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General Specification of Main Laying Materials for Waterworks



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1. Purpose

This Standard provides “Materials Standards & Specifications Section’s Engineers” the specification of materials used for water works.

2. Scope

This Standard is applicable to all materials used for waterworks.

3. Responsibilities & Authorities

Responsibilities and authority for ensuring that the steps in this guideline shall be carried out are specified at relevant steps in the guideline and include:

- Manager, Water Planning Department
- Head, Materials Standards & Specifications Section
- Materials Standard Engineer.
- Materials Specification Engineer.

If the responsible personnel listed above are absent, these responsibilities shall be designated to the relevant staff.

4. Abbreviations & Terminology

KM : Qatar General Electricity and Water Corporation

KAHRAMAA : Qatar General Electricity and Water Corporation

WP : Water Planning

MSS : Materials Standards & Specifications Section

GIS : Geographical Information System

NDS : Planning & Network Development Section

Term	Description
BS	British Standard- one of the international standards used in General Specifications for main laying materials for waterworks
ISO	International Standards Organization - one of the international standards used in General Specifications for main laying materials for waterworks.
WRC	Water Research Council- international body who certifies the non-toxicity of material if contact with potable water.
Manufacturer	A company whose business is manufacturing a certain product
Material	An item intended to be used in a certain construction works or projects.
Specification	A detailed exact statement of particulars, especially a statement prescribing materials, dimensions and quality of work for something to be built, installed or manufactured.

Section – 1

General

1.1 SUITABILITY OF MATERIALS

- 1.1.1 All materials in direct contact with potable water must have a health certificate issued by Worldwide Known Quality Body Certifier with potable water of +50°C (See Appendix 'IV') in accordance with requirement of BS6920:2000 "Suitability of Non-Metallic Products for use in direct contact with Water Intended for Human Consumption with regards to their effect on the quality of water" and complies with KAHRAMAA Water Quality Requirements and GCC standards as detailed in Appendix 'I'
- 1.1.2 All materials shall be suitable for using with minimum working water temperature at 50° C, and all materials shall conform to PN16 standards.
- 1.1.3 The manufacturer shall supply new materials from any of the latest approved KAHRAMAA manufacturers list and furnish to Water Network Planning Department for review and approval.
- 1.1.4 All the relevant certificates of the materials/manufacturers must be in Original OR Notarized copy for Technical Evaluation and must be in Arabic or English language.

1.2 TRANSPORT & STORAGE OF MATERIALS

- 1.2.1 All materials handling, transporting and storing should comply with KAHRAMAA requirements and General Specifications for Main laying Materials and manufacturer recommendation to avoid damages due to handling.
- 1.2.2 All materials shall be stored according to environmental conditions detailed in Appendix 'II'.
- 1.2.3 Upon materials delivery to the Contractor's stores at site, the manufacturer responsibility to direct the contractor to unpack, open all crates etc., and unload to areas as directed by the Store controller or KAHRAMAA Site Engineer. The contractor shall provide all timbers and packing, necessary for the correct stacking of pipes, fittings and other delivered materials.
- 1.2.4 All Coated materials such as (Epoxy, Polyurethane, and Risen) shall be handled with special care during loading, transportation and unloading to avoid accidental damage, and must be stored far from sunlight.
- 1.2.5 All Pipes and fittings must be stacked off the ground on 150 x 100 cm timber skids to be provided by the Contractor. The stacking shall be done according to the manufacturer's recommendations. Taking into consideration that stacked area should be compacted or graveled.

- 1.2.6** All materials which are subject to deterioration by Ultraviolet Light such as Rubber epoxy gaskets, fixing materials, instruments, polyethylene sheeting etc. must not be exposed to direct sunlight.

1.3 MANUFACTURER 'S CERTIFICATION

- 1.3.1** The Applicant must have a valid ISO 9001 Certificate issued by the granting certifier body holding BS EN ISO/IEC 17021:2011 certificates.
- 1.3.2** The applicant must have successful records of experiences for supplying of minimum 15 years in International market and 5-year minimum in regional / GCC market for prequalifying.
- 1.3.3** Provide the QA/QC plan.
- 1.3.4** Provide organization chart including personals Crucial Vita.
- 1.3.5** All certificates must be in Original OR Notarized copy
- 1.3.6** All certificates must be in Arabic OR English language.

1.4 STANDARDS

- 1.4.1** The Tenderer shall follow the latest KAHRAMAA General Specifications of Main laying Materials for Waterworks.
- 1.4.2** In case of material's specification were not mentioned in this document, the Tenderer shall follow the latest edition of one of the following appropriate relevant standards such as BS, ISO, EN or DIN with all subsequent amendments up to the year of the materials order. Submit complete documents to Water Network Planning department for further evaluation.

1.5 MATERIAL COATING & INTERNAL COMPONENTS

- 1.5.1** All materials in direct contact with potable water must have a health certificate issued by Worldwide Known Quality Body Certifier (See Appendix IV) as per requirement of BS6920:2000 "Suitability of Non-Metallic Products for use in contact with Water Intended for Human Consumption with regards to their effect on the quality of Water"
- 1.5.2** Coating shall be smooth, and mirror finish without any air bubbles or pebbles, and the thicknesses shall as per the relevant specifications given below;
- I. The minimum thickness is 300-micron Fusion bonded epoxy (Polymeric anticorrosion) coating as per WIS No. 4-52-01.
 - II. The minimum thickness is 300-micron Electrostatic ally applied epoxy coating.
 - III. The minimum thickness is 300-micron Fluidized bed epoxy coating.
- 1.5.3** The coating quality shall conform to the following tests as per the relevant specifications given below:
- **Adhesion Test:** Coating adhesion to metal shall not be less than 12N/mm² (BSI BS EN ISO 4624).

- **Holiday Test:** Coating porosity shall be “zero” on 3 kV DC tester.
- **Hardness:** Intrinsic Rockwell hardness shall be between 50 - 60, according to DIN EN ISO 2815.
- **Impact resistance:** For applying of impact energy of 5 Nm on coating the cracks should not be developing, when tested by 3 kV DC tester.

1.6 INSPECTION AND TESTING

- 1.6.1** Pre-Inspection Arrangement shall comply with the requirements as per the attached procedure. (See Appendix V).
- 1.6.2** All materials shall be inspected and tested to ensure compliance with KAHRAMAA requirements and General Specifications for Main laying Materials. The testing shall be carried out according to relevant standards approved by Water Network Planning Department.
- 1.6.3** KAHRAMAA have the right to test any materials before they leave the manufacturer’s premises or after delivery to the site.
- 1.6.4** KAHRAMAA have the right to reject any non-compliant materials after delivery to the site, notwithstanding any preliminary test approval of the materials at the manufacturer’s premises.
- 1.6.5** The cost of all tests necessary to ensure compliance with the Project Documentation, shall be borne by the Contractor/ Manufacturer.
- 1.6.6** The number of samples to be tested must be not less than One Number of each size of the ordered materials at accredited laboratory.
- 1.6.7** KAHRAMAA reserves the right to witness the FAT and provide comments/rejection of the material.
- 1.6.8** The manufacturer shall always allow access during manufacturing and testing to the premises in which the material being manufactured.
- 1.6.9** Upon receipt of materials at the contractor's site store, materials to be inspected by Supervising Consultant of the subject project.
- 1.6.10** Upon KAHRAMAA Engineer receipt of the Materials Request for Inspection, he will visit the contractor store. If any damage on the Pipe’s / Fitting’s is observed and it can be repaired, it's the contractor's responsibility to perform the repair in accordance with the manufacturer's recommendations and the approval of KAHRAMAA - repair works should be carried under direct supervision of the manufacturer.
- 1.6.11** KAHRAMAA reserves the right to reject the supplied material during final inspection or at later date, if found not as per the General Specification and will have the right

to put the Manufacturer under “ON HOLD “or “BLACKLISTED “until further action.

1.6.12 The non-repairable rejected materials, which were not complying with KM Specifications during inspection and marked by the Engineer (rejected), must be removed by the Contractor and to be shipped outside State of Qatar and proof of shipping documents to be submitted to KAHRAMAA.

1.6.13 KAHRAMAA reserves the right to witness all types of testing locally, and the tests shall be carried out in accordance with applicable standards and codes.

1.6.14 Upon project requirement KAHRAMAA reserves the right to request the following Inspection certificates as per BS EN 10204:2004 (Type 3.1 and Type 3.2)

1.7 PACKING

1.7.1 The material/item shall be packed in compliances with KM and Manufacturer recommendation and procedure.

1.7.2 At Site, (from the pre-Inspection arrangement) all items shall be packed individually and put into the wooden box, which shall be close and open type. Every layer in wooden box shall be clamped properly to avoid abrasion during transit and damage to coating.

1.7.3 The cutting of pipes shall be kept to a minimum and after cutting the remaining length of calibrated pipes shall be suitably marked and re-stacked together with the remaining calibrated pipes.

1.8 TECHNICAL CLARIFICATION

1.8.1 In case there are disputes, KAHRAMAA shall have the right to ask the manufacturer all the technical documents that will help in clarifying this dispute.

1.9 SAMPLES

1.9.1 Samples shall be provided when required by the engineer or instructed by the project documentation. Materials subsequently supplied shall conform to the quality of the samples which have been approved by the engineer.

1.9.2 Each sample shall bear a securely fixed label bearing the following information:

- I. Project Identification.
- II. Contractor Identification.
- III. Sample Identification including all information as to Manufacturer, Model Number, and Catalogue Number.

1.9.3 Materials subsequently supplied shall conform to the quality of the samples which have been approved by the engineer.

1.10 WARRANTY

1.10.1 All materials must be subject to warranty minimum period of 5 years; the duration of warranty is subject to evaluation of KAHRAMAA.

1.10.2 The applicant shall ensure the availability of after sales support, services and spare parts in Qatar.

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Section - 2

Ductile Iron Pipes and Fittings

2.1 GENERAL

These Clauses Shall Be Read in Continuation of Section 1 of This Specification.

2.1.1 All pipes and fittings shall be manufactured and tested from approved grade of ductile iron, accordance to BSEN-545:2006/ ISO 2531:1998, 4179:2005, 8179-1:2004 including any subsequent amendments and as specified below.

2.2 CLASS OF PIPES AND FITTINGS

2.2.1 Ductile iron spigot and socket pipe shall be Class K-9.

2.2.2 Ductile iron fittings shall be Class K-12, and branch fittings shall be Class K-14.

2.3 JOINTS

2.3.1 Spigot, socket pipes & fittings joints shall be provided with approved integrally cast 'push-in' type joints, each joint being supplied with an approved jointing- ring designed by the manufacturer solely for the purpose of sealing the joint., with an approved EPDM Rubber gasket to EN 681-1/ISO 4633, type WA.

2.3.2 Collars shall be Mechanical Joint Type, suitable for normal pressure PN16.

2.3.3 Mechanical Joint Collars shall be supplied with accessories. Glands shall be made of ductile iron; fasteners shall be made of ductile iron or mild steel hotdip galvanized with minimum thickness of 70 micron and Gaskets shall be EPDM type.

2.3.4 All flanged pipes shall be integrally casted flanges.

2.3.5 All non-standard flanged pipes sizes between DN50 to DN600 accepted to be integrally casted, or screwed drilled to BS EN 1092:1997-2, PN16.

2.3.6 All flanged pipes and fittings used in pump stations shall be integrally casted

2.3.7 All flanged pipes and fittings shall be supplied with approved EPDM multilayer cotton reinforced rubber gasket accordance to EN 1514-1 as per section 21; which in comply with the requirement of BS6920:2000 and shall be kept in a sealed sun proof bag with written information of the same.

2.3.8 The manufacture specification of all-joint details, gaskets and jointing rings shall be supplied to the Engineer by the Tenderer / Contractor for approval.

2.3.9 All jointing materials shall comply with Clause 1.1.1 of this specification.

2.4 LENGTH OF PIPES

2.4.1 All pipes shall be supplied in the lengths minimum 5.50 meters or as per project requirement.

2.5 MARKING

2.5.1 All pipes & fittings shall be marked in accordance with BSEN-545:2006/ISO-2531:1998 as following:

- Manufacturer's name or logo;
- Year of manufacture;
- The identification as ductile iron;
- The DN;
- The PN rating of flanges when applicable;
- Reference to standard;
- Class Designation (K9, K12 or K14)

2.5.2 The first five markings given above shall be cast-on; the other markings can be applied by any method, e.g. painted on the casting or attached to the packaging.

2.5.3 Additional marking on the pipes and fittings must be included such as;

- Tender Number
- Contractor's Name

2.6 CERTIFICATE OF TEST

2.6.1 Upon the Tenderer / Contractor shall provide signed certificates accredited by third party stating the results of all tests as specified in BSEN 545:2006 / ISO 2531:1998, 4179:2005, 8179-1:2004 and BS 3416:1991.

2.6.2 KAHRAMAA reserves the right to witness the required tests such as tensile, mechanical (physical), and chemical tests according to BSEN 545:2006, test pieces selected based on not less than one test piece for every batch of items.

