmax : 1000 Gallons/hour  
Dial Registration : Minimum 10 million Imperial Gallons.  
Suitable for : Automatic Meter Reading System

- (e) The meters shall have a metallic lid hinged to the counter box cover to prevent accumulation of dust and foreign matter on the counter top glass. The top glass shall be made of glass material, thick & tempered type to resist breakage, scratching & abrasion.
- (f) The water meters shall have a sealing wire to prevent access to the counter mechanism and inlet and outlet couplings shall be drilled for seal wire holes.
- (g) The water meters shall have an internal strainer or strainer placed upstream of the measuring element. Perforation size should be provided along with details of materials
- (h) The water meters shall be of class 'C' type as mentioned in Clause 5.2 of ISO 4064/11, and with permissible errors according to Clause 5.1 of the same specification.
- (i) Water meters must have check valve to prevent reverse flow.

- (j) The manufacturer of the water meters must provide proof that they have obtained the International Quality Assurance Certificate, category ISO 9001/9002.
- (k) The water meter must be easily serviceable and maintenance with interchangeable parts available from the manufacturer.
- (l) The register shall be direct reading and without use of multiplying factors.
- (m) The counter shall rest automatically to zero at least ten million imperial gallons. The register chamber shall always be free of moisture condensation.
- (n) The water meters shall operate properly in horizontal position/vertical position/ inclined position.

#### 31.4 **Material**

The water meters shall be made of suitable non-corroding, non-toxic, temperature resistant materials in accordance with BS 5728 and suitable for use in water supply in U.A.E., in compliance with clause 1.0 and 2.4 of this specification.

The water meter body shall be of brass (zinc must be minimized) or injection moulded plastic material which should be resistant to deterioration by ultra violet radiation or any other metal (cast iron is not acceptable) with suitable surface treatment and resistant to corrosion. The components inside meters in contact with water, including the strainer shall be sufficiently resistant to any deterioration due to chlorinated water.

Internal rotary components shall be of injection-moulded plastic, non-tainting and which inhibit any scale formation.

The stainless steel parts shall be of high grade. All materials should comply with the latest relevant British standard specification or equivalent.

#### 31.5 **Marking**

All water meters shall be clearly and indelibly marked with the following information, either grouped or distributed on the casing, the indicating device dial or an identification plate. The water meter cover, being detachable, shall never be used for this purpose.

- (a) Name or trademark of the manufacturer.
- (b) Metrological class, nominal flow rate in Imp. Gallon/min. and pressure loss in bars.
- (c) Year of manufacture.
- (d) Serial number.
- (e) One or two arrow/s indicating the direction of flow.
- (f) Maximum working pressure (16 bars).
- (g) The letters FEWA which represents Federal Electricity & Water Authority.
- (h) Mark of type approval.

31.6 **Spare Parts**

A separate price list of all different spare parts (not including the body) of each size must be submitted with the tender. This price list is important in studying and judging the tender, however, the total cost of spare parts will not be included in the schedule of prices and the total amount of tender

31.7 **Manuals**

The successful tenderer will have to supply five (5) sets (all in English) of maintenance manuals and fully illustrated spare parts books for each size and type of supplied water meters.

31.8 **Warranty**

All water meters should be under warranty for 5 years from the date of supply.

This warranty shall be comprehensive and against any defects arising from defective design, materials or workmanship. Such warranty must be supported by proofs that the material used does not age during the lifetime of the meter, nor will it be negatively affected by the water quality and temperatures prevailing in U.A.E.

31.9 **Type Approval**

On request, the manufacturer must provide Type Approval Certificates from the country where he is based.

31.10 **Tools**

5 sets of tools for servicing/repairing the 1" water meters must be supplied without any extra charges.

31.11 **Inspection**

Supplier should intimate FEWA prior to the shipment to enable the FEWA officials to inspect the water meters in the factory. Minimum 2% or 10 Nos. whichever is more of water meter must be tested in the presence of FEWA representative. Test and test procedures shall be in accordance with the specification. All test certificates, including the one certifying that water meters would withstand 50°C/60°C must be submitted to FEWA Office, Dubai.

All these tests must be done without any extra charges.

**32 UNDERGROUND FIRE HYDRANT**

The underground fire hydrant shall be of compact model, DN 80/100 mm, and shall be manufactured to BS 750 type 2. It shall be of screw down type with screwed 2½" round threaded outlet. The hydrant shall be suitable for handling potable water. The inlet flange shall be drilled to the standards B.S.4504 PN16

The body, bonnet and the stopper shall be of Ductile Iron, GGG-50, to DIN 1693/BS EN 1563 grade 500-7. The stem shall be stainless steel grade 316 and the stem cap shall be of cast iron, GG-25 to DIN 1691 / BS EN 1561. The stem sealing shall be of nitrile rubber capable of being changed under pressure. All the

assembling bolts, washers, clamps, circlips and set screws shall be of stainless steel grade 316. The thrust collar and stopper nut shall be of dezincification resistant brass CZ 132. The threaded outlet and body seat ring shall be of gun metal to BS 1400 LG 2-C. The dust cap shall be of gun metal attached to the body with SS chain. Hydrants shall be provided with a drilled plug to keep the barrel free of residual water after use.

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The hydrants shall be coated internally with 300 microns, DFT, non toxic fusion bonded epoxy system and externally with fusion bonded epoxy coating system with a DFT of 300 microns

(min). The complete hydrant shall be hydraulically tested to BS 750 and the hydrant shall be accompanied with a test certificate issued by the manufacturer.

### **33.0 HIGH DENSITY POLYETHYLENE PIPES AND FITTINGS (SDR11)**

#### **33.1 Scope**

The scope of this specification is to specify the required properties of pipes made from high density polyethylene (HDPE) **SDR11** or high performance polyethylene (HPPE) to be used for water mains.

#### **33.2 Applicable Standards**

The following codes and standards, to the extent specified herein form a part of this specification. The latest edition of these codes shall govern the work.

- 33.3 ISO 4427 - Polyethylene (PE) pipes for water supply specification or equivalent International Standard.
- 33.4 ISO= 161-1 : 1996 - Thermoplastic pipes for the conveyance of fluids - Nominal outside diameters and nominal pressures – Part 1: Metric Series.
- 33.5 ISO-1167 : 1996 - Thermoplastic pipes for the conveyance of fluids - Resistance to internal pressure - Test Method.
- 33.6 !SO-4065 : 1996 - Thermoplastic pipes - Universal wall thickness table.
- 33.7 ISO-3126 - Plastic Pipes - Measurement of dimensions.
- 33.8 ISO-13761 - Plastic pipes and fittings - Pressure reduction factors for polyethylene pipeline systems for use at temperatures above 20°C.
- 33.9 ISO- 7005-3 - Metallic flanges - Parts, copper alloy and composite flanges.