2.6.3 Where specified tests are to be witnessed, the tests shall be carried in accordance with the manufacturer's quality control procedure of the relevant international standard.

2.7 EXTERNAL & INTERNAL COATING OF DUCTILE IRON PIPES & FITTINGS DURING MANUFACTURING

2.7.1 All materials shall conform and meet all the requirements of BSEN545:2006/ISO2531:1998, ISO4179:2005, ISO8179:2004, BS3416:1991 and BS6920:2000.

- 2.7.2** All ductile iron pipes and fittings shall be internally lined by centrifugal method with 1+0 Resistance Cement (SRC) mortar lining as per requirement of BSEN 545:2006 or ISO 4179:2005 or coated internally by epoxy coating.
- 2.7.3** Ductile Iron Pipes and Fittings shall be cured in curing chambers.
- 2.7.4** For Ductile Iron Pipes and Fittings coated with epoxy externally or internally, it shall be conformed one of the following methods;
- Fusion bonded epoxy coating shall be minimum thickness 300-micron (Polymeric anticorrosion) coating as per WIS 4-52-01, EN 14901, ISO 18468 or DIN 30677
 - Electrostatic ally applied epoxy coating shall be minimum thickness 300 micron.
 - Fluidized bed epoxy coating shall be minimum thickness 300 micron.
 - The color of coating shall be “Blue”, Code RAL-5002/5005/5010/5012/5015/5017/5022, “Black”, Code RAL-9004/9005/9011/9017, or “Grey” Code RAL-7000/7001/7011/7012.
- 2.7.5** The external coating for pipes / fittings shall be of metallic Zinc coating of 130 g/m² on pipes and Zinc rich paint coating of 150 gm/m² on Ductile Iron Fittings as per BSEN 545:2006 or ISO 8179-1:2004.
- 2.7.6** The external finishing layer to all pipes and fittings after the application of the Zinc coating shall be of bitumen coating as per BS3416:1991, Type 2. The mean thickness shall be not less than 70 µm and the local minimum thickness not less than 50 µm.
- 2.7.7** The internal cement lining shall be uniformed and smooth as possible and shall be within the tolerance limit acceptable by the International standards.
- 2.7.8** The thickness of internal cement lining in Ductile Iron Pipes & Fittings shall be as follows in accordance with BSEN 545:2006 as follows (See table 01):

Table (01) Thickness of Internal Cement Lining

Nominal Size	Thickness
80-300mmØ	4.0mm
350-600mmØ	5.0mm
700-1200mmØ	6.0mm
1400-2000mmØ	9.0mm

- 2.7.9** The contractor shall supply confirmation from manufacturer that cement lining to be used is suitable for use with the range of chemical characteristics of water detailed in Appendix “I.”
- 2.7.10** The internal section of sockets of pipes and fittings shall be painted with a minimum 100-micron thick epoxy coating. The coating shall be suitable for use in contact with potable water at +50° C.

2.8 FACTORY APPLIED POLYETHYLENE EXTERNAL COATING

- 2.8.1** The factory applied polyethylene external coating shall be applied by extrusion or any other approved method as per BSEN 14628:2005 (Ductile iron pipes, fittings and accessories External polyethylene coating for pipes Requirements and test methods).
- 2.8.2** The factory applied polyethylene external coating shall be type PE-D pipe zinc-coated with minimum thicknesses accordance with BSEN 14628:2005 as follows (See table 02):

Table (02) Minimum Coating Thicknesses

Nominal Size	Thickness
80-250mmØ	2.5mm
300-450mmØ	3.0mm
500-1200mmØ	3.5mm
1400-2000mmØ	4.0mm

- 2.8.3** The color code of polyethylene external coating shall be Blue color RAL-5002/5005/5010/5012/5015/5017/5022.

2.9 PROTECTION OF ABOVE GROUND & INSIDE CHAMBERS DUCTILE IRON PIPES & FITTINGS

- 2.9.1** External coating of ductile iron pipes & fittings to be laid above ground or inside chambers shall be coated with zinc primer as per ISO 8179:2004, and then followed by an application of bituminous finish coating. Bituminous finish coating shall contain aluminum of not less than 20% in the dry film and shall be in silver.
- 2.9.2** The internal section of sockets of pipes and fittings shall be painted with a minimum 100-micron thick epoxy coating. The coating shall be suitable for use in contact with potable water at +50° C.

2.10 SPECIAL PROTECTION OF DUCTILE IRON PIPES & FITTINGS

- 2.10.1** External coating of ductile iron pipes & fittings to be laid on location of high-water table shall be coated with Polyurethane/Epoxy coating with minimum thickness of 300 microns.
- 2.10.2** Ductile iron pipes and fittings which are completely immersed in water (i.e. piping inside reservoir) shall be coated with a minimum 300microns thickness fusion bonded epoxy.

2.11 PIPE CUTTING

- 2.11.1** Unless specified otherwise the Contractor shall supply a minimum of 2% of pipes of each diameter gauged (calibrated) along two third of the pipe entire length starting from the spigot end. These pipes shall be clearly marked by the factory and stored separately in the Contractor's store yard.
- 2.11.2** Where it is necessary to cut pipes, the cutting shall be neatly and accurately performed by machine so as to leave the pipe end a true circle and normal to the pipe axis and the cut ends

shall be chamfered and painted as per manufacturer's recommendations for damaged coatings and generally to the original coating (Zinc & Primer / Epoxy) of the Ductile Iron pipes and fittings.

2.12 PACKING

2.12.1 The packing shall be as per Section 1, Clause 1.7 of this specification.

2.12.2 Pipes of small diameters shall be packed in bundles. Every pipe shall be separated from each other with the help of properly designed wooden spacers. The bundle shall be secured firmly with proper straps and well faced wooden base supports for proper transport, handling and storage. Every bundle shall have only one length of pipe.

2.12.3 For big diameters, it should be supplied separately.

2.12.4 All pipes and fittings shall be supplied with plastic end caps & shall be maintain in good condition until the pipe is ready to be installed in the trench.

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Section - 3

Slip-On Coupling, Flange Adaptors, Dismantling Joints and Gripper Couplings

3.1 GENERAL

These clauses shall be read in continuation of Section 1 of this Specification.

3.2 SLIP-ON COUPLINGS

- 3.2.1 Slip-on couplings shall be manufactured from either Ductile Iron or Rolled Steel and shall be designed and tested in accordance to EN 14525:2004 / BS 8561:2013.
- 3.2.2 Slip-on couplings shall be suitable for use with ductile iron pipes to BSEN 545 / ISO 2531 up to DN500 mm and for sizes from DN600 mm and above mechanical collar shall be used.
- 3.2.3 Slip-on couplings shall be suitable for normal pressure PN16.
- 3.2.4 Slip-on couplings shall be of the following properties as given in Table (03).

3.3 FLANGE ADAPTORS

- 3.4.1 Flange Adaptors shall be manufactured from either Ductile Iron or Rolled Steel and shall be designed and tested in accordance to EN 14525: 2004 / BS 8561:2013.
- 3.4.2 Flange Adaptors shall be suitable for use with ductile iron pipes to BSEN 545 / ISO 2531.
- 3.4.3 Flange adaptors shall be suitable for jointing the flanges to PN16 according to EN 1092/ISO 7005
- 3.4.4 Flange Adaptors shall be of the following properties as given in Table (03).

3.4 DISMANTLING JOINTS

- 3.5.1 Dismantling Joints shall be manufactured from either Ductile Iron or Rolled Steel and shall be designed and tested in accordance to EN 14525: 2004 / BS 8561:2013.
- 3.5.2 Dismantling Joints are designed for flanged pipe systems and shall therefore be suitable for jointing the flanges to PN16 according to EN 1092/ISO 7005
- 3.5.3 Dismantling Joints shall be of the following properties as given in Table (03).

3.5 GRIPPER COUPLINGS/FLANGE ADAPTORS

- 3.6.1 Gripper Couplings/Flange Adaptors shall be manufactured from either Ductile Iron or Rolled Steel and shall be designed and tested in accordance to EN 14525: 2004 / EN 12842:2012 / BS 8561:2013.

3.6.2 Gripper Couplings/Flange Adaptors shall be suitable for joining between PE pipe (PE100, SDR11) to Ductile Iron pipe, for restraint on PE Pipes a support liner is required.

3.6.3 Gripper Couplings/Flange Adaptors shall be suitable for joining between PE pipe to PE pipe (PE100, SDR11), for restraint on PE Pipes a support liner is required.

3.6.4 Gripper Couplings / Flange Adaptors properties shall be as per Table (03).

3.6 MATERIALS OF SLIP-ON COUPLINGS, FLANGE ADAPTORS, DISMANTLING JOINTS, & GRIPPER COUPLINGS

3.6.1 The Slip-on Couplings, Flange Adaptors, Dismantling Joints, & Gripper Couplings shall be of following properties as given in Table (03).

Table (03) Properties of Slip-on Couplings, Flange Adaptors, Dismantling Joints, & Gripper Couplings

Materials	Relevant Standards
Body/Center Sleeve/ End Rings	Ductile Iron. to BS EN 1563 :2011/ISO 1083 :2004, Grade EN-GJS-450-10/ EN-GJS-500-7, ISO 450-10/ ISO 500-7/ EN 14525 :2004, EN-GJS-400-15
	Rolled Steel to BS EN 10025-2: 2004 Grade S275
Gasket	EPDM Rubber as per EN 681-1:1996 or ISO 4633:2002; Hardness Class 60-70
Fasteners	Shall be Austenitic Stainless-Steel Grade A4 or Grade 316/316L (1.4401/1.4404)
	Low Carbon (Mild) Steel, Hot Dip Galvanized with minimum coating thickness 70 micron in accordance with WIS 4-52-03, EN ISO 10684 or BS EN ISO 1461.

3.7 MATERIAL COATING & INTERNAL COMPONENTS

3.7.1 The entire body shall be coated both internally and externally with either of the following:

- 300-micron Fusion bonded epoxy (Polymeric anticorrosion) coating as per GSK or WIS No. 4-52-01.
- 300-micron Electrostatic ally applied epoxy coating.
- 300-micron Fluidized bed epoxy coating.

3.7.2 In special cases, Rilsan coating with 300 microns can be approved.

3.7.3 The color of coating shall be “Blue”, Code RAL-- 5002/5005/5010/5012/5015/5017/5022 or “Black”

- 3.7.4 All materials coating shall be WRC, DVGW, SGS, and DWI., KIWA, NSF 61 or other Worldwide Known Quality Body Certifiers in contact with potable water at +50°C.
- 3.7.5 All casting shall be properly finished, sand blasted and cleaned before coating
- 3.7.6 Coating shall be smooth, and mirror finish without any hairline cracks/ air bubble/ pinhole.
- 3.7.7 **Adhesion Test:** Adhesion of coating to metal shall not be less than 12N/mm².
- 3.7.8 **Holiday Test:** Porosity of coating shall be “zero” on 3 kV DC tester.
- 3.7.9 **Hardness:** Intrinsic Rockwell hardness shall be between 50 - 60, according to DIN EN ISO 2815.
- 3.7.10 **Impact resistance:** For applying of impact energy of 5 Nm on coating the cracks should not develop and shall be tested by 3 kV DC tester.

3.8 MARKING

- 3.8.1 It is mandatory that all Couplings, Flange Adaptors, and Dismantling Joints shall have clearly marked in the casting of the body the following information;
- A. Size of valve DN in mm.
 - B. Pressure rating PN in Bars.
 - C. Manufacturer name / logo.
 - D. Identification of Material type
 - E. Manufacturing Standards Number.
 - F. Year of manufacture.
 - G. Identification of the minimum and maximum outside diameters (range of external diameters over which the product works);
- 3.8.2 All Couplings, Flange Adaptors, and Dismantling Joints shall have individual identification strip which shall be marked by engraving or embossing on a metal strip, the name of manufacturer, individual serial number, tender number, Year of manufacturing, the DN, and the PN rating.
- 3.8.3 The metal strip shall be of minimum size of 100mm x 30mm and shall be fixed securely and permanently at appropriate location by glue of industrial grade with a melting point higher than 80°C and shall not be screwed or riveted.

3.9 PACKING

- 3.7.1 The packing shall be as per Section 1, Clause 1.7 of this specification.

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Section - 4

Corrosion Protection of Ductile Iron Pipes, Fittings & Accessories

4.1 GENERAL

These clauses shall be read in continuation of Section 1 of this Specification.

4.2 BITUMINOUS WRAPPING TAPE

- 4.2.1 Bituminous tapes shall be manufactured and tested according to EN 12068, ISO 21809 and DIN 30672.
- 4.2.2 Bituminous tapes shall be of high mechanical resistance and for use at service temperature up to 60 °C as specified in EN 12068 and DIN 30672.
- 4.2.3 Bituminous tapes shall be supplied with width of 150 mm and 225 mm and with minimum length 25 m up to 75 m per rolls
- 4.2.4 The tape shall be supplied with a wider high-quality silicon release paper covering complete tape and both sides of the tape shall have a minimum of 5mm wider silicon release paper to prevent edge contamination.

4.3 BITUMINOUS WRAPPING TAPE PROPERTY

- 4.3.1 The wrapping tape shall be conforming to the following specifications given in table below.