#### **33.10 Material**

#### **33.11 General**

The pipes shall be manufactured from polyethylene containing only those anti-oxidants, U V stabilizers and pigments necessary for the manufacture of pipes conforming to this specification and for its end use, including weldability when it is possible. **Country of origin must be U.A.E./West Europe/Japan/U.S.A.**

The material of the polyethylene pipes and fittings which is in contact with or likely to come in contact with drinking water shall not constitute a toxic hazard, shall not support microbial growth and shall not give rise to unpleasant taste or odour, cloudiness or discoloration of the water. The concentration of substances, chemical and biological agents reached from materials in contact with drinking water, and measurements of the relevant organoleptic/physical parameters, shall not exceed the maximum values recommended by the World Health Organization.

Fittings shall be manufactured for working pressure of 16 Bar.

- Nominal diameter of the pipe shall be the outer diameter of pipe.
- Standard dimension ratio (SDR) it is ratio between outer diameter of pipe and its wall thickness.

### 33.12 **Colour**

The pipe shall be black with red coloured markings.

### 33.13 **arbon Content**

The carbon black content in the compound for black pipes shall be  $2.25 \pm 0.25\%$  by mass, when measured in accordance with ISO 6964.

### 33.14 **Dispersion of Carbon Black**

When determined in accordance with ISO 11420, the dispersion of the carbon black shall be equal to or less than grade 3.

### 33.15 **Dispersion of Blue Pigments**

When determined in accordance with ISO 13949, the dispersion of blue pigment shall be equal to or less than grade 3.

### 33.16 **Thermal Stability**

When determined in accordance with ISO/TR 10837 the induction time shall be at least 20 min. when tested at 200° C.

### 33.17 **Effects on Water Quality**

Materials in contact with drinking water shall not constitute a toxic hazard, shall not support microbial growth and shall not give rise to unpleasant taste or odour, cloudiness or discoloration of the water.

### 33.18 **Physical Properties**

Polyethylene pipes and fittings shall be high density polyethylene pipes (HDPE) and shall comply with the requirements of ISO 4427 type **PE100**.

The minimum required strength (MRS) of the material compound shall be 100 Mpa at 20°C and 50 years life time. The design stress shall be 8 Mpa.

The polyethylene pipes and fittings shall meet the following specification:

- Minimum density measured according to ISO 1872  $> 959 \text{ kg/m}^3$
- Melt flow rate measured according to ISO 1133:
  - at 2.16 kg load  $< 0.15 \text{ g/10 min.}$
  - at 5.0 kg load  $< 0.5 \text{ g/10 min.}$
- Tensile strength at yield = 23 Mpa
- Elongation at break  $> 600\%$
- Thermal conductivity at :  $0.4 \text{ W/m}^0 \text{ k}$
- Vicat softening point at 1 kg load = 124°C
- The thermal stability of polyethylene material shall meet the requirement of ISO 4427.

### 33.19 Dimensions of Pipes

The pipe dimensions, which are based on standard dimensions ratio 11 (SDR 11) are specified in Table 1.

Table 1: Pipe dimensions

#### Polyethylene Pipes ISO 4427 - PE100 Product Data Sheet

Nominal OD (min) mm	Maximum OD mm	Maximum Ovality mm	Wall Thickness for Pipe Series ISO 4427	
			SDR 11 - PN16	
			min	max
20	20.3	1.2	2.3	2.6
25	25.3	1.2	2.3	2.7
32	32.3	1.3	3.0	3.5
40	40.4	1.4	3.7	4.3
50	50.4	1.4	4.6	5.3
63	63.4	1.5	5.8	6.7
75	75.5	1.6	6.8	7.9
90	90.6	1.8	8.2	9.5
110	110.6	2.2	10.0	11.5
125	125.6	2.5	11.4	13.2
140	140.9	2.8	12.7	14.7
160	161.0	3.2	14.6	16.8
180	181.1	3.6	16.4	19.6
200	201.2	4.0	18.2	21.8
225	226.4	4.5	20.5	24.5
250	251.5	5.0	22.7	27.2
280	281.7	9.8	25.4	30.4
315	316.9	11.1	28.6	34.3
355	357.2	12.5	32.2	38.6
400	402.4	14.0	36.3	43.5
450	452.7	15.6	40.9	49
500	503.0	17.5	45.4	54.4
560	563.4	19.6	50.8	60.9
630	633.8	22.1	57.2	68.6
710	714.0	24.9		
800	805.0	28.0		
900	905.0	31.5		
1000	1005.0	35.0		

Straight pipes shall be supplied in standard of 11.8 m ( $-0 +150$  mm) measured at  $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ . Unless otherwise specified, coil lengths shall not exceed 100 m. the coils shall be wrapped and shall not be exposed to direct sunlight.

33.20 **Pressure Reduction Factor for PE pipeline systems for use at temperatures above 20°C**

Reduction factors to be applied to obtain the maximum allowable operating pressure for elevated – temperature operation of PE pipes and fittings shall be comply to the Table 7 of ISO 4427.

33.21 **Hydrostatic Strength**

Hydrostatic strength of pipes and fittings shall comply to the Table 8 of ISO 4427 when tested in accordance with ISO 1167.

33.22 **Thermal Stability**

The induction time for test specimens taken from pipes shall be at least 20 min. when tested at 200° C in accordance with ISO/TR 10837. The test specimens shall be taken from the inside the pipe.

33.23 **Fusion Compatibility**

Pipes and fittings shall be joined by butt fusion or using electro-fusion fittings and the joints shall conform to the requirements specified in Table 8 of the ISO 4427.

33.24 **Marking**

33.25 All pipes shall be indelibly marked at maximum interval, of 1m. The marking shall indicate at least the following information:

- Manufacturer's Name or trade mark
- Nominal outside diameter (NOD) in millimeters (mm)
- Nominal wall thickness
- Designation of the pipe material
- Nominal pressure
- Production data
- Number of the international standard

33.26 Fittings shall be marked as follows:

33.27 **Butt-fusion fittings:**

1. Manufacturer's name and logo
2. Standard
3. Size in mm
4. Type of fittings
5. SDR
6. Month and year of manufacture.

33.28 **Shipping**

The contractor/supplier shall provide packing and shipping procedures for approval by FEWA and shall comply with the following requirements.

33.29 **Delivery**

Delivery of the plastic pipes and fittings to FEWA Stores/FEWA Areas, shall be not later than six months after the stamped manufacturer date, for it to be acceptable.

33.30 **UV Protection**

To obtain this exemption the manufacturer shall inform FEWA one month prior to manufacture for inspection and approval of the protective method. All silos of coiled pipe shall be shrink-wrapped in UV-blocking black plastic. The black plastic shall be thick enough to prevent accidental tearing and passages of visible light. The UV-blocking plastic wrap shall filter out 100% of the UV radiation from reaching any portion of the pipe.

33.31 **Tie-Downs**

Tie-downs shall be at least 100 mm wide and be clean and free from sand, gravel and other such materials. For straight length pipe a minimum 6 tie-downs are required.

33.32 **Pallets**

The pallets shall be suitable for transporting the materials from the place of manufacture to the designated receiving location without causing any damage to the pipe.

33.33 **Overhang**

Pipes shall not over hang at either end of the trailer.

33.34 **Stacking**

The manufacturer shall not ship small coils stacked inside silos of larger coils.

33.35 **Trucking**

Where pipes are transported by vehicles, the vehicles should have a flat bed and free from sharp edges or projections.

33.36 **End Caps**

Straight lengths and coils of pipe shall have internally fitted end caps that prevent direct and debris from entering the pipe during handling, storage and transport.

33.37 **Vendor Documentation**

The supplier shall furnish the following vendor data as a minimum, with the bid:

- Catalogues, Brochures
- Dimensional details of pipes and fittings.
- Complete details of testing facilities at manufacturer works

### 33.38 **Fittings/Stub Flange**

The fittings shall be injection moulded or formed from material compatible to that of the pipe., stub flanges with **PPV with steel core backing rings** shall be used or special restrained transition fittings approved by FEWA. The flanges shall be drilled to BS 4504 PN16.

Complete set of bolt and nut, gasket shall be supplied to each flange. Bolt & nuts shall be conforming to BS 970 Part 1:1983, BSEN 10090:1998 - Stainless Steel Grade 316 and gasket shall be rubber reinforced with cotton of thickness not less than 3 mm.

### **BELOW GROUND APPLICATION OF POLYETHYLENE PRODUCTS AND SUPPLEMENTARY PRODUCTS FOR WATER DISTRIBUTION AT MAXIMUM OPERATING PRESSURES OF 16 BAR**

All fittings, saddles, adaptors and spigot end fittings included in this document should be designed for use with water distribution systems and be supplied from manufacturers complying with the requirements of ISO 9001.

### **34.0 SPECIFICATIONS FOR ELECTRO FUSION FITTINGS AND SADDLES**

All fittings shall be injection moulded from recognised top quality PE 100 resin.

All fittings must conform with the requirements of EN 12201-3 and be suitable to be used in conjunction with pressure pipes from polyethylene manufactured to the appropriate ISO and CEN standards.

All fittings must be packed in such a way to allow instant use on site without additional cleaning.

Each carton or protective package must clearly indicate its contents.

The heating coils contained in each individual fitting and saddle should be so designed that only one complete process cycle is necessary to fully electrofuse the fitting to the adjoining pipe or pipeline component as applicable.

No heating element may be exposed and all coils are to be fully imbedded into the body of the fitting for protection purposes.

The pipe fixation device shall be an integral part of the body for all fittings in the sizes up to and including nominal diameter 63 mm and on saddles up to 250mm.

An individual data carrier card in compliance with ISO 7810 and ISO 7811 containing a magnetic strip and an appropriate barcode or codes as well as manual setting information for data transfer purposes must be supplied with each fitting.

All fittings must have moulded-in identification and appropriate product information.

Process voltage of all fittings must not exceed a maximum of 39.5 volts.

Insulated contact heads for the terminal pins are to be provided.

Terminal pin size shall be 4 mm in diameter.

A limited path style fusion indicator acting for each fusion zone as visual recognition of completed fusion cycle should be incorporated into the body of the fitting or saddle near or adjacent to the terminal.

The design of the fusion indicators must prevent the escape of fusion melt.

All couplers in the sizes up to and including nominal diameter 250 mm must have an easily removable centre stop not requiring tools for removal.

Internal or externally threaded transition adaptors in the nominal sizes up to and including 2" must be designed with an integrated polyethylene collar from PE 100 for jointing purposes not relying on rubber or synthetic seals for leak prevention.

Threaded adapter bodies may be from brass or stainless steel and should be of the modular principle, not being supplied moulded into an electrofusion fitting socket.

All saddles up to mains size nominal diameter 250 mm should be designed with two separate halves having a single hinge type attachment and are to be correctly processed without specialised external spring-loaded tooling.

For tapping saddles above and including 75mm, the top half of the saddle shall be equipped with an electrofusion outlet which can accept various other modular system components such as tapping tees, adapters, valve tees, caps, stop-off attachments, pipes etc., that are simultaneously fused together with the saddle to mains joint in one operation.

For Duo block saddles, each branch outlet is to be equipped with an integral clamping device.

The branch spigot of tapping tees must be long enough to allow a second joint if necessary or to attach a compression fitting.

All pipe saddle sizes above nominal diameter 63 x 40 mm are to allow a 360° rotation of any modular system component placed in the electrofusion socket outlet.

Safe tapping into a mains must be possible under the defined allowable maximum water pressure according to the respective pipe series and ambient temperature.

The tapping saddle cutter is to be designed to seal-off the central passage way in the uppermost position.

The cutter design must fully contain the cut-out coupon and not produce shavings.

It must be possible to permanently seal-off the top of the saddle with an electrofused cap in the mains sizes from nominal diameter 63 mm and above.

An efficient means of tapping branch saddles and fittings is to be made available.

### **35.0 SPECIFICATIONS FOR SPIGOT END FITTINGS**

All fittings must be injection moulded from recognised top quality PE 100 resin or be manufactured from injection moulded parts.

All fittings are to conform to the requirements of EN 12201-3.

All fittings shall be packed to allow instant use on site without additional cleaning.

### **35.1 PACKAGING**

All Electrofusion fittings must be packed in transparent protective bags.

All Electrofusion fittings must then be packed in carton boxes.

If only one type of product is packed all carton boxes shall have a label showing the manufacturer identification, the description of the product, the drawing of the product, the relevant size and the quantity.

### **35.2 PRODUCT TRAINING AND TECHNICAL INFORMATION**

The manufacturer or material supplier shall provide a specialised theoretical and active practical product training given by qualified instructors to enable installers of the above mentioned products to be able to understand and use the products and associated tooling correctly and efficiently under site conditions.

The courses are to be held on the purchaser's own premises upon demand.

The manufacturer is to provide accurate and easy-to-understand assembly instructions in at least one internationally recognised language which can be used at any subsequent time for reference purposes.

Clearly defined information in book or leaflet form concerning the full range of relevant products and accessories to ease product selection and their usage are to be provided by the supplier in at least one major international language.

### **35.3 Unloading**

Unloading at stores/sites (Sharjah,R.A.K,Dhaid,Fujairah,Dibba) must be carried out carefully under the control and responsibility of the contractor/supplier. Care should be taken to avoid severe impact with any solid object (i.e. other pipes, ground etc.). All packing and transportation expenses shall be deemed to be included in the supply rates, and no extra payment shall be made by FEWA for the same.

36.0

## CENTRIFUGAL PUMP & MOTOR

### SPECIFICATION OF PUMP

This specification defines the technical requirements for Split Casing Centrifugal pumps. The Specification has been produced to ensure that all potential Contractors provide equipment to a recognisable quality standard and is in line with good engineering practice. Any potential deviations from this specification must be clearly highlighted at the tender stage.

British Standards are referred to in this section, but relevant ISO or DIN Standards are acceptable.

However, consistence must be guaranteed between the quoted Standards/ Codes proposed by the Tenderer and clear mention of those will be indicated in his proposal.

BS 21 Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions).

BS 599 Methods of testing pumps.

BS 1387 Specification for screwed and socketed steel tubes and tubulars and for plain end steel tubes suitable for welding or for screwing to BS 21 pipe threads.