Table (04) Bituminous Wrapping Tape Property Data Sheet

SR. No.	Property	Test Standards	Unit	Data
A.	Physical			
1	Color			
1.1	Backing	---	---	Blue RAL 5002/5005/5010/5012/5015/5017/5022.
1.2	Adhesive Compound	---	---	Black
1.3	Release Paper	---	---	White/Cream
B.	Mechanical			
2	Backing Type (Outer layer)	---	---	PVC
3	Backing Thickness Min.	---	mm	0.75
4	Adhesive Thickness Min.	---	mm	0.75
5	Total Thickness Min.	---	mm	1.5
6	Elongation	BS 2782	%	≥ 270
7	Tensile Strength at 23° C	EN 12068	N/mm	≥ 10
8	Tear Strength	ASTM D1004	N	≥ 35
9	Impact Resistance at 23° C	EN 12068	Nm	≥ 15
10	Microbiological resistance	EN 12068 /ASTM G21		Observed Growth: None
11	Adhesion to primed pipe surface	ASTM D 1000	N/mm	≥ 2.75
12	Adhesion to Tape	ASTM D 1000	N/mm	≥ 2.75
	Pressure		N/mm ²	≥ 10

13	Indentation resistance at 23° C and T _{max} ,	Holiday detection	EN 12068	-	pass
		Residual thickness		mm	≥ 0.6
B.	Electrical				
13	Dielectric Strength		ASTM D149	kV	≥ 40
14	Specific Electrical Insulation resistance		EN 12068	Ωm ²	≥ 10 ⁸
15	Cathodic disbandment resistance at 23° C, 28 days		EN 12068; ASTM G 8	mm	≤10
C.	General				
16	Water vapor Permeability		BS 2782, ASTM E 96	g/m ² /24h	≤ 0.4
17	Water Absorption		ASTM D 570	%	≤ 0.2
D.	Temperature Range				
18	For wrapping		---	° C	0 to + 60
19	In service		---	° C	0 to + 60
20	For storage		---	° C	up to 30
E	Shelf Life				
21	Shelf life		---	year	≤ 2

4.4 APPLICATION OF THE BITUMINOUS TAPES

- 4.4.1 For Pipe diameters up to 200 mm, 150 mm width tape shall be used. For diameters 300 mm and above, 225 mm width tape shall be used.
- 4.4.2 To increase the wrapping protection efficiency, pipe diameters up to 300mm must be wrapped using semi-Automatic Tape Wrapping Machine and for pipe diameters above 300mm, Fully Automatic Wrapping Machine should be used.
- 4.4.3 For all types of fitting with diameters 100 mm and above, 150 mm width tape shall be used.
- 4.4.4 For normal application, high-water table, (Sabkha), high resistivity or contaminated areas, the wrapping tape shall be 55% overlap with enough tension in accordance with manufacturer instructions to ensure complete conformability and smoothed out as application proceeds to avoid air pockets.
- 4.4.5 Surface preparation shall be cleaned in accordance with manufacturer recommendations.
- 4.4.6 The wrapped Pipes / joints shall be holiday tested according to EN 12068, ISO 21809 and DIN 30672 and the porosity shall be “zero” on a DC voltage of 5 kV + 5 kV/mm of original thickness of the coating.

4.5 NON-CRYSTALLINE LOW-VISCOSITY POLYOLEFIN-BASED WRAPPINGS TAPES

- 4.5.1 The specification of Non-crystalline low-viscosity polyolefin (e.g. polyisobutylene, other polybutene's, or atactic polypropylene) based tape shall be Type 13 A according to ISO

21809-3. This tape shall consist of a polyolefin-based corrosion preventing compound (Adhesive) and a polymeric outer wrap tape (backing).

4.5.2 The Non-crystalline low-viscosity polyolefin-based tapes shall be of high mechanical resistance and for use at service temperature up to +60 °C

4.5.3 The tape shall be supplied with width of 100 mm and 200 mm and with length minimum 20 meter.

4.5.4 The tape shall be supplied with a wider high-quality silicon release paper covering complete tape and both sides of the tape shall have a minimum of 5mm wider silicon release paper to prevent edge contamination.

4.6 NON-CRYSTALLINE LOW-VISCOSITY POLYOLEFIN-BASED WRAPPING TAPE PROPERTY

4.6.1 The wrapping tape shall be as per table below which is based on ISO 21809-3 and EN 12068:

Table (05) Non-crystalline low-viscosity polyolefin-based Data Sheet

Property		Test Temp.	Unit	Requirements		Test Method
Non-crystalline low-viscosity polyolefin compound (Adhesive)						
Minimum thickness		23 °C	mm	0.75 mm		ISO 21809-3
Glass transition temperature		-	°C	< Minimum application temp minus 20		ISO 11357-2
Drip resistance		minimum +80 °C		No dripping of the compound		ISO 21809-3
Specific electrical insulation resistance	- R _{S100}	23 °C	Ω.m²	≥ 10 ⁸		ISO 21809-3
	- R _{S100} /R _{S70}			≥ 0,8		
Peel strength test and adhesion test of the reinforced compound with respect to pipe and to plant coating before and after thermal ageing resistance and before and after hot water immersion test, both for 100 days at T _{max} + 20 °C		23 °C	N/mm	≥ 0.04	Cohesive separation mode Coverage ≥95 %	ISO 21809-3
		T _{max}		≥ 0.02		
Lap Shear Test		23 °C	N/mm²	≥ 0.004	Cohesive separation mode Coverage ≥95 %	ISO 21809-3
		T _{max}		≥ 0.002		

Outer wrap — Polymeric tape (Backing)				
Peel strength outer layer to outer layer	23 °C	N/mm	≥ 0.2	ISO 21809-3
	T_{max}		≥ 0.02	
Peel strength of outer layer to backing of compound	23 °C	N/mm	≥ 1.0	
	T_{max}		≥ 0.1	
Peel strength ratio (layer to-layer and to compound tape) after hot water immersion for 100 days at T_{max} 95 °C.	23 °C	-	≥ 0.75	ISO 21809-3
Peel strength ratio (layer to-layer) after thermal ageing for 100 days at $T_{max} + 20$ °C	23 °C	-	≥ 0.5	ISO 21809-3
Peel strength ratio (layer to compound tape) after hot water immersion for 100 days at T_{max} 95 °C.	23 °C	-	≥ 0.75	ISO 21809-3
Complete wrapping				
Backing Color	-	-	Blue RAL 5002/5005/5010/5012/5015/5017/5022	
Adhesive Color	-	-	Cream /Off-White	
Minimum total thickness	23 °C	mm	1.5 mm	ISO 21809-3
Holiday detection at 5 kV/mm + 5 kV	-	-	No holiday	ISO 21809-3
Impact resistance	23 °C	J	≥ 15 No Holiday detection at 5 kV/mm + 5 kV	EN12068/ ISO 21809-3
Indentation resistance	Pressure	23 °C and T_{max}	N/mm ²	ISO 21809-3
	Residual thickness		mm	
Cathode disbandment resistance at 28 days	23 °C and T_{max}	mm	0 mm, no holiday Self-Healing*	Annex F (and Annex B)
Microbiological Resistance	23 °C	-	pass	EN 12068 /ASTM G21
Water absorption	23 °C	%	< 0.02	ASTM D570
Water vapor permeability	23 °C	g/m ² /day	<0.2	ASTM E96
Temperature for wrapping	-	°C	- 20°C to +60°C	-
Temperature In service	-	°C	-45°C to +60°C	-
Temperature for storage	-	°C	up to 30°C	-

4.7 APPLICATION OF THE NON-CRYSTALLINE LOW-VISCOSITY POLYOLEFIN-BASED TAPES

- 4.7.1 For Pipe diameters up to 200 mm, 100 mm width tape shall be used. For diameters 300 mm and above, 200mm width tape shall be used.
- 4.7.2 To increase the wrapping protection efficiency, pipe diameters up to 300mm must be wrapped using semi-Automatic Tape Wrapping Machine and for pipe diameters above 300mm, Fully Automatic Wrapping Machine should be used.
- 4.7.3 For all types of fitting with diameters 100 mm and above, 100 mm width tape shall be used.
- 4.7.4 For normal application, minimum 15mm overlap is required. In case of high-water table, (Sabkha), high resistivity or contaminated areas, the wrapping tape shall be 55% overlap with enough tension in accordance with manufacturer instructions to ensure complete conformability and smoothed out as application proceeds to avoid air pockets.
- 4.7.5 The substrate should be free from condensing water which can be reached by keeping the temperature at least 3°C above dew point. The substrate should be dry, clean and protected against negative weather influences.
- 4.7.6 The area to be coated must be clean, dry, and free from oil, grease and dust. All contamination including mill-scale must be removed. De-gloss and degrease the surfaces by using an abrasive pad and isopropyl alcohol, e.g. a lint-free cloth.
- 4.7.7 The wrapped Pipes / joints shall be holiday tested and the porosity shall be “zero” on a DC voltage of 5 kV + 5 kV/mm of original thickness of the coating

4.8 POLYMERIC WRAPPING TAPE

- 4.8.1 Polymeric tapes shall be manufactured and tested according to EN 12068 and ISO 21809.
- 4.8.2 Polymeric tapes shall be of high mechanical resistance and for use at service temperature up to 60 °C as specified in EN 12068 and DIN 30672.
- 4.8.3 Polymeric tapes shall be supplied with width of 150 mm and 225 mm and with length minimum 25 m.
- 4.8.4 The tape shall be supplied with a wider high-quality silicon release paper covering complete tape and both sides of the tape shall have a minimum of 5mm wider silicon release paper to prevent edge contamination.

4.9 POLYMERIC WRAPPING TAPE PROPERTY

- 4.9.1 The polymeric tape shall conform to the minimum requirements given in Table 04 which are based on ISO 21809-3 and EN 12068:

Table (06) Polymeric Wrapping Tape Property Data Sheet

Property		Test Temp.	Unit	Requirements	Test Method
Backing Color		-	-	Blue RAL 5002/5005/5010/5012/5015/5017/5022.	
Adhesive Color		-	-	Grey	
Backing thickness		23 °C	mm	≥ 0.4 mm	ISO 21809-3 /EN 12068
Adhesive thickness		23 °C	mm	≥ 0.6 mm	ISO 21809-3 /EN 12068
Holiday detection at 5 kV/mm + 5 kV		-	-	No holiday	ISO 21809-3 /EN 12068
Impact resistance		23 °C	J	≥ 15 No Holiday detection at 5 kV/mm + 5 kV	EN12068/ ISO 21809-3
Indentation resistance,	Pressure	23 °C and T _{max}	N/mm ²	10	EN12068/ ISO 21809-3
	Residual thickness		mm	≥ 0.6	
Specific electrical insulation resistance	- R _{S100}	23 °C	Ω.m ²	≥ 10 ⁸	EN12068/ ISO 21809-3
	- R _{S100} /R _{S70}			≥ 0.8	
Cathode disbandment resistance at 28 days		23 °C	mm	≤15 mm	EN12068/ ISO 21809-3
Lap Shear Test		23 °C	N/mm ²	≥ 0.05	EN12068/ ISO 21809-3
		T _{max}		≥ 0.05	EN12068/ ISO 21809-3
Peel strength layer to layer	Inner to inner and outer to inner	23 °C	N/mm	≥ 1.5	EN12068/ ISO 21809-3
		T _{max}		≥ 0.2	
	Outer to outer	23 °C		≥ 0.2	
		T _{max}		≥ 0.2	
Peel strength to pipe surface		23 °C	N/mm	≥ 1	EN12068/ ISO 21809-3
		T _{max}		≥ 0.1	
Peel strength to plant-coating		23 °C	N/mm	≥ 0.4	
		T _{max}		≥ 0.04	
Peel strength to pipe surface after hot water immersion for 28 days at 50 °C or 80 °C.		23 °C	N/mm	≥ 0.4	EN12068/ ISO 21809-3
Peel strength to plant-coating after hot water immersion for 28 days at 50 °C.				≥ 0.4	
Microbiological Resistance		23 °C	-	pass	EN 12068 /ASTM G21
Water absorption		23 °C	%	< 0.02	ASTM D570
Water vapor permeability		23 °C	g/m ² /day	<0.2	ASTM E96
Temperature for wrapping		-	°C	- 20°C to +60°C	-
Temperature In service		-	°C	-45°C to +60°C	-
Temperature for storage		-	°C	up to 30°C	-

4.10 APPLICATION OF THE POLYMERIC TAPES

- 4.10.1 For Pipe diameters up to 200 mm, 150 mm width tape shall be used. For diameters 300 mm and above, 225 mm width tape shall be used.
- 4.10.2 To increase the wrapping protection efficiency, pipe diameters up to 300mm must be wrapped using semi-Automatic Tape Wrapping Machine and for pipe diameters above 300mm, Fully Automatic Wrapping Machine should be used.
- 4.10.3 For normal application, minimum 25mm overlap is required. In case of high-water table, (Sabkha), high resistivity or contaminated areas, the wrapping tape shall be 55% overlap with enough tension in accordance with manufacturer instructions to ensure complete conformability and smoothed out as application proceeds to avoid air pockets.
- 4.10.4 Surface preparation shall be cleaned in accordance with manufacturer recommendations.
- 4.10.5 The wrapped Pipes / joints shall be holiday tested according to EN 12068, ISO 21809 and DIN 30672 and the porosity shall be “zero” on a DC voltage of 5 kV + 5 kV/mm of original thickness of the coating.