BS 1452 Cast Irons

BS 3100 Cast stainless steels

BS 4278 Specification for eyebolts for lifting purposes.

BS 4504 Circular flanges for pipes, valves and fittings (PN designated).

BS 4999 General requirements for rotating electrical machines.

BS 5316 Specification for acceptance tests for centrifugal mixed flow and axial pumps.

Part 1: Class C tests.

EN 292 Safety of machinery Basic concepts

EN 294 Safety of machinery safety distances to prevent reaching danger zones.

### **36.1 Pump Design**

The pump shall be a single stage horizontal centrifugal axially split design. The impeller shall be supported between bearings.

Impellers shall be of the double entry shrouded type.

Casings shall be of a single volute design utilising an internal splitter.

The pumps shall be designed for continuous duty at the rated parameters.

The pumps shall be designed to allow quick and easy dismantling and to allow the renewal of the impeller without removing the suction and discharge pipe work.

The pumps shall be designed such that they may be put in to service from the standby condition without any special provisions or precautions.

In the case of accidental reverse rotation, the Tenderer shall give a clear statement regarding the limitations/ restrictions acceptable to the pump/ motor set.

Pump vents and drains shall be collected and piped to suitable drain points.

### **36.2 Pump Performance**

The pump head versus flow characteristics shall be stable, rise continually to closed valve head and be non-over loading.

The closed valve head shall be a minimum of 110% of the duty head.

The Tenderer shall select the most economic pumps given the constraints of the operating parameters, as operating costs will be considered in association with the capital costs in the evaluation.

The Tenderer shall provide manufacturer brochures, for the plant offered, this shall include details of thrust bearings, lubrication and sealing.

The margin on NPSH available to NPSH required shall be at least 1.5m at duty.

The pump driver shall be rated for a minimum margin on absorbed power of 10%, based on maximum duty flow.

The optimum efficiency of the pumps shall be designed for operation of 2 or more pumps in parallel, as required.

The pump characteristic curves (Capacity, Head, Power, NPSH, Efficiency, Speed) shall be included in this offer including the resulting characteristic curve for the different possibilities of parallel operation.

The combined noise level of pump drive and motor shall not exceed 85 dbA at 1 m from the unit.

The pump shall be designed for a minimum service life of 15 years.

### **36.3 Pump Casing**

The pump casings shall be of Stainless Steel 316L. Suction and delivery branches shall be incorporated in the bottom half casing and include tapings for pressure gauges. Austenitic stainless steel drain plugs shall be provided at the lowest point of the casing and air release valves (of stainless steel construction) complete with bleed lines shall be provided on the pump. Flanges shall comply with BS 4504 or equivalent.

Pump casings and discharge pipe work up to and including the isolation valves and non-return valves, shall be rated for the maximum closed valve head developed, including the maximum suction pressure.

The pump removable half casing shall have ribs with cored holes for ease of lifting during disassembly. The removable half casing shall also have dowels for alignment and jacking screws.

Pump casing split flange bolting shall be stainless steel BS 6105 GR A4-70.

### ***Casing Wear Rings***

Casing wear rings where fitted shall be locked to prevent rotation by dowel or similar approved method. Ease of replacement shall be a major design criterion. The wear rings shall be 316L stainless steel and designed such that hydraulic pressure aids the sealing of the ring into the pump casing. Casing wear rings shall be incorporated on all rotating/ stationary interfaces.

## **36.4 Bearings**

### **36.4.1 Thrust Bearing**

The axial thrust generated shall be taken by an appropriate thrust bearing design composed of either spheriodal roller contact or deep groove ball bearings.

Thrust bearing arrangement incorporated into the motor housing are not permitted.

Setting of thrust bearings shall account for dynamic loading albeit setting is carried out with the machinery stationary.

Bearings shall be sealed grease lubricated or alternatively fitted with constant level oilers.

### **36.4.2 Rolling Element Bearing**

Ball or roller bearings shall be rated to give a minimum life of 40,000 hours at the rated operating load without replacement. Bearings shall be protected by water thrower and labyrinth type seal as a minimum. The use of V rings or other rubber components as the sole water thrower is not acceptable.

### **36.4.3 Bush Bearings/Restriction Bushes**

Bush bearings/ Restriction bushes (including stuffing box neck bushes), where utilised, shall be in orkot or equal, and positively locked to prevent rotation.

### **36.4.4 Bearing Housings**

The bearing housings shall be flange mounted and dowelled for ease or realignment. Shimming of bearings is not permitted.

### **36.4.5 Sealing**

### **36.4.6 General**

The means of sealing shall be mechanical seal.

The stuffing box shall be unitary construction with the pump casing. Detachable stuffing boxes are not permitted.

### **36.4.7 Mechanical Seals**

Mechanical seals shall be designed to operate with a positive suction head and delivery head as specified. The seals shall be self water lubricated and cooled, and shall not in normal use permit any controlled leakage from the pump.

The Tenderer shall specify the type, size and material of the mechanical seal he intends to supply. It shall be the responsibility of the pump manufacturer to ensure that the tolerances required by the seal manufacturer are not exceeded.

The Tenderer shall ensure that the seal, face and component materials of the mechanical seal are suitable for the media being sealed. Under operational conditions thermal loading of the seal components shall be within the capacity of the seal design and wear rate is minimised.

### **36.4.8 Seal/Gland Drainage**

Seal/gland drainage shall be collected in a collecting tray formed integrally with the pump casing stuffing box. The tray shall not extend high enough to submerge the gland in the event of drain hole blockages.

### **36.4.9 Pump Shaft**

### **36.5 Pump Shaft Design**

The shaft material shall be Duplex stainless steel (25/5) or similar.

The diameter of the sleeve shall not be taken into account when calculating shaft stiffness.

### **36.6 Shaft Sleeves**

Where shafts are exposed to the process fluid and where they pass through the sealing gland they shall be fitted with sleeves of 316L Stainless Steel, positively driven by the impeller key and which extend through the stuffing box. The finish of the sleeve at the seal faces shall be 1.6  $\mu\text{m}$ , min.

Shaft sleeves and bearings shall be positively retained by use of a single shaft nut and tab type lock washer. Other non positive methods of locking are not acceptable. Sleeve retention by threading to the shaft is unacceptable.

### **36.7 Balance**

The rotating assembly shall be dynamically balanced in the factory.

### **36.8 Impellers**

Impellers shall be 316L Stainless Steel.

The impeller shall be keyed and positively secured to the pump shaft and shall be designed so that there is no tendency for any parts to unlock due to reverse rotation of the pump.

Renewable impeller wear rings shall be fitted.

The combination of wear rings shall be non-galling. Impeller wear rings shall be stainless steel.

### **36.9 Couplings**

Couplings shall be provided to permit the removal of drive shafts, bearings, etc. without removing the pump or motor.

Couplings shall be of the rubber tyre type unless otherwise specified. Rubber tyres shall be of chloroprene material.

### **37 Rating Plates/Markings**

Rating plates shall be fitted to all pumps and shall be manufactured and fixed by corrosion resistant material and include full details of the pump including type, serial number, duty point flow head, speed, design pressure, year of manufacture, min/max fluid temp, min/max suction temp.

The weight of the pump set, motor and bed plate or stool shall be marked on the pump set data plate.

The pump set shall be CE marked and be fitted with all applicable warning notices.

#### **37.1 Guarding**

All machine enclosures shall be safeguarded in accordance with EN 292 and EN 294 with guards fixed to either the pump set bed plate, pump or motor which ever is appropriate. Couplings shall be totally enclosed.

Openings at gland locations shall be guarded using perforated plate to allow viewing of leakage.

Apertures in the guards shall not exceed the requirements of EN 294.

### **37.2 Lifting Brackets**

All lifting brackets, shackles and lifting eyebolts shall be manufactured from steel with minimum ultimate tensile strength of 430 MN/m<sup>2</sup>, and certified in accordance with BS 4278 or equivalent. Both bolt and hole shall be permanently marked, preferably by punching, with the diameter and thread form used. All eyebolts shall be of the collar type.

### **37.3 Pipe Work**

All pipe work on the pump casing shall be Austenitic Stainless Steel, Grade 316L.

### **37.4 Quality Assurance**

The Tenderer or his nominated manufacturer shall operate a Quality system compliant with ISO 9001 1994.

The Tenderer or his nominated manufacturer shall prepare a quality plan detailing the measures to be used during manufacture in order to assure the quality of the finished product. The quality plans shall be submitted to the Ministry at the Bid stage for information only.

### **37.5 Materials**

To summarise, the pump materials shall be as follows:

Casing	- 316L stainless steel
Casing Wear Rings	- 316L stainless steel
Impeller	- 316L stainless steel
Shaft	- Duplex stainless steel 25/5
Shaft sleeve	- 316L stainless steel
Fastener	- Stainless steel BS 6105 GR A4-70

## **38 SPECIFICATION OF MOTOR**

### **38.1 General**

All motors shall be designed, manufactured, tested, installed and commissioned as per Standard IEC 34 and shall comply with the requirements of this Contract.

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Unless otherwise specified and/or approved all AC motors shall be of the squirrel cage induction type provided with deep slots or double squirrel cages.

All motor as far as applicable shall be from the same manufacturer.

Motors of the same ratings must be fully interchangeable.

All motors shall be supplied, complete with terminal boxes, cable glands and where specified, heaters and other monitoring and protection devices such as devices to monitor winding temperature, bearing vibration, etc.

All motor in general shall be 3 phase, 50 Hz motor.

The general construction of the motors shall be stiff and rigid. Casing made of light metal alloy will not be acceptable for motors above 10 kW rating. All precautions shall be taken to avoid any type of corrosion and electrical ionization effects taking place between different kinds of metals.

All motors shall be fitted with approved types of lifting hooks or eye bolts as suitable.

All motors shall be suitable for the atmospheric environment and climatic conditions prevailing at the Plant Site.

### **38.2 Standard**

All motors shall be designed, manufactured and tested according to latest revision of IEC 34 Standards.

### **38.3 Design, construction and operational condition**

The service voltage for the motors shall be:

- 415V  $\pm$  20%, A.C. 3 phase, 50 Hz.

Motors shall be designed for direct online start using soft starter under the full voltage. After a loss of voltage for 3 sec., motors must be

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capable to reaccelerate their driven equipment in less than 10 seconds at a voltage of 75% Un.

The maximum starting current of any motor shall not exceed 6 times nominal current of the motor.

Restart failure shall be less than 70% of rated voltage at rated load.

The rating of each motor shall be high enough to meet the requirements of its connected load without infringing upon the service factor.

The load demand on the motor shall be considered at least with a 10% excess margin over the expected maximum power demand of the driven machine. The service factor, being the ratio of the installed motor output to the required power at the shaft of the driven machine (calculated as above) shall be as follows:

POWER DEMAND	SERVICE FACTOR
Upto 1 kW	1.3
More than 1 kW upto 10 kW	1.2
More than 10 kW upto 50 kW	1.15
More than 50 kW	1.1

AC three-phase motors shall have high power factors not inferior to those indicated below unless approved otherwise.

Rating	1-10 kW	10-50 kW	50-200 kW	above 200 kW
2 and 4 pole	0.82	0.86	0.87	0.88
6 pole	0.78	0.82	0.85	0.86
8 pole	0.73	0.78	0.80	0.82
10 and 12 pole	0.70	0.73	0.78	0.80
Above 12 pole	0.68	0.70	0.73	0.75

A.C. motors shall be capable of operating continuously under rated output conditions at any frequency between 48 and 52 Hz and/or with

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any voltage deviation between 90% and 110% of the nominal voltage. A transient over voltage of 130% of the nominal voltage shall as well be sustained. Further, the motors shall be capable of delivering the maximum torque as required by the driven machine when running at 70% nominal voltage for a period of 10 seconds without injurious overheating or slipping.

The pullout torque for continuously loaded motors shall be at least 160% of the rated motor torque and for intermittently loaded motors 200% of the rated motor torque.

All motors must be capable to withstand when running with the rated load without any mechanical or electrical damage any voltage dips for a period of 3 s (at zero voltage) through 10 s (at 65% nom. voltage).

#### **38.4 Windings and Insulation Class**

The insulation of all motors shall be of Class F, according to IEC 85, with Class B temperature rise during starting and in steady state operation at full load. However, class B temperature limit may be exceeded in case of starting at reduced voltage, but under no circumstances shall exceed the temperature limit of class F insulation. The motor shall be suitable for operation in damp locations, for occasional contact with corrosive gases and vapours and for considerable fluctuations in temperature. The insulation shall not contain shellac or asphaltic components.

The starter winding shall be made of copper and suitably braced to withstand the forces due to direct-on-line starting at 110% designed voltage.

Interphase connections inside the machine shall be made at the non-driving end and the winding connections and tails shall be non-hygroscopic.

The stator winding shall be of sufficient cross-sectional area to withstand the maximum prospective fault power on the system for a duration as determined by the next coordinated electrical protection devices.

The rotor winding shall be designed to give trouble-free continuous service, including repeated direct-on-line starting. The rotor shall be

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subjected to a 120% overspeed test for 2 minutes to show that there is no deformation or winding dislocation.

### **38.5 Starting**

A.C. Motors shall be designed for direct on-line starting with soft starters. They shall be capable of being switched on without damage, to an infinite bus at 110% of the designed voltage with a maximum residual voltage of 100% even in phase opposition. For starting the motors under load a momentary voltage drop of 30% referred to nominal voltage should be taken into consideration. The maximum starting current shall not exceed the following value:

- 6 times rated current for L.V. motors.

With 80% of the nominal voltage applied to the motor terminals each motor shall be capable of accelerating its associated load to full speed with a minimum accelerating torque of 5% of full load torque.

All motors, unless otherwise agreed shall be capable of six starts in one hour equally spaced in time with the coupled load and initially at specified ambient temperature. At the end of the sixth the temperature of the insulated windings shall not exceed the max. permitted temperature for class B insulation, and the cage windings shall suffer no injurious heating.

In addition, each motor shall be capable of enduring 3 (three) successive starts with the motor initially at operating temperature and the temperature of the winding at the end of three starts shall not exceed class B limit plus 10°C.