4.11 PETROLATUM WRAPPINGS TAPES

- 4.11.1 Petrolatum tapes shall be manufactured and tested according to EN 12068 and ISO 21809
- 4.11.2 Petrolatum tapes shall have a good mechanical resistance and for use at service temperature up to 50 °C

4.12 PETROLATUM WRAPPING TAPE PROPERTY

- 4.12.1 The petrolatum tape shall conform to the minimum requirements given in Table 07:

Table (07) Petrolatum Wrapping Tape Property Data Sheet

Property		Test Temp.	Unit	Requirements	Test Method
Color		-	-	Brown	
Thickness		-	mm	≥ 1.0 mm	ISO 21809-3 /EN 12068
Holiday detection (at 5 kV/mm + 5 kV)		-	V	No holiday	ISO 21809-3 /EN 12068
Impact resistance (No Holiday detection at 5 kV/mm)		23 °C	J/mm	≥ 0.8	EN12068/ ISO 21809-3
Indentation resistance,	Pressure	23 °C and T_{max}	N/mm ²	0.1	EN12068/ ISO 21809-3
	Residual thickness		mm	≥ 0.6	
Specific electrical insulation resistance	- R_{S100}	23 °C	$\Omega.m^2$	$\geq 10^6$	EN12068/ ISO 21809-3
	- R_{S100}/R_{S70}		-	≥ 0.8	
Cathode disbandment resistance at 28 days		23 °C	mm	≤ 20 mm	EN12068/ ISO 21809-3
Peel strength to pipe surface and plant-coating		23 °C	N/mm	Shall leave a film of compound, visible	EN12068/ ISO 21809-3

			without magnification, on the entire surface of the substrate	
Peel strength to pipe surface and plant-coating before and after hot water immersion for 28 days at 30 °C	23 °C	N/mm	Shall leave a film of compound, visible without magnification, on the entire surface of the substrate	EN12068/ ISO 21809-3
Drip resistance	45 °C		No dripping of the compound	EN12068/ ISO 21809-3
Breaking Strength		N/mm	> 4	ASTM D1000
Tensile strength	23 °C	N/mm	≥ 19	ASTM D 638
Dielectric strength		kV/mm	20	ASTM D-149
Breakdown voltage (double wrap)		kV	> 16	ASTM D149
Elongation at break		%	> 15	ASTM D1000
Water absorption	23 °C	%	< 0.02	ASTM D570
Water vapor permeability	23 °C	g/m ² /day	<0.2	ASTM E96
Microbiological Resistance	23 °C	-	pass	EN 12068 /ASTM G21
Temperature for wrapping	-	°C	- 20°C to +60°C	-
Temperature In service	-	°C	-45°C to +60°C	-
Temperature for storage	-	°C	up to 30°C	-

4.13 APPLICATION OF THE POLYMERIC TAPES

4.13.1 Surface preparation shall be cleaned in accordance with manufacturer recommendations.

4.13.2 The overlap of the tape on plant-applied coating shall be at least 50 mm after final application. The width of the tape used depends on the diameter of the pipes. For all types of manual application, an appropriate width shall be chosen to avoid wrinkling of the tape, which can occur if the tape is too wide.

4.13.3 Where the assembled joints have a step-down, a compatible, mouldable mastic filler may be required and shall be applied at the step-down area prior to application of the petrolatum coating. The maximum step-down size allowed without mastic filler shall be as specified by the manufacturer's installation recommendations unless otherwise specified by the end user.

4.13.4 Heat shrinkable sleeve shall be used as per project requirements.

4.14 HEAT SHRINKABLE COATINGS

4.14.1 Heat shrinkable coatings shall be manufactured and tested according to EN 12068 and ISO 21809

4.14.2 Heat shrinkable coatings shall be of high mechanical resistance and for use at service temperature up to 60 °C.

4.14.3 Heat shrinkable coatings be a laminate that consist of a cross-linked polyolefin-based backing with an adhesive on one side.

4.14.4 The heat shrinkable materials come in the form of wrap-around sleeve with either separate or attached closure supplied in individually precut sizes or in roll form with minimum coating thickness of 2.5 mm as supplied.

4.14.5 The backing shall consist substantially of Polyethylene or a Polyethylene copolymer.

4.14.6 The adhesive shall be mastic adhesive type with maximum operating temperature of up to 60 °C (mastic).

4.15 HEAT SHRINKABLE COATINGS PROPERTY

4.15.1 The heat shrinkable coatings shall conform to the minimum requirements given in Table 08:

Table (08) Heat Shrinkable Coatings Property Data Sheet

Property		Test Temp.	Unit	Requirements	Test Method
Backing Color		-	-	Black	
Adhesive Color		-	-	Black	
Backing thickness		23 °C	mm	≥ 1.0 mm	ISO 21809-3 /EN 12068
Adhesive thickness		23 °C	mm	≥ 1.5 mm	ISO 21809-3 /EN 12068
Holiday detection (at 5 kV/mm + 5 kV)		-	-	No holiday	ISO 21809-3 /EN 12068
Impact resistance (No Holiday detection at 5 kV/mm + 5 Kv.)		23 °C	J	≥ 15	EN12068/ ISO 21809-3
Indentation resistance,	Pressure	23 °C and T _{max}	N/mm ²	10	EN12068/ ISO 21809-3
	Residual thickness		mm	≥ 0.6	
Specific electrical insulation resistance	- R _{S100}	23 °C	Ω.m ²	≥ 10 ⁸	EN12068/ ISO 21809-3
	- R _{S100} /R _{S70}			≥ 0.8	
Cathode disbandment resistance at 28 days		23 °C	mm	≤15 mm	EN12068/ ISO 21809-3
Lap Shear Test		23 °C	N/mm ²	≥ 0.05	EN12068/ ISO 21809-3
		T _{max}		≥ 0.05	EN12068/ ISO 21809-3
Peel strength layer to layer	Inner to inner and outer to inner	23 °C	N/mm	≥ 1.5	EN12068/ ISO 21809-3
		T _{max}		≥ 0.2	
	Outer to outer	23 °C		≥ 0.2	
		T _{max}		≥ 0.2	
Peel strength to pipe surface		23 °C	N/mm	≥ 1	EN12068/ ISO 21809-3
		T _{max}		≥ 0.1	
Peel strength to plant-coating		23 °C	N/mm	≥ 0.4	
		T _{max}		≥ 0.04	

Peel strength to pipe surface after hot water immersion for 28 days at 50 °C or 80 °C.	23 °C	N/mm	≥ 0.4	EN12068/ ISO 21809-3
Peel strength to plant-coating after hot water immersion for 28 days at 50 °C.			≥ 0.4	
Tensile strength	23 °C	N/mm	≥ 20	ASTM D 638
Resistance to joint deflection and displacement			Pass	DIN 30672
Microbiological Resistance	23 °C	-	pass	EN 12068 /ASTM G21
Dielectric strength		kV/mm	≥ 20	ASTM D-149
Water absorption	23 °C	%	< 0.02	ASTM D570
Water vapor permeability	23 °C	g/m ² /day	< 0.2	ASTM E96
Elongation	%		> 400	ASTM D1000
Hardness		Shore D	> 45	ISO 868 / ASTM D2240
Temperature for wrapping	-	°C	- 20°C to +60°C	-
Temperature In service	-	°C	-45°C to +60°C	-
Temperature for storage	-	°C	up to 30°C	-

4.16 HEAT SHRINKABLE COATINGS APPLICATIONS

4.16.1 The manufacturer shall provide the specific application procedure.

4.16.2 Surface preparation shall be cleaned in accordance with manufacturer recommendations.

4.16.3 The overlap of the heat-shrinkable coating shall be at least 50 mm after final application.

The overlap/underlap at the closure area shall be as specified by the manufacturer.

4.16.4 Where the assembled joints have a step-down, a compatible, moldable mastic filler may be required and shall be applied at the step-down area prior to application of the heat-shrinkable coating. The maximum step-down size allowed without mastic filler shall be as specified by the heat-shrinkable coating manufacturer' s installation recommendations unless otherwise specified by the end user.

4.17 WRAPPING TAPES AND HEAT SHRINKABLE COATINGS MARKING

4.17.1 The manufacturer shall give enough information to identify the wrapping tape and shall supply as a minimum the technical information as listed below.

- Manufacturers name or logo.
- Date of manufacture
- Width of the tape
- Nominal Thickness
- International Standard designation

- Batch Number

4.18 WRAPPING TAPES AND HEAT SHRINKABLE COATINGS STORAGE

4.18.1 Wrapping tape shall be stored in dry, cool, well ventilated condition, the temperature of the store shall not exceed 30° C and out of direct sunlight, adhesive material should not flow out of the release paper (bleeding) or existing air bubble and there shall not be any end blocking.

4.19 WRAPPING TAPES AND HEAT SHRINKABLE COATINGS PACKING

4.19.1 All rolls shall be placed in a cardboard carton in layers in vertical position in accordance to manufacturer recommendation.

4.19.2 The boxes shall be marked minimum at two places given name and logo of manufacturer, batch number, type, Size and quantity with a minimum height letter of 50mm.

4.20 PRIMER

4.20.1 The primer shall be of fast drying type. Its only purpose shall be to maintain the surface cleanliness condition of the cleaned prepared D.I. pipe surface prior to tape application. It shall be free flowing at the application temperature ranges as per table below and have the ability to cover voids, pits and welds, and shall be resistive to fungi bacteria.

4.20.2 The primer shall be supplied as per table below:

Table (09) Primer Data Sheet

Property	Data
Flash Point, C °	21 to 32
Solid Content, %	≤ 55
Viscosity, CP	100 - 300
Coverage m ² /l	4 - 10
Type	Solvent-based Bitumen
Application temperature (°C)	-20 to +60
Operating temperature (°C)	-20 to +60
Dry time (at 20°C)	≤ 10 minutes
Shelf life (year)	≤ 2
Drum Capacity (Liters)	20 to 25

4.21 PRIMER MARKING

5.16.1 The manufacturer shall give enough information as listed below:

- Manufacturers name or logo.
- Date of manufacture
- Batch Number
- Expiry date
- Type of material

4.22 PRIMER STORAGE

4.22.1 primer shall be stored in dry, cool, well ventilated condition, the temperature of the store shall not exceed 30° C and out of direct sunlight.

4.23 PRIMER PACKING

4.23.1 The primer shall be supplied in a drum of capacity 20 to 25 Liters.

4.23.2 Drums shall be put into a wooden box, which shall be close and open type.

4.23.3 The boxes shall be marked minimum at two places given name and logo of manufacturer, batch number, type and quantity with a minimum height letter of 50mm.

4.24 MOULDING PUTTY (FILLER)

5.16.2 The joint molding putty used on all types of pipe joints shall be inert/non-toxic putty.

5.16.3 The putty shall be suitable for use with the approved PVC/Bituminous tape wrapping materials. The putty shall be that recommended by the tape manufacturer.

4.25 MOULDING PUTTY MATERIAL AND APPLICATION

4.25.1 Putty shall consist of the following properties as given in the following table

Table (10) Putty Consist Data Sheet

Property	Data
Color	Black / Beige
Shrinkage:	Nil
Temperature range Application:	up to 50 ° C
Temperature range in service:	up to 70 ° C
Specific Gravity	0.605
Specific Volume	1653 cm³/kg
Flash Point	> 185 °C

4.26 MOULDING PUTTY PACKING

4.26.1 The putty shall be supplied in 20-25 kg drums or smaller packages as approved by the Engineer.

4.26.2 The packing shall be as per Section 1, Clause 1.7 of this specification.

4.27 MOULDING PUTTY MARKING

4.27.1 Drums shall be marked, minimum at Two sides given the following details with letters with a minimum height of 50mm:

- a. Name and logo of manufacturer,
- b. Batch Number,
- c. Manufacturing date.
- d. Weight (Kg)

4.28 MOULDING PUTTY STORAGE

4.28.1 Putty should be stored in original containers until required for use. Store in dry,

4.28.2 Cool, well ventilated condition, out of direct sunlight and other major sources of heat.

4.29 PACKING

4.29.1 The packing shall be as per Section 1, Clause 1.7 of this specification.

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Section - 5

Polyethylene Sleeve for Ductile Iron Pipes Corrosion Protection

5.1 GENERAL

These clauses shall be read in continuation of Section 1 of this Specification.