All motors shall be capable to withstand at least 300 starts per year.

### **38.6 Ventilation and Type of Enclosure**

Unless otherwise specified, all motors shall be of the totally enclosed fan cooled type, protection class IPW 54 according to IEC recommendations 34-6 and 529.

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Where motors are installed outdoors, a weather-proof design shall be chosen. Motorized valves shall be of protection class IP 65.

Unless otherwise specified, all Motors shall be of the natural air cooled self-ventilating type. Generally the cooling air shall be drawn from the non-driving end of the motor.

Wherever cooling tubes for air/ air heat exchangers are used, their surface subjected to the ambient air shall be applied with special coating to protect on long term basis against erosion and corrosion. Cooling tubes of motors installed outdoors and subjected to aggressive atmospheres e.g. chemicals, high salt content or heavy sand or dust laden air shall be made of stainless steel.

In design calculations for the motor cooling system the Site ambient conditions shall be taken as reference. The motor nameplate ratings shall be based on Site ambient conditions as specified.

Motor installed outdoor shall be provided with fabricated coverings of galvanized steel. Alternatively, they may specially be designed so that a maximum metal-temperature of 85 °C will not have a detrimental effect to the motor.

Suitable facilities shall be provided at the lowest point of the casing for draining condensed moisture. All motors above 1 kW shall be equipped with automatically controlled heaters for protection against internal condensation of moisture during standstill periods. Such AC heaters shall be suitably fixed inside the winding covers, the leads shall be led to LV terminal box.

The paint finish shall be suitable for heat humid climates and corrosive atmosphere, prevailing at each installation site.

### **38.7 Bearings**

As far as applicable and unless otherwise specified self-lubricating ball and roller bearings with solid recess shall be provided for all L.V. motors.

All motors with ratings of about 1 kW and above shall be equipped with a type of lubricator which allows greasing while the motor is running and

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which prevents over-lubrication. Additionally, the bearings shall be fitted with grease nipples permitting the use of a universal grease gun.

Self-lubricated bearings shall be equipped with an easily accessible lubrication pot with overflow pipe and oil collecting vessel.

The bearing sleeves if approved shall be designed such as to permit the immediate formation of an oil film during the first shaft rotations. This shall likewise be possible after sustained stand-still periods of at least 6 months. The measures to be taken beyond this period shall clearly be described by the Contractor subject to approval by the FEWA.

Bearing sleeves when provided shall be designed for easy removal and check without dismantling the whole bearing. All bearings shall be carefully protected and sealed against sand or dust penetration and oil leakage.

In case of independent bearings, motor and bearing pedestals shall be fitted on a common base plate.

For motors equipped with ball or roller bearings, adequate means are to be provided during stand-still periods to prevent the brinelling effect. During transport and shipping such motors shall receive a special bearing insert.

Unless otherwise specified, vertical motors shall have either ball or roller thrust bearings designed to withstand all thrust forces and to support the motor and the driven equipment. Thrust bearings shall each have a sealed lubrication system capable of relubrication in service. Where ball or roller bearings cannot be used, specially designed bearings (such as the Kingsbury thrust bearing) must be employed.

Necessary provision shall be made to prevent damage to bearings by shaft currents, by insulating both the drive and non-drive end bearings and their associated connections, the insulation at the drive end bearing being bridged by a removable copper strap.

For the transport of motors equipped with ball or roller bearings special bearing inserts shall be provided to prevent transport damages.

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As a consequence of any existing shaft voltage, the flow of shaft currents is to be prevented by proper bearing insulation at one side.

The Contractor shall provide maintenance instructions with typical service record charts, etc. for all type of motors.

### **38.8 Shaft and couplings**

The motors shall be provided with a free shaft extension of cylindrical shape with key and key way according to IEC Recommendation 72-1.

The motor half-coupling shall be pressed on the motor shaft and shall be balanced together with it. A coupling guard shall be provided.

### **38.9 Terminal boxes and earthing**

The terminal boxes shall be of ample sizes to enable connections to be made in a satisfactory manner. Cable supports shall be provided with terminal boxes.

The terminal boxes with the cables installed shall be suitable for connection to supply systems having the short-circuit capacity and fault clearance time determined by the next relevant motor protective devices.

Terminal boxes shall be supplied, suitable for the specified area classification of the motor locations. They shall be sized so that feeder cables can be connected to motor leads without damage to the cable or the leads.

The terminal leads, terminals, terminal boxes and associated equipment shall be designed to withstand the respective system design short-circuit level. Special care shall be taken to ensure that the terminal box for motors is amply sized so as to accommodate the increased cable cross section due to the prevailing Site conditions.

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Unless otherwise specified or approved, the terminal box shall be positioned on the side of the motor and shall permit turning by 90 and 180 degrees.

A permanently attached connection diagram shall be mounted inside the terminal box cover giving the desired direction of rotation. If motors are suitable for only one direction of rotation this shall be clearly indicated.

Terminal boxes shall be of robust design and totally enclosed (IP 55) to prevent the ingress of moisture and dust. All joints shall be flanged with gaskets of neoprene or similar material. For motors above 1 kW the terminal box shall be sealed from the internal air circuit of the motor. Terminal boxes or parts thereof shall consist either of grey cast iron, light metal alloy or galvanized steel.

Depending on the size, all L.V. motors shall be fitted with an approved cable sealing and dividing box or with a gland plate installed in the terminal box and drilled as required and provided with suitable fittings (cable glands) for the cable entry which shall be temporarily plugged or sealed during transport.

Terminal boxes shall be fitted with an approved cable sealing - and dividing box and a pressure relief diaphragm located to direct flames and/or hot gases away from personnel. All cables connecting the motor shall be installed in metal conduits of approved type.

No compound filled terminal boxes shall be acceptable.

The cable terminal boxes shall be amply sized to fit with the number and kind of cables used.

All windings ends shall be brought out to terminal blocks or stud type insulators.

For earthing purposes each motor shall have two (2) adequately sized bolts with washers at the lower part of the frame. In addition each terminal box shall likewise contain one earthing screw.

The grounding cables overall diameter shall be specified on the data sheets. The resistance of the wire from motor to common earth shall not exceed 0.1 Ohm.

### **39 Lifting and Installation Dispositions**

All motors shall be provided with one or more lifting eye-bolts, rings or lugs capable of supporting the total weight of the motor. If lugs are concealed by enclosure, warning plates shall be attached to both sides of the motor warning against improper lifting.

The equipment to be supplied shall include all accessories necessary for the installation of the motors (e.g. dowel holes, anchor bolts, ..).

#### **39.1 Measuring and Monitoring**

All L.V. motors above 100 kW shall be provided with :

- Winding temperature thermometers with two double element RTDs embedded in each phase of the stator windings. The thermometers shall have two stage temperature monitoring contacts for alarm and protection trip.
- RTDs with temperature monitoring device for both side bearings. Alarm and protection contacts shall be provided.
- Bearing vibration pick up and monitoring device with alarm and trip contacts.