- 5.1.1 The polyethylene sleeve shall be manufactured according to ISO 8180 and BS 6076.
- 5.1.2 The film shall be manufactured of virgin Linear low-density polyethylene material conforming or a mixture of polyethylene and/or ethylene and olefin copolymers.
- 5.1.3 The raw material used for making the film shall have a volume resistivity of at least 1015 ohm-centimeters and a density varying from 0.910 to 0.935 g/ cm³.
- 5.1.4 Protection against UV rays is required, the raw material shall be stabilized by the addition of an appropriate product.
- 5.1.5 The film shall be made of pure material.
- 5.1.6 The film shall be a single layer extruded as a tube and supplied in lay flat form.
- 5.1.7 The film shall not contain holes, splits, splices, perforations or other through thickness discontinuities affecting its strength or impermeability.
- 5.1.8 The color of the film shall be blue (RAL-5002/5005/5010/5012/5015/5017/5022).

5.2 DIMENSIONS

- 5.2.1 The nominal thickness of the film shall be 225 microns with tolerance of ± 25 microns. The minimum thickness at any point shall be not less than 200 microns.
- 5.2.2 The nominal lay flat width of the tubular film shall conform to the dimensions given in table (11) as per BS 6076. The tolerance on width shall be ± 2.5 %.

Table (11) Flat width of film for various pipe sizes

Sr. No.	Nominal Ø of D.I. Pipe in mm	Lay flat width in mm
1	80	280
2	100	320
3	150	435
4	200	540
5	300	755
6	400	980
7	450*	1090
8	500*	1215
9	600	1440
10	700*	1610
11	800*	1825
12	900	2025
13	1,000*	2255
14	1,200	2500
15	1,400	2800
16	1,600	3100

Note: * The subject Diameter's are not be used in a new potable water network construction.

5.3 TYPICAL PROPERTIES AND TESTING

5.3.1 The typical mechanical properties and the test method are given in table (12) below:

Table (12) Typical Properties and Testing for Polyethylene Sleeve

Mechanical properties	Unit	Typical value	Test method
Raw material Density	g/ cm ³	0.910 to 0.935	ISO 1183-1
Tensile strength at Break in the longitudinal and transverse directions	N/mm ²	≥ 20	ISO 527-3
Elongation at Break in the longitudinal and transverse directions	%	≥ 500	ISO 527-3
Impact resistance	grams	≥ 900	ISO 7765-1
Propagation tear resistance	N	≥ 20	ISO 6383-2
Dielectric strength	V/μm	≥ 32	ASTM D149

5.4 MARKING

5.4.1 Polyethylene sleeve shall be supplied with a center guideline printed on the middle of the tape and the markings shall consist the following;

- KAHRAMAA logo,
- Number of the international Standard
- Manufacturers name & logo,
- Date of manufacturing.
- Flat Width & thickness of the sleeve,
- Size of the Relevant DI pipe in mm.
- UV resistant

5.5 PACKING

5.5.1 Each roll shall be individually packed and protected with shrinkable plastic sheet and marked with name and logo of manufacturer, Tender No/Title., Type, Size and quantity of material in black/blue color letters with a minimum height of 50mm.

5.5.2 The packing shall be as per Section 1, Clause 1.7 of this specification.

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Section - 6

Trench Marker Tape

6.1 GENERAL

These clauses shall be read in continuation of Section 1 of this Specification.

- 6.1.1 The tape shall be manufactured according to EN 12613.
- 6.1.2 The tape shall be made of non-biodegradable low-density virgin polyethylene in blue color (RAL-5002/5005/5010/5012/5015/5017/5022).
- 6.1.3 The tape shall have a good chemical resistance and shall be able to withstand soil tolerance from PH 2.5 to PH 11.
- 6.1.4 The non-detectable tape for metallic material shall be 150mm wide and 200-micron thickness with a tolerance of $\pm 2\%$. The rolls shall be of 500-meter long tape.
- 6.1.5 Detectable warning tape for non-metallic material shall be 150mm wide, and 250-micron thickness with a tolerance of $\pm 2\%$. The rolls shall be of 500-meter long tape to detect the pipe through metal detector.

6.2 MARKING

- 6.2.1 The tape shall be inscribed with both Arabic and English in black color with a minimum height of letters 75 mm as follows:

For water mains – with the words

CAUTION: POTABLE WATER MAIN BELOW

-----احذر! خط مياه رئيسي صالح للشرب بالأسفل-----

For service connections – with the words

CAUTION: POTABLE WATER SERVICE CONNECTION BELOW

-----احذر! توصيلة خدمات مياه صالحة للشرب بالأسفل-----

- 6.2.2 The trench marker tape shall be supplied with the following printed markings:

- KAHRAMAA logo
- Manufacturers name & logo
- Date of manufacturing
- Width & thickness of the tape
- Batch Number
- The standard

6.3 TECHNICAL PROPERTIES FOR NON-DETECTABLE TAPE

6.3.1 The technical properties for non-detectable table are given in table (13) below:

Table (13) Technical Properties for Non-Detectable Tape

Property	Units	Value minimum	Test method
Test strength at Break (longitudinal)	N/mm ²	12	ISO 527-3
Test strength (transversal)	N/mm ²	10	ISO 527-3
Elongation (longitudinal)	%	350	ISO 527-3
Elongation (transversal)	%	350	ISO 527-3

6.4 TECHNICAL PROPERTIES FOR DETECTABLE TAPE

6.4.1 The technical properties for detectable table are given in table (14) below:

Table (14) Technical Properties for Detectable Tape

Property	Units	Value minimum	Test method
Test strength (longitudinal)	N/mm ²	30	ISO 527-3
Test strength (transversal)	N/mm ²	30	ISO 527-3
Elongation (longitudinal)	%	400	ISO 527-3
Elongation (transversal)	%	400	ISO 527-3

6.5 PACKING

6.5.1 The packing shall be as per Section 1, Clause 1.7 of this specification.

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Section - 7

Gate valves

7.1 GENERAL

These clauses shall be read in continuation of Section 1 of this Specification.

7.1.1 All gate valves shall be manufactured and tested in accordance with BS-5163 Type 'B'/ BSEN 1171, BSEN 1074 and their amendments.

7.1.2 All gate valves shall be: -

- A. Double flanged drilled according to BSEN 1092-2, PN16 (raised face).
- B. Face –to-face dimensions according to BSEN 558-1; Series 3, 14, 15, 29 and 30.
- C. The nominal pressure is PN16 bar.
- D. With inside screw, solid wedge and shall be of non-rising stem type.
- E. Operated using a removable key through a valve cap, by hand wheel or electrical actuator.
- F. Suitable for use in a closed end test.
- G. Designed for clockwise closing and be marked accordingly.
- H. Resilient seat type.

7.1.3 All Gate valves and gear boxes shall be suitable for use with water temperature up to 50°C in climate and soil conditions encountered in the State of Qatar.

7.1.4 For some specific applications controlling the process requires to avail fully open/fully close indications/signals for operation or protection purposes in this case the valve shall be equipped with proper enclosure/provision to install the limit switches or fitted with smart end position unit providing the necessary output signal.

7.2 MATERIALS OF GATE VALVES

7.2.1 The Gate valve shall be of following properties as given in Table (15).

Table (15) Properties of the Gate Valve Data Sheet

Property	Data
Body/Bonnet/Gland	DI GGG- 40/50, DIN1693, BS EN 1563 :2011, Grade EN-GJS-400-15, Grade EN-GJS-500-7, ISO400-15, ISO500-7.
Wedge core	DI GGG- 40/50, DIN1693, BS EN 1563 :2011, Grade EN-GJS-400-15, Grade EN-GJS-500-7, ISO400-15, ISO500-7.
Bonnet Gasket/O-rings	Highest grade of EPDM rubber
Stem	Duplex stainless steel 416 or 420 /stainless steel 316L/BS 970 Gr 431 S29 with the threaded portion being formed by rolling process

Stem Nuts	Stainless Steel 316L /A4 or Gunmetal or DZR to BS 1982 or BS 2874 CZ132
Built-in Fasteners	Stainless Steel 316/316L or A4 and shall be protected against corrosion

7.2.2 The wedge shall be completely vulcanized by EPDM and coupled to the valve stem by gunmetal or dezincification resistance brass nut slide into the specifically designed slot hole in wedge or rigidly fastened into the wedge body by forging before rubber vulcanization.

7.2.3 The Rubber material of the wedge shall be of “EPDM EDK- 70” and the minimum thickness shall be 1.5 mm, and all sealing surfaces not less than 4.0 mm.

7.2.4 All component parts of the valve body i.e. bonnet, and stem seal housing shall be fastened together, where setscrews are used, the socket shall be provided with a PVC cap.

7.3 GATE VALVE STEM SEALS

7.3.3 Gate valves up to and including 300 mm Ø shall have ‘O’ ring seals which are to comprise of seal, wiper rings and lip seal. There shall be a minimum of two wiper rings or one wiper ring and one lip seal in addition to the seal rings and shall be made of synthetic rubber material.

7.3.4 Gate valves above 300mm may have either ‘O’ ring seals, or stuffing boxes fitted with an approved ‘Teflon’ or graphite-based packing material.

7.3.5 The stem sealing shall be maintenance free.

7.3.6 There shall not be any direct contact with spindle and bonnet to avoid cold welding.

7.4 MATERIAL COATING & INTERNAL COMPONENTS

7.4.1 The entire body of gate valves shall be coated both internally and externally with either of the following:

- 300-micron Fusion bonded epoxy (Polymeric anticorrosion) coating as per GSK or WIS No. 4-52-01.
- 300-micron Electrostatic ally applied epoxy coating.
- 300-micron Fluidized bed epoxy coating.

7.4.2 In special cases, Rilsan coating with 300 microns can be approved.

7.4.3 The color of coating shall be “Blue”, Code RAL-- 5002/5005/5010/5012/5015/5017/5022.

7.4.4 All materials coating shall be WRC, DVGW, SGS, and DWI., KIWA, NSF 61 or other Worldwide Known Quality Body Certifiers in contact with potable water at +50°C.

7.4.5 All casting shall be properly finished, sand blasted and cleaned before coating

7.4.6 Coating shall be smooth, and mirror finish without any hairline cracks/ air bubble/ pinhole.

7.4.7 **Adhesion Test:** Adhesion of coating to metal shall not be less than 12N/mm².

7.4.8 **Holiday Test:** Porosity of coating shall be “zero” on 3 kV DC tester.

7.4.9 **Hardness:** Intrinsic Rockwell hardness shall be between 50 - 60, according to DIN EN ISO 2815.

7.4.10 **Impact resistance:** For applying of impact energy of 5 Nm on coating the cracks should not develop and shall be tested by 3 kV DC tester.

7.4.11 All above mentioned tests shall be carried out according to WIS 4-52-01, EN 14901, ISO 18468, BS EN ISO 4624 or DIN 30677.

7.5 HAND-WHEEL

7.5.1 Gate valves shall be supplied with cast iron hand wheels marked “Open” and “Closed” with arrow in appropriate directions. The design shall be such that it can be removed if necessary.

7.6 ACCESSORIES

7.6.1 Each Gate valve shall be supplied with all accessories such as: -

- Caps.
- The number of torque wrench with bit / flank socket shall be Supplied:
 - a) From 1 to 20 valves, 1 torque wrench and bit / flank socket should be supplied.
 - b) For 20 valves and above 20% of the supplied quantity of torque wrench and bit / flank socket should be supplied.
- For the reservoir (RPS) the number of hand wheel shall be Supplied:
 - a) From 1 to 20 valves, 1 hand wheel should be supplied.
 - b) For 20 valves and above 20% of the supplied quantity of hand wheel should be supplied.
- Extension Operating Spindle as per KAHRAMAA Standard Drawings, rod with all accessories such as coupling, cap, Wall Bracket, etc.

7.6.2 Valve keys shall be of the heavy-duty mild steel, lever type, shall be and to be capable of opening valves against their designed working pressure heads and shall be capable of producing enough torque to close the valve to a drop tight extent.

7.6.3 For gate valve the number of valves operating “T” keys shall be supplied:

- From 1 to 20 valves, 1 of operating “T” key should be supplied.
- For 20 valves and above 20% of the supplied quantity of operating “T” key should be supplied.

7.7 TESTING

7.7.1 The gate valve shall be tested as per BS EN 1074 / BS EN 12266 as follows:

- Hydraulic test for body - 24 bar
- Hydraulic test for seat (both sides) - 17.6 bar

7.7.2 A factory test certificate shall be issued for each Gate valve giving its serial numbers and shall be submitted to KAHRAMAA at the time of supply.

7.7.3 KAHRAMAA reserves the right to witness the dimensional, functionality, hydraulic and coating tests of the valves at manufacturer factory/locally, coating test shall be carried out as per clause 7.4

7.8 MARKING

7.8.1 It is mandatory that all gate valves shall have clearly marked in the casting of the body the following information;

H. Size of valve DN in mm.

I. Pressure rating PN in Bar.

J. Manufacturer name / logo.

K. Foundry name / logo.

L. Identification of Material type

M. Manufacturing Standards Number.

N. Year of manufacture.

7.8.2 All gate valves shall have individual identification strip which shall be marked by engraving or embossing on a metal strip, the name of manufacturer, individual serial number, tender number and Year of manufacturing.

7.8.3 The metal strip shall be of minimum size of 100mm x 30mm and shall be fixed securely and permanently at appropriate location by glue of industrial grade with a melting point higher than 80°C and shall not be screwed or riveted.

7.9 GEAR BOX

7.9.1 All gear box shall be suitable for use with water temperature up to 50°C.

7.9.2 Coating shall be as per clause 7.4

7.9.3 Fasteners shall be Stainless Steel 316/316L or A4.

7.9.4 Gearbox shall be of:

- Standard ratio 1.1-10.1 (as per project requirement)
- Torque ranges 400-40,000 Nm.
- Thrust range 4,000-250,000 daN

- 7.9.5 Open and Close position indicators shall be marked over the gear box body for physical identification.
- 7.9.6 The properties of the gearbox shall be as given in Table (16).

Table (16) Properties of the Gearbox Data Sheet

Property	Data
Body & body cover	Ductile Iron GGG40/GGG50/SG/EN GJS 400-15/500-7/ ISO 400-15/ ISO 500-7 or high Carbon Steel
Bevel gear-shaft	Steel / Carbon steel
Gear	SG Iron, BS EN 1563 Grade 700-2, GGG 50 or AISI 1045
Bearing	Steel
Stem nut	Aluminum Bronze / Steel / DZR Brass

- 5.16.4** A metal strip/Name plate for gear box details such as manufacturer details, torque details etc. shall be fixed securely and permanently over the gear box.

7.10 MOTORISED ACTUATOR

- 7.10.1 Actuator shall be non-intrusive type, designed for valve in accordance to EN 15714-2:2010.
- 7.10.2 Electric type actuators shall include the motor, operator unit gearing, limit switches, torque switches, de clutch lever, auxiliary hand wheel, forward reversing and off position switches for local valve operation, local position indicator, local and remote selector switch, terminal for remote control, valve status and position indications (as specified below).
- 7.10.3 The actuator motor and all electrical enclosure shall be waterproof (IP68) according to EN 60529 against submersion up to 8 m head of water for 96 hours. Motor shall be totally enclosed non ventilated construction with class F insulation with temperature rise limited to class B according to IEC 85.
- 7.10.4 Motors shall be of the totally enclosed non ventilated type (TENV), motors shall be protected by 3 thermal contacts, which are embedded in the motor windings.
- 7.10.5 Motors must be totally separated from the lubricant-filled gearing of the actuator, allowing replacement of motor without losing any lubricant regardless of mounting position.
- 7.10.6 Actuator shall be suitable for operations in ambient temperature up to 50°C and capable of prolonged operations in a sand laden atmosphere. Available torque shall be at least two times the valve manufacturer's maximum torque requirements. The motor shall be designed especially for use on valve operation, having high torque capacity coupled with low inertia. Motor shall be of sufficient size to open or close a

valve against the maximum specified differential pressure when the voltage drop at the motor is 10% of the nominal voltage.

7.10.7 Limit and torque switches to be operated by counter gear driven cams, which are mechanically linked to the driving devices, without slip-clutches. Battery backed limit sensing shall not be used to avoid malfunction of the actuator in case of power failure or dead battery.

7.10.8 Actuator shall be equipped with both mechanical indicator and blinking indicator which continuously shows the valve travel from fully open to fully close and vice versa.

7.10.9 Electrical power to the motor shall be 3 phase, 50 Hz, 415 V or subject to project requirement. Heater and thermostats shall be provided for high humidity condition.

7.10.10 The power gearing shall be consisting of helical gears of heat-treated steel and worn gearing of hardened alloy steel. All power gearing shall be lubricated with high speed parts on anti-friction bearing. It shall be possible to remove the motor/actuator from the valve without taking the valve out of service.

7.10.11 Provision shall be made for the incorporation of 4-20 mA position transmitters, powered internally to transmit the valve position remotely. The actuator shall be provided at least or minimum with following normally open/close dry contacts for monitoring following status remotely:

Open, Close, Healthy/Available, Failed, In Remote and Local.

Also following provision to control actuator from remotely through NO/NC potential free contact.

Open & Close (In Desired Position), Stop

7.10.12 The integral motor controls shall include solid state contacts (thyristors) for modulating duty actuators.

7.10.13 Whenever LCD display is provided in actuator lockable protection cover must be provided.

7.10.14 OEM/Agent should be available locally for round the clock service support.

7.10.15 An anti-condensation heater must be installed inside the actuator, suitable for continuous operation. Actuator must provide an alarm signal in case of failure of the anti-condensation heater.

7.11 MOTORIZED ACTUATOR SPARE PARTS

7.11.1 The following spare parts shall be provided, but not limited to the following:

1. 2No. of complete set of Motorized valve actuators of each model and rating should be supplied as spares.

2. 2No. of OEM Tool kit, that of high quality and housed in a suitable, lockable metal box.

7.12 PACKING

7.12.1 The packing shall be as per Section 1, Clause 1.7 of this specification.

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Section - 8

Butterfly Valve

8.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

- 8.1.1 All butterfly valves shall be manufactured and tested in accordance with BS EN 593 or equivalent.
- 8.1.2 All butterfly valve flanges shall be drilled to BSEN 1092-2 (raised face).
- 8.1.3 Butterfly valves shall be of the following types;
- A. Concentric, Double or Triple Offset rubber lined.
 - B. Double flanged design. Face-to-face dimensions shall be as per BSEN 558-1:
 - Series 20 (Rubber-lined concentric type with Replaceable lining).
 - Series 13 & 14 for Double/Triple Offset valves.
 - C. The nominal pressure is PN16 bar.
 - D. Operated using a removable key.
 - E. Suitable for use in a closed end test.
 - F. designed for clockwise closing and to be marked accordingly.
- 8.1.4 All butterfly valves and gear boxes shall be suitable for use with water temperature up to 50°C in climate and soil conditions encountered in the State of Qatar.
- 8.1.5 For some specific applications controlling the process requires to avail fully open/fully close indications/signals for operation or protection purposes in this case the valve shall be equipped with proper enclosure/provision to install the limit switches or fitted with smart end position unit providing the necessary output signal.

8.2 MATERIALS OF BUTTERFLY VALVE

- 8.2.1 The butterfly valve shall be of following properties as given in Table (17).

Table (17) Properties of the Butterfly Valve Data Sheet

Property	Data
Body	DI GGG- 40/50, DIN1693, BS EN 1563 :2011, Grade EN-GJS-400-15, Grade EN-GJS-500-7, ISO400-15, ISO500-7.
Body Seat	Shall be Stainless Steel 316L/A4
Disc	DI GGG- 40/50, DIN1693, BS EN 1563:2011, Grade EN-GJS-400-15, Grade EN-GJS-500-7, ISO400-15, ISO500-7 or SS 316L shall be of solid one-piece casting (non-hollow).
Disc Seat (retaining ring)	Shall be Stainless Steel 316L/A4
Disc Gasket	Must be of the highest grade of EPDM rubber

Bearing	PTFE filled line steel bearing (self-lubricated)
Built-in Fasteners	Shall be Stainless Steel 316L /A4
Shaft	Duplex Stainless Steel 416 or 420 and shall be 100% dry shaft design
Lining	Must be of the highest grade of EPDM rubber with minimum thickness 3mm.

8.3 MATERIAL COATING AND INTERNAL COMPONENTS

8.3.1 All casting shall be properly finished, sand blasted and cleaned before coating.

8.3.2 Coating shall be smooth, and mirror finish without any hairline cracks/ air bubble/ pinhole.

8.3.3 The entire body of valves shall be coated both internally and externally with either of the following:

- 300-micron Fusion bonded epoxy (Polymeric anticorrosion) coating as per GSK and WIS No. 4-52-01.
- 300-micron Electrostatic ally applied epoxy coating.
- 300-micron Fluidized bed epoxy coating.

8.3.4 In special cases, Rilsan coating with 300 microns can be approved.

8.3.5 The color of coating shall be “Blue”, Code RAL-- 5002/5005/5010/5012/5015/5017/5022.

8.3.6 All materials coating shall be WRC, DVGW, SGS, and DWI., KIWA, NSF 61 or other Worldwide Known Quality Body Certifiers in contact with potable water at +50°C.

8.3.7 **Adhesion Test:** Adhesion of coating to metal shall not be less than 12N/mm².

8.3.8 **Holiday Test:** Porosity of coating shall be “zero” on 3 kV DC tester.

8.3.9 **Hardness:** Intrinsic Rockwell hardness shall be between 50 - 60, according to DIN EN ISO 2815.

8.3.10 **Impact resistance:** For applying of impact energy of 5 Nm on coating the cracks should not develop, when tested by 3 kV DC tester.

8.3.11 All above mentioned tests shall be carried out according to WIS 4-52-01, EN 14901, ISO 18468, BS EN ISO 4624 or DIN 30677.

8.4 HAND-WHEEL

8.4.1 Butterfly valves shall be supplied with cast iron hand wheels marked “Open” and “Closed” with arrow in appropriate directions. The design shall be such that it can be removed if necessary.

8.5 ACCESSORIES

8.5.1 Each Butterfly valve shall be supplied with all accessories such as: -

- Caps
- The number of torque wrench with bit / flank socket shall be Supplied:
 - a) From 1 to 20 valves, 1 torque wrench and bit / flank socket should be supplied.
 - b) For 20 valves and above 20% of the supplied quantity of torque wrench and bit / flank socket should be supplied.
- For the reservoir (RPS) the number of hand wheel shall be Supplied:
 - a) From 1 to 20 valves, 1 hand wheel should be supplied.
 - b) For 20 valves and above 20% of the supplied quantity of hand wheel should be supplied.
- Extension Operating Spindle as per KAHRAMAA Standard Drawings, rod with all accessories such as coupling, cap, Wall Bracket, etc.

8.5.2 Valve keys shall be of the heavy-duty mild steel, lever type, shall be and to be capable of opening valves against their designed working pressure heads and shall be capable of producing enough torque to close the valve to a drop tight extent.

8.5.3 For butterfly valve the number of valves operating “T” keys shall be supplied:

- I. From 1 to 20 valves, 1 of operating “T” key should be supplied.
- II. For 20 valves and above 20% of the supplied quantity of operating “T” key should be supplied.

8.6 TESTING

8.6.1 All valves shall be individually pressure tested as per BS EN 1074 / BS EN 12266 for the following hydraulic pressure:

- Hydraulic test for Body - 24 Bar
- Hydraulic test for Seat (Both sides) - 17.6 Bar

8.6.2 A factory test certificate shall be issued for each butterfly valve giving its serial numbers and shall be submitted to KAHRAMAA at the time of supply.

8.6.3 KAHRAMAA reserves the right to witness the hydraulic test and coating test of the valves at manufacturer factory/locally, coating test shall be carried out as per clause 8.3.

8.7 MARKINGS

8.7.1 All valves shall have clearly marked in the casting of the body and Disc with the following information:

- A. Size of valve DN in mm.

- B. Pressure rating PN in Bars.
- C. Manufacturer name / logo.
- D. Foundry name / logo.
- E. Identification of Material type
- F. Manufacturing Standards Number.
- G. Year of manufacture.

8.7.2 All Butterfly valves shall have individual identification strip which shall be marked by engraving or embossing on a metal strip, the name of manufacturer, individual serial number, tender number and Year of manufacturing.

8.7.3 The metal strip shall be of minimum size of 100mm x 30mm and shall be fixed securely and permanently at appropriate location by glue of industrial grade with a melting point higher than 80°C and shall not be screwed or riveted.

8.8 GEAR BOX

8.8.1 All gear box shall be suitable for use with water temperature up to 50°C.

8.8.2 The coating shall be as per clause 8.3

8.8.3 Fasteners shall be Stainless Steel 316/316L or A4.

8.8.4 Open and Close position indicators shall be marked over the gear box body for physical identification.

8.8.5 The properties of the gearbox shall be as given in Table (18).

Table (18) Properties of the Gearbox Data Sheet

Property	Data
Body & body cover	Ductile Iron GGG40/GGG50/SG/EN GJS 400-15/500-7/ ISO 400-15/ ISO 500-7
Worm Wheel	Ductil Iron EN-GJS-500-7 of any or Any High Carbon Steel
Worm gear-shaft	Ductil Iron EN-GJS-500-7 , Steel C40 / Carbon steel
Gear	SG Iron, BS EN 1563 Grade 700-2, GGG 50 or AISI 1045
Bearing	Steel
Stem nut	Aluminum Bronze / Steel / DZR Brass

8.8.6 A metal strip/Name plate for gear box details such as manufacturer details, torque details etc. shall be fixed securely and permanently over the gear box.

8.9 MOTORIZED ACTUATOR

8.9.1 Actuator shall be non-intrusive type, designed for valve in accordance to EN 15714-2:2010.

8.9.2 Electric type actuators shall include the motor, operator unit gearing, limit switches, torque switches, de clutch lever, auxiliary hand wheel, forward reversing and off

position switches for local valve operation, local position indicator, local and remote selector switch, terminal for remote control, valve status and position indications (as specified below).

- 8.9.3 The actuator motor and all electrical enclosure shall be waterproof (IP68) according to EN 60529 against submersion up to 8 m head of water for 96 hours. Motor shall be totally enclosed non ventilated construction with class F insulation with temperature rise limited to class B according to IEC 85.
- 8.9.4 Motors shall be of the totally enclosed non ventilated type (TENV), motors shall be protected by 3 thermal contacts, which are embedded in the motor windings.
- 8.9.5 Motors must be totally separated from the lubricant-filled gearing of the actuator, allowing replacement of motor without losing any lubricant regardless of mounting position.
- 8.9.6 Actuator shall be suitable for operations in ambient temperature up to 50°C and capable of prolonged operations in a sand laden atmosphere. Available torque shall be at least two times the valve manufacturer's maximum torque requirements. The motor shall be designed especially for use on valve operation, having high torque capacity coupled with low inertia. Motor shall be of sufficient size to open or close a valve against the maximum specified differential pressure when the voltage drop at the motor is 10% of the nominal voltage.
- 8.9.7 Limit and torque switches to be operated by counter gear driven cams, which are mechanically linked to the driving devices, without slip-clutches. Battery backed limit sensing shall not be used to avoid malfunction of the actuator in case of power failure or dead battery.
- 8.9.8 Actuator shall be equipped with both mechanical indicator and blinking indicator which continuously shows the valve travel from fully open to fully close and vice versa.
- 8.9.9 Electrical power to the motor shall be 3 phase, 50 Hz, 415 V or subject to project requirement. Heater and thermostats shall be provided for high humidity condition.
- 8.9.10 The power gearing shall be consisting of helical gears of heat-treated steel and worn gearing of hardened alloy steel. All power gearing shall be lubricated with high speed parts on anti-friction bearing. It shall be possible to remove the motor/actuator from the valve without taking the valve out of service.
- 8.9.11 Provision shall be made for the incorporation of 4-20 mA position transmitters, powered internally to transmit the valve position remotely. The actuator shall be

provided at least or minimum with following normally open/close dry contacts for monitoring following status remotely:

Open, Close, Healthy/Available, Failed, In Remote and Local.

Also following provision to control actuator from remotely through NO/NC potential free contact.

Open & Close (In Desired Position), Stop

8.9.12 The integral motor controls shall include solid state contacts (thyristors) for modulating duty actuators.

8.9.13 Whenever LCD display is provided in actuator lockable protection cover must be provided.

8.9.14 OEM/Agent should be available locally for round the clock service support.

8.9.15 An anti-condensation heater must be installed inside the actuator, suitable for continuous operation. Actuator must provide an alarm signal in case of failure of the anti-condensation heater.

8.10 MOTORIZED ACTUATOR SPARE PARTS

8.10.1 The following spare parts shall be provided, but not limited to the following:

1. 2No. of complete set of Motorized valve actuators of each model and rating should be supplied as spares.
2. 2No. of OEM Tool kit, that of high quality and housed in a suitable, lockable metal box.

8.11 PACKING

8.11.1 The packing shall be as per Section 1, Clause 1.7 of this specification.

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Section - 9

Air Valves

9.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

- 9.1.1 Air valves shall be manufactured and tested in accordance with BS EN 1074 – 4 or equivalent.
- 9.1.2 Air valves shall be suitable for a nominal pressure PN16 bar.
- 9.1.3 Air valves materials shall be suitable for use with potable water at a temperature of +50°C.
- 9.1.4 Air valve heads should be positioned vertically.
- 9.1.5 Air Valve shall be Anti Surge Vacuum Break Type based on project specification.
- 9.1.6 All air valves shall be BSPT taper-threaded according to ISO 7-1 and EN 10226-2 for sizes below 50 mm (2") or flanged according to BS EN 1092-2 for bigger sizes.

9.2 MATERIALS OF AIR VALVE

- 9.2.1 The Air valve shall be of following properties as given in Tables (19).

Table (19) Properties of the Air Valve Data Sheet

Property	Data
Body/Bonnet/Stem Support/Stem Guide	DI GGG- 40/50, DIN1693, BS EN 1563 :2011, Grade EN-GJS-400-15, Grade EN-GJS-500-7, ISO400-15, ISO500-7.
Floats	Highest Density of Polyethylene, SS 316/316L or A4.
Bonnet Gasket/O-rings/Nozzle Seat	Highest grade of EPDM rubber
Stem	Duplex stainless steel 416 or 420/ stainless steel 316L/BS 970 Gr 431 S29 with the threaded portion being formed by rolling process
Stem Nuts	Stainless Steel 316/316L/A4 or Gunmetal or DZR to BS 1982 or BS 2874 CZ132
Built-in Fasteners	Stainless Steel 316/316L or A4 and shall be protected against corrosion

9.3 TYPES OF VALVES

9.3.1 Air Release Valve (Single Function)

- 9.3.1.1. Air release valve or “single function valve” designed to automatically release small pockets of accumulated air while system operates under pressure.

9.3.2 Double Functions Air Valve

9.3.2.1. Double functions / combination of small and large orifice air valve and are designed to exhaust large quantities of air automatically during pipeline filling and admit large quantities of air when the internal pressure drops below atmospheric pressure.

9.3.3 Triple Action Air Valve

9.3.3.1. These triple action air valves are a combination of both large and small orifices, the main functions of these valves are discharge of large volumes of air during pipe filling, air release during working conditions, and entrance/admission of large volumes of air during pipeline draining.

9.4 TESTING

9.4.1 All valves shall be individually pressure tested as per BS EN 1074 for the following hydraulic pressure:

- Hydraulic pressure test = 24 bar

9.4.2 A factory test certificate shall be issued for each air valve giving its serial numbers and shall be submitted to KAHRAMAA at the time of supply.

9.4.3 KAHRAMAA reserves the right to witness the hydraulic test and coating test of the valves at manufacturer factory/locally, coating test shall be carried out as per clause 9.8.

9.5 MATERIAL COATING AND INTERNAL COMPONENTS

9.5.1 All casting shall be properly finished, sand blasted and cleaned before coating.

9.5.2 Coating shall be smooth, and mirror finish without any hairline cracks/ air bubble/ pinhole.

9.5.3 The entire body of valves shall be coated both internally and externally with either of the following:

- 300-micron Fusion bonded epoxy (Polymeric anticorrosion) coating as per GSK and WIS No. 4-52-01.
- 300-micron Electrostatic ally applied epoxy coating.
- 300-micron Fluidized bed epoxy coating.

9.5.4 In special cases, Rilsan coating with 300 microns can be approved.

9.5.5 The color of coating shall be “Blue”, Code RAL-- 5002/5005/5010/5012/5015/5017/5022.

- 9.5.6 All materials coating shall be WRC, DVGW, SGS, and DWI., KIWA, NSF 61 or other Worldwide Known Quality Body Certifiers in contact with potable water at +50°C.
- 9.5.7 **Adhesion Test:** Adhesion of coating to metal shall not be less than 12N/mm².
- 9.5.8 **Holiday Test:** Porosity of coating shall be “zero” on 3 kV DC tester.
- 9.5.9 **Hardness:** Intrinsic Rockwell hardness shall be between 50 - 60, according to DIN EN ISO 2815.
- 9.5.10 **Impact resistance:** For applying of impact energy of 5 Nm on coating the cracks should not develop, when tested by 3 kV DC tester.
- 9.5.11 All above mentioned tests shall be carried out according to WIS 4-52-01, EN 14901, ISO 18468, BS EN ISO 4624 or DIN 30677.

9.6 MARKINGS

- 9.6.1 All air valves shall have clearly marked in the casting of the body with the following information:
- A. Size of valve DN in mm.
 - B. Pressure rating PN in bar.
 - C. Manufacturer name / logo.
 - D. Foundry name / logo.
 - E. Identification of Material type
 - F. Manufacturing Standards Number.
 - G. Year of manufacture.
- 9.6.2 All Air valves shall have individual identification strip which shall be marked by engraving or embossing on a metal strip, the name of manufacturer, individual serial number, tender number and Year of manufacturing.
- 9.6.3 The metal strip shall be of minimum size of 100mm x 30mm and shall be fixed securely and permanently at appropriate location by glue of industrial grade with a melting point higher than 80°C and shall not be screwed or riveted.

9.7 PACKING

- 9.7.1 The packing shall be as per Section 1, Clause 1.7 of this specification.

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Section - 10

Fire Hydrants

10.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

UNDERGROUND FIRE HYDRANT

10.1.1 All fire hydrants shall be manufactured and tested in accordance with latest BS 750, BS EN 14339, BS EN 1074-1, BS EN 1074-6, BS EN 1092, BS 336:2010 and its amendments.

10.1.2 Fire hydrants shall be type 2 in accordance with BS 750.

10.1.3 Fire hydrants shall be screw down type with captive stopper.

10.1.4 Fire hydrants shall be medium, fixed type stopper. Simple drain plugs with needle hole.

10.1.5 Drain plug must be Stainless Steel.

10.1.6 Fire hydrants shall have a design life of a minimum 50 years.

10.2 MARKING

10.2.1 All fire hydrants shall have clearly marked in the casting of the body the following information.

- A. Size of valve DN in mm.
- B. Pressure rating PN in bars.
- C. Manufacturer name / logo.
- D. Foundry name / logo.
- E. Identification of Material type
- F. Manufacturing Standards Number.
- G. Year of manufacture.

10.2.2 All fire hydrants shall have individual identification strip which shall be marked by engraving or embossing on a metal strip, the name of manufacturer, individual serial number, tender number, and Year of manufacturing.

10.2.3 The metal strip shall be of minimum size of 100mm x 30mm and shall be fixed securely and permanently at appropriate location by industrial type cold welded glue and shall not be screwed or riveted. The glue shall be of industrial grade with a melting point higher than 80°C.

10.3 MATERIALS

10.3.1 The underground fire hydrant shall be of following properties as given in Table (20).

Table (20) Properties of the underground fire hydrant Data Sheet

Property	Data
Body/Bonnet/Gland	DI GGG- 40/50, DIN1693, BS EN 1563 :2011, Grade EN-GJS-400-15, Grade EN-GJS-500-7, ISO400-15, ISO500-7.
Wedge core	DI GGG- 40/50, DIN1693, BS EN 1563 :2011, Grade EN-GJS-400-15, Grade EN-GJS-500-7, ISO400-15, ISO500-7.
Bonnet Gasket/O-rings	Highest grade of EPDM rubber
Stem	Duplex stainless steel 416 or 420 /stainless steel 316L/BS 970 Gr 431 S29 with the threaded portion being formed by rolling process
Stem Nuts	Stainless Steel 316L /A4 or Gunmetal or DZR to BS 1982 or BS 2874 CZ132
Outlet	Copper alloy BS EN 1982, BS EN 12163 or stainless steel 316/316L or A4
Built-in Fasteners	Stainless Steel 316/316L or A4 and shall be protected against corrosion

10.3.2 All fire hydrants shall have “O” ring seals which are to comprise of seal and wiper rings and shall be made of synthetic rubber material. Removable gland fire hydrants shall not be accepted.

10.3.3 The stopper shall be completely vulcanized by EPDM or a suitable designed EPDM seal fasten with properly design arrangement, suitable for life of the fire hydrant and coupled to the stem by gunmetal or DZR brass nut slides into specifically designed slot hole in stopper or rigidly fastened into the stopper body by forging before rubber vulcanization.

10.3.4 If stopper is completely vulcanized, the rubber material shall be of “EPDM” EDK-70 or equivalent and the minimum thickness shall be 1.5mm and on all sealing surfaces shall not be less than 4.0mm.

10.3.5 The stopper nut shall be made of gunmetal to BS 1982 or BS 2874 CZ 132.

10.4 CONNECTIONS

10.4.1 Inlet flanges shall be drilled to suite ductile iron flanges as detailed in BS EN 1092, PN-16 rating.

10.4.2 Fire hydrants shall have a pressure rating of 16 Bar and shall be subject to a working test pressure of 24 Bar.

10.4.3 All materials shall be suitable for use with potable water at a temperature of 50°C.

10.4.4 Outlets shall be 2.5” (inches) male London Round Thread.

10.4.5 The screwed outlet shall be provided with a cap to cover the outlet. It shall be securely attached to the fire hydrant by a chain or other flexible device.

10.4.6 Fire hydrants are to be designed for clockwise closing.

10.5 COATINGS

10.5.1 All fire hydrants shall have their entire body coated, both internally and externally with either of the following:

- 300-micron Fusion bonded epoxy (Polymeric anticorrosion) coating as per WIS No. 4-52-01.
- 300-micron Electrostatic ally applied epoxy coating.
- 300-micron Fluidized bed epoxy coating.
- The color of coating shall be “Blue”, Code RAL 5002/5005/5010/5012/5015/5017/5022.

10.5.2 All materials coating shall be WRC, DVGW, SGS, and DWI., KIWA, NSF 61 or other Worldwide Known Quality Body Certifiers in contact with potable water at 50 degrees centigrade.

10.5.3 All casting shall be properly finished, sand blasted and cleaned before coating.

10.5.4 Coating shall be smooth, and mirror finish without any hairline cracks.

10.5.5 **Adhesion Test:** Adhesion of coating to metal shall not be less than 12N/mm² (BSI BS EN ISO 4624).

10.5.6 **Holiday Test:** Porosity of coating shall be “zero” on 3 kV DC tester.