#### **39.2 Vibrations and noise level**

Under all operating conditions the noise level of motors shall not exceed 85 dB (A) at 1 m. In order to prevent undue and harmful vibrations all motors shall be statically and dynamically balanced.

Double amplitude values of vibration shall not exceed the following:

- 15  $\mu\text{m}$  at 50 Hz
- 7  $\mu\text{m}$  at 100 Hz

### **39.3 Wiring**

All secondary wiring shall be of the heat resistant type silicone rubber insulation, reinforced and protected with metal braid. All wiring for measuring and monitoring is to be brought to one common terminal box.

### **39.4 Rating plates and marking**

Each motor shall have a rating plate marked in accordance with IEC 34-1.

The direction of rotation of unidirectional motors shall be clearly indicated by means of an arrow located on the non-driving end shield of the motor.

### **39.5 Tests**

#### **39.6 Tests in the Manufacturer's Works**

Each motor shall be factory tested. Tests shall be performed in accordance with IEC standards. At least the following tests shall be performed under full responsibility of the Contractor.

- Measurement of winding resistances;
- No-load and short-circuit measurements and plotting of no-load and load characteristics;
- Measurement of starting current and torque;
- Efficiency measurement (type test certificate);
- Heat run test (type test certificate);
- Dielectric test;
- Measurement of insulating resistance;
- Overspeed test;
- Air gap measurement;
- Measurement of motor vibrations (on motors rated 100 kW and higher);
- Measurement of noise level (type test, on motors rated 100 kW and higher).

40. **Control Panel**

Design and supply of M.C.C. panel (IP54) for the above mentioned pumps with all required power and control circuit, all types of protections for pumps, M.C.C. panel shall be manufactured with steel protected by epoxy of 300 micron or any other suitable material and it must be approved by FEWA. Minimum important protection and accessories shall be provided as follows:

- Σ DOL soft starter 415V, 50Hz.
- Σ Capacity to be designed by the contractor.
- Σ Electronic overload/motor protection relay.
- Σ Control relay.
- Σ Control MCB.
- Σ Ammeter.
- Σ Core balance CT.
- Σ Earth leakage relay.
- Σ Current transducer.
- Σ Motor temperature sensors to be connected and displayed on the panel.
- Σ Unbalance protection.
- Σ Motor stall protection/locked rotor protection.
- Σ Selector switch for location of control, 4 position switch, OFF, M.C.C., LOCAL, SCADA.
- Σ Current transducer.
- Σ Auxiliary contacts for future connection to SCADA, TRIP, ON, OFF, DCS ON/OFF command.
- Σ Heating, motor current value, winding temperature and bearing temperature.

## 41.0

### **Butt Fusion Tooling Equipment**

This specification gives general requirements for butt fusion machines and is specifying design features of the basic machine, planer unit, heating element and data recording. The specification will be a guidance to ensure that the quality of the butt fusion tools is on a high level.

All Butt Fusion equipment included in this document should be designed for use with water distribution systems and must be supplied from manufacturers complying with the requirements of ISO 9001 and ISO 14001 .

#### **Definitions:**

**must:** indicates a mandatory requirement

**should:** indicates best practice and is the preferred option. If an alternative method is used then a suitable and sufficient risk assessment must be completed to show that the alternative method delivers the same, or better, level of protection.

### 41.1 **GENERAL SPECIFICATION**

All Butt fusion equipment must conform with the requirements of ISO 12176-1 and DVS 2207-1 and 2208-1.

The machines must be able to joint straight or coiled pipes. The pipe sizes are 110mm,160mm,200mm,250mm and 315mm. Individual pipe sizes must be accommodated by the use of not more than two layers of clamping inserts, which have to be fully interchangeable within the machine.

#### **41.2 SPECIFICATION OF THE BASIC MACHINE**

The base framework shall be fitted with four aluminum clamps, to guarantee proper pipe alignment.

Clamps inclination about 35° - 45° , to guarantee a good accessibility for removing the welded pipe, must be warranted.

With machines up to maximum diameter 315mm the upper clamps can be hinged to the frame enable opening/closing more easy.

Removable or relocatable clamping units must be foreseen in order to weld elbows or special fittings such as T or Y pieces.

#### **41.3 SPECIFICATION FOR PLANER**

The planer tool shall be a single and double-side surface planer.

Load transfer via maintenance-free mechanism has to be provided.

A safety lock mechanism to hook the planer on the Base machine must be integrated.

Safety micro switch to prevent undesired start-up is a mandatory request.

The cutting plates must have two cutting edges in order to change once during life time.

#### **41.4 SPECIFICATIONS FOR HEATING ELEMENT**

The heating surface must be coated with non-stick PTFE-coating. The colour of the PTFE coating must be such that, after the plate has been used for jointing operations, the presence of any surplus pipe material (PE,PP) on the plate must be readily visible, regardless of any degradation of the pipe material or the coating.

The heating element temperature must be electronically controlled

The heating element shall be provided for an easy placement in the correct working position

THE SPECIFICATIONS FOR HYDRAULIC UNIT  
The housing of the hydraulic unit should consist of metal or casting iron. Two handles for carrying should be mounted.

A clearly visible pressure gauge with precision scaling has to be implemented.

The control and refilling of the oil has to be easily done.

#### **41.5 SPECIFICATIONS OF FUSION DATA RECORDER**

The data recorder must record the complete fusion process. All fusion parameters – pressure, time, temperature- shall be recorded and could be called up and shown on the display.

The operator must be guided through the preparation and the complete fusion process by the data recorder unit

An error analysis system will recognize deviation from the defined parameters and will signalize the deviation during the fusion cycle.

The data recorder must include an onboard printer.

**An interface to connect an external printer should be integrated.**

The data recorder must be fitted with a battery to bridge power failures.

The data of the fusion record has to be available in electronic format for further analysis.

The operator language must be selectable. All instructions as well as the print out has to be in the selected language.

The fusion parameters must be corresponding to the standards and directives of the country in use.

The data recorder must have the possibility of configuration to the specific applications in terms of use: operator identity , order number, job site, jointing number.

The housing of the data recorder must have the possibility to protect the display during transport for example by closing a plastic cover.

**41.6 Technical Specifications**

Working Temperature Range	:	-10°C - + 50°C
Voltage	:	176 VAC to 276 VAC
Rated Voltage	:	230 VAC
Battery Operation	:	> 8 hour. Built in battery with automatic charging connection
Standard Frequency	:	47 Hz up to 65 Hz
Protection Rating of Housing	:	IP 65
Memory Storage	:	100 records on internal memory storage
Interface	:	RS232

**41.7 PRODUCT TRAINING AND TECHNICAL INFORMATION**

The manufacturer or the sales representative shall provide a specialized theoretical and active practical product training given by qualified instructors to enable installers of the above mentioned products to be able to understand and use the products and associated tooling correctly and efficiently under site conditions.

The courses are to be held on the purchaser's own premises upon demand.

In addition to the main subject matter all training courses shall additionally cover other associated distribution pipeline products as well as routine repair and maintenance procedures.

Additional training courses for inspectors, group leaders and teaching staff are to be provided upon request.