10.5.7 **Hardness:** Intrinsic Rockwell hardness shall be between 50 - 60, according to DIN EN ISO 2815.

10.5.8 Impact resistance: For applying of impact energy of 5 Nm on coating the cracks should not develop, when tested by 3 kV DC tester.

10.5.9 All above mentioned tests shall be carried out according to WIS 4-52-01, EN 14901, ISO 18468, BS EN ISO 4624 or DIN 30677.

10.6 TESTING

10.6.1 All fire hydrants shall be tested as per BS 750 as follows: -

- Hydraulic test for body - 24 Bar
- Hydraulic test for seat - 17.6 Bar

10.6.2 A factory test certificate shall be issued for each fire hydrant giving its serial number. This certificate shall be submitted to KAHRAMAA at the time of supply.

10.6.3 KAHRAMAA reserves the right to witness the testing of the valves locally. Testing shall be carried out in accordance with applicable codes and standards for the

particular FH. Each FH shall be subjected to hydrostatic body and seat pressure test as mentioned in clause 10.6.1.

10.7 STAND PIPES

10.7.1 Stand pipes shall be of revolving head type, the heads to be fitted with chained blanking plugs with a minimum height of 950mm and manufactured from aluminum alloy or equivalent.

10.7.2 Inlet shall be 2.5" (inch) female London Round Thread to fit fire hydrants to BS 750 and outlet shall be 2.5" instantaneous male to BS 336.

10.8 ACCESSORIES

10.8.1 Each fire hydrant shall be supplied with following:

- Bolts, nuts, washers and 3 mm cotton reinforced rubber gasket for each flange.
- Antifreeze bolts for fire hydrants, 1 per 20 fire hydrants.
- Stand pipe, 1 per 20 fire hydrants.

10.8.2 For underground fire hydrant the number of fire hydrant operating "T" keys shall be supplied:

- I. Operating keys" T" 5% of the supplied amount of the fire hydrant.
- II. For 20 fire hydrants and above 20% of the supplied quantity of operating "T" key should be supplied.

10.9 PACKING

10.9.1 The packing shall be as per Section 1, Clause 1.7 of this specification.

ABOVE GROUND FIRE HYDRANT (PILLAR TYPE)

10.9.2 The aboveground pillar type fire hydrants shall be of the breakable pillar type in accordance to BSI BS EN 14384:2005.

10.9.3 All fire hydrants shall be equipped as given below:

- The fire hydrants shall be approved by Civil Defense of State of Qatar.
- The hydrant shall be fitted with 2 No couplings of 2"1/2 including caps made of aluminum alloy or Gunmetal (EN 1982, grade CuSnPb5).
- Bronze valve seat ring, or Gunmetal (EN 1982 grade CuSn6Zn45Pb2)
- Stainless steel 316 spindle.
- A frangible section which breaks on impact, at the same time as the clamping washers.
- DN 100mm and DN 150mm, PN 16 rating to EN 1092-2 standard.
- A screw and nut device fitted on the stem holder so that the valve remains closed in case of impact.
- Automatic drain valve.

- The pillar type fire hydrant shall be supplied with an aluminum alloy hood (protection box), to be closed and opened through a key, and every pillar hydrant shall be supplied with one key.
- Each two pillar hydrants supplied shall be provided with one extra repair kit for the breakable section.

10.10 MARKING

10.10.1 All pillar type fire hydrants shall have clearly marked in the casting of the body the following information.

- A. Number of Standard Code.
- B. Manufacturer's name and/or logo.
- C. Material designation of body and bonnet.
- D. DN
- E. PN

10.10.2 All Hydrants shall be durably marked on the upper part with the following:

1. Direction of opening
2. Number of turns to open

10.10.3 All pillar type fire hydrants shall have individual identification strip which shall be marked by engraving or embossing on a metal strip, the name of manufacturer, individual serial number, tender number, and Year of manufacturing.

10.10.4 The metal strip shall be of minimum size of 100mm x 30mm and shall be fixed securely and permanently at appropriate location by industrial type cold welded glue and shall not be screwed or riveted. The glue shall be of industrial grade with a melting point higher than 80°C.

10.10.5 The marking plate shall be fixed on the hood at the factory.

10.11 COATING

10.11.1 All pillar type fire hydrants shall have their entire body coated, both internally and externally with either of the following:

- Coating shall be smooth, and mirror finish without any hairline cracks.
- 300-micron Fusion bonded epoxy (Polymeric anticorrosion) coating as per GSK and WIS No. 4-52-01.
- 300-micron Electrostatic ally applied epoxy coating.
- 300-micron Fluidized bed epoxy coating.
- In special cases, Rilsan coating with 300 microns can be approved.
- The hood shall also be epoxy coated, to achieve a D.F.T (Dry Film Coating) of not less than 60 microns.

- The color of coating shall be “Red”, Code RAL-3000/3001/3002/3016/3024.

10.11.2 All casting shall be properly finished, sand blasted and cleaned before coating.

10.11.3 All materials coating shall be WRC, DVGW, SGS, and DWI., KIWA, NSF 61 or other Worldwide Known Quality Body Certifiers in contact with potable water at 50 °C.

10.12 TESTING

10.12.1 All pillar type fire hydrants shall be tested in factory as the follows: -

- Hydraulic test for body - 24 bar in open position.
- Hydraulic test for seat - 17.6 bar in closed position.

10.12.2 **Adhesion Test:** Adhesion of coating to metal shall not be less than 12N/mm².

10.12.3 **Holiday Test:** Porosity of coating shall be “zero” on 3 kV DC tester.

10.12.4 **Hardness:** Intrinsic Rockwell hardness shall be between 50 - 60, according to DIN EN ISO 2815.

10.12.5 **Impact resistance:** For applying of impact energy of 5 Nm on coating the cracks should not develop, when tested by 3 kV DC tester.

10.12.6 All above mentioned tests shall be carried out according to WIS 4-52-01, EN 14901, ISO 18468, BS EN ISO 4624 or DIN 30677.

10.12.7 A factory test certificate shall be issued for each pillar type fire hydrants giving its serial number and this certificate shall be submitted to KAHRAMAA at the time of supply.

10.12.8 KAHRAMAA reserves the right to witness all types of testing locally, and the tests shall be carried out in accordance with applicable codes and standards for the particular pillar type fire hydrants.

10.13 ACCESSORIES

10.13.1 Each fire hydrant shall be supplied with following:

- Master universal keys 10% of the supplied amount of the fire hydrants
- Operating keys 10% of the supplied amount of the fire hydrants.
- Additional repair kit 10% of the supplied amount of the fire hydrants, consist of the following: -
 - I. One set of brackets.
 - II. Four numbers of fasteners.
 - III. One set of rubber gasket.
 - IV. Valve Plug.

- Protection hood Cover with master universal key, 10% of the supplied amount of the fire hydrants

10.14 PACKING

10.14.1 The packing shall be as per Section 1, Clause 1.7 of this specification.

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Section - 11

Check Valve

11.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

- 11.1.1. All check valves shall be manufactured in accordance to BSEN 1074-3 and EN 12266 or equivalent.
- 11.1.2. All check valve flanges shall be drilled to BSEN 1092-2, PN16.
- 11.1.3. The design of the valve body shall be such that there is adequate clearance around the back of the door to minimize jamming by rags and debris. Stops shall be provided to limit the back lift of the disc and shall be positioned to prevent fouling.
- 11.1.4 All check valves shall be suitable for use with water temperature up to 50°C in climate and soil conditions encountered in the State of Qatar.

11.2. MATERIALS OF CHECK VALVE

- 11.2.1. Check or non-return valves below the size DN 300 mm (inclusive) shall be of the swing, non-slam, noiseless type having flanged connections. The rating of the flanges shall be as per the design conditions of the operating system and as indicated in the Data Sheet.
- 11.2.2 Check valves of sizes above DN 300 mm shall be high dynamic, spring loaded, non-slam, noiseless long pattern, metal seated type manufactured API 6 D standards. The rating of the flanges shall be in accordance with the standards indicated in the data sheets.
- 11.2.3 The design of the valve internal parts shall allow the disc to respond very quickly to any flow changes and shall achieve movement from fully open to fully close in less than 0.15 seconds.
- 11.2.4 The single helical spring shall be fully shielded from the process stream by the central flow diffuser. The metal to metal sealing shall achieve tight shut off with 100% reliability.

11.3. MATERIALS OF SWING CHECK VALVE

- 11.3.1 All Swing Check valves shall be of the following types;
 - A. Double flanged design. Face-to-face dimensions shall be as per BSEN 558-1,
 - B. Series 1, series 10, series 14 or series 48.
- 11.3.2 The Swing Check Valve shall be conforming to the following specifications given in Table (21).

Table (21) Properties of the Swing Check Valve Data Sheet

Property	Data
Body / Cover / bonnet / weight / hinge	DI GGG- 40/50, DIN1693, BS EN 1563 :2011, Grade EN-GJS-400-15, Grade EN-GJS-500-7, ISO400-15, ISO500-7.
Flap / Disc / Arm / Lever	DI GGG- 40/50, DIN1693, BS EN 1563 :2011, Grade EN-GJS-400-15, Grade EN-GJS-500-7, ISO400-15, ISO500-7.
Retaining ring	Stainless Steel 316/316L /A4
O-ring / Sealing ring	Elastomer EPDM
Bonnet Gasket	Elastomer EPDM
Bearing bush	Bronze or Stainless Steel
Shaft / Pin	Stainless Steel 316/316L /A4
Built-in Fasteners	Stainless Steel 316/316L or A4 or Bronze and shall be protected against corrosion

11.4. MATERIALS OF RECOIL AND SLOW CLOSING TYPE

11.4.1 All Recoil and slow closing type shall be of the following types;

- A. Double flanged design. Face-to-face dimensions shall be as per BSEN 558-1,
- B. Series 14 (Rubber-lined concentric type with Replaceable lining).

11.4.2 The Recoil and slow closing type shall be conforming to the following specifications given in Table (22).

Table (22) Properties of the Recoil and slow closing type Data Sheet

Property	Data
Body / Cover / bonnet / Weight / Flap	DI GGG- 40/50, DIN1693, BS EN 1563 :2011, Grade EN-GJS-400-15, Grade EN-GJS-500-7, ISO400-15, ISO500-7.
Body Seat	Stainless Steel 316/316L or A4 or Bronze
Retaining ring	Stainless Steel 316/316L /A4
O-ring / Sealing ring	Elastomer EPDM
Bonnet Gasket	Elastomer EPDM
Bearing bush	Bronze or Stainless Steel
Shaft/Pin	Stainless Steel 316/316L /A4
Built-in Fasteners	Stainless Steel 316/316L or A4 or Bronze and shall be protected against corrosion

11.5. MATERIALS OF SPRING-LOADED AXIAL / NOZZLE CHECK VALVE

11.5.1 All Axial / Nozzle Check valves shall be of the following types Double flanged design.

Face-to-face dimensions shall be as per BSEN 558-1,

11.5.2 All Axial / Nozzle Check valves shall be of the following types;

A. Double flanged design. Face-to-face dimensions shall be as per BSEN 558-1,

B. Series 14 (Rubber-lined concentric type with Replaceable lining).

11.5.3 The Axial / Nozzle Check Valve shall be conforming to the following specifications given in Table (23).

Table (23) Properties of the Axial / Nozzle Check Valve Data Sheet

Property	Data
Body / Disc / Shaft Support	DI GGG- 40/50, DIN1693, BS EN 1563 :2011, Grade EN-GJS-400-15, Grade EN-GJS-500-7, ISO400-15, ISO500-7.
Retaining ring	Stainless Steel 316/316L /A4
O-ring / Sealing ring	Elastomer EPDM
Disc Gasket	Elastomer EPDM
Bearing bush	Bronze or Stainless Steel
Shaft / Spring	Stainless Steel 316/316L /A4
Built-in Fasteners	Stainless Steel 316/316L or A4 or Bronze and shall be protected against corrosion

11.6. MATERIAL COATING AND INTERNAL COMPONENTS

11.6.1. The entire body of check valves shall be coated both internally and externally with either of the following:

- 300-micron Fusion bonded epoxy (Polymeric anticorrosion) coating as per GSK or WIS No. 4-52-01.
- 300-micron Electrostatic ally applied epoxy coating.
- 300-micron Fluidized bed epoxy coating.

11.6.2. In special cases, Rilsan coating with 300 microns can be approved.

11.6.3. The color of coating shall be “Blue”, Code RAL 5002/5005/5010/5012/5015/5017/5022.

11.6.4. All materials coating shall be WRC, DVGW, SGS, and DWI., KIWA, NSF 61 or other Worldwide Known Quality Body Certifiers in contact with potable water at +50°C.

11.5.1. The internal and external surfaces of the valve and the disc shall be blast cleaned to SA 2.5, ISO 8501 standards and coated with fusion bonded epoxy coating system to a dry film thickness of 300mm.

11.6.5. All casting shall be properly finished, sand blasted and cleaned before coating

- 11.6.6. Coating shall be smooth, and mirror finish without any hairline cracks/ air bubble/ pinhole.
- 11.6.7. **Adhesion Test:** Adhesion of coating to metal shall