The manufacturer has to provide accurate and easy-to-understand operating instructions in at least one internationally recognized language, which can be used at any subsequent time for reference purposes.

Clearly defined information in book or leaflet form concerning the full range of relevant products and accessories to ease product selection and their usage are to be provided by the supplier in at least one major international language.

#### **41.8 GENERATOR**

Generator must be suitable to operate the butt fusion welding machine.

**42****DATA SHEET FOR HIGH DENSITY POLYETHYLENE (HDPE)****PIPES AND FITTINGS**

Item	Description	Unit	Data to be filled
1.0	<b>HIGH DENSITY POLYETHYLENE PIPES</b>		
1.1	Manufacture - Name of manufacturer - Place of manufacture (city & town) - Name of local agent - Phone/Fax no. of agent		* * * *
1.2	Standard Applicable		ISO 4427
1.3	Type of Pipe		HDPE PE 100 SDR 11
1.4	Pipe Material - Minimum required strength - Design stress - Minimum density - Melt flow rate - Tensile strength - Elongation at break	MPa MPa Kg/m <sup>3</sup> g/10 min g/10 min Mpa %	10 at 20°C 8 959 < 0.15 at 2.16 kg load < 0.5 at 5 kg load 23 >600
1.5	Pipe Colour		Black with blue marking
1.6	Working pressure	bar	*
1.7	Coil Length	M	100 maximum
2.0	<b>FITTINGS (MATERIAL AS ABOVE)</b>		
2.1	Manufacturer  - Name of manufacturer - Place of manufacture (city & town) - Name of local agent - Phone/Fax no. of agent		* * * *
2.2	Type of fittings		*
2.3	Flanges		

**Notes:**

\* These variables to be filled by Vendor /Contractor

\*\* These variables to be filled by the issuer.

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**SCHEDULE 'A'**

**ASBESTOS CEMENT PIPE DATA SHEET**

Nominal dia. DN	Di mensi ons			Cl assi fi cati on			Additional Information
	Outside dia. at machined end mm.	Wall thickness at machined end mm.	Pipe length mm	PN : Nominal Pressure (Bar)	PT : Test Pressure in Factory (Bar)	PB : Burst Pressure (Bar)	
NAME OF MANUFACTURER : COUNTRY OF ORIGIN :							

DATE :  
PLACE :

NAME OF TENDERER

STAMP & SIGNATURE

: 119 :

**SCHEDULE 'B'**

**GATE VALVE DATA SHEET**

Nominal dia. DN & Type	Rating		Material				End Connection	Coating			Remarks
	P (bar)	Temp (C°)	Body	Seat	Disc/wedge	Stem		Body Int.	Disc/wedge	External	
NAME OF MANUFACTURER : COUNTRY OF ORIGIN :											

DATE :

NAME OF TENDERER

STAMP & SIGNATURE

PLACE :

: 120 :

**SCHEDULE 'C'**

**BUTTERFLY VALVE DATA SHEET**

Nominal dia. DN & Type	Rating		Material				End Connection	Coating			Operating Mechanism
	P (bar)	Temp (C°)	Body	Seat	Disc	Shaft		Body inside	Disc	Outside	
NAME OF MANUFACTURER : COUNTRY OF ORIGIN :											

DATE :

NAME OF TENDERER

STAMP & SIGNATURE

PLACE :

: 121 :

**SCHEDULE 'D'**

**AIR VALVE DATA SHEET**

Nominal dia. DN - mm	Type	Rating		Material				Coating		Remarks
		P (bar)	Temp (C°)	Body	Float	Guides	Nipples	Internal	External	
NAME OF MANUFACTURER :										
COUNTRY OF ORIGIN :										

DATE :

NAME OF TENDERER

STAMP & SIGNATURE

PLACE :

: 122 :

**SCHEDULE 'E'**

**NON RETURN VALVE DATA SHEET**

Nominal dia. DN & Type	Rating		Material				End Connection	Coating			Remarks
	P (bar)	Temp (C°)	Body	Seat	Disc	Shaft		Body inside	Disc	Outside	
NAME OF MANUFACTURER : COUNTRY OF ORIGIN :											

DATE :

NAME OF TENDERER

STAMP & SIGNATURE

PLACE :

: 123 :

**SCHEDULE 'F'**

**WATER METER DATA SHEET**

Nominal dia. DN & Type	Rating		Material		Metrological Class	Year of Manufacture	Maximum Registration of Counter	Recommended Flow		Body Length	Head Loss	Reading in Cu. Meter/ Gallons
	P (bar)	Temp (°C)	Body	Internal Parts				Maximum	Minimum			
NAME OF MANUFACTURER : COUNTRY OF ORIGIN :												

DATE :

NAME OF TENDERER

STAMP & SIGNATURE

PLACE :

**SCHEDULE 'G'****GRP PIPE/FITTINGS DATA SHEET****(For each diameter/pressure/service)**

DESCRIPTION	UNIT	(DN) NOMINAL DIAMETER		
Service (underground/above ground)	-			
Reference to proposed standard	-			
Maximum operating pressure	bar			
Max. allowable site test pressure	bar			
Max. allowable vacuum	bar			
Max. service temperature	Deg.C			
<u>PIPE WALL</u>				
Nominal total wall thickness	mm			
<u>Inner Liner</u>				
- Thickness	mm			
- Resin type				
- Glass type				
<u>Structural Wall</u>				
- Thickness	mm			
- Resin type				
- Glass type				
- Aggregate				
<u>Exterior Layer</u>				
- Thickness	mm			
- Resin type				
- Glass type				
Pipe Length	m			
Type of Joint				
Barcol Hardness	-			
UV resistance provided	-			

Contd.....(Schedule 'G')

DESCRIPTION	UNIT	(DN) NOMINAL DIAMETER		
<u>Mechanical Properties</u>				
Minimum initial specific stiffness - STIS	N/M2			
Initial longitudinal tensile strength	KN/M2			
Initial hoop tensile strength	KN/M2			
Minimum axial tensile strength	Mpa			
NAME OF MANUFACTURER : COUNTRY OF ORIGIN :				

DATE :  
PLACE :

NAME OF TENDERER

STAMP & SIGNATURE

**SCHEDULE 'H'**

**CONFORMITY/NON-CONFORMITY**

<b>S.No.</b>	<b>DESCRIPTION OF MATERIALS</b>	<b>CONFORM TO THE FEWA SPECS YES / NO</b>	<b>DEVIATION FROM THE SPECS IN DETAILS</b>

DATE :

NAME OF TENDERER

STAMP & SIGNATURE

PLACE :



**SIZES AND LENGTH OF BOLTS**

<b>Flange Size</b>	<b>Bolt Size &amp; length</b>	<b>NOS</b>
50 mm	M16x150	4
80 mm	M16x150	8
100 mm	M16x150	8
150 mm	M20x170	8
200 mm	M20x170	12
250 mm	M24x190	12
300 mm	M24x190	12
350 mm	M27x200	16
400 mm	M27x220	16
450 mm	M27x230	20
500 mm	M30x240	20
600 mm	M33x250	20
800 mm	M33x300	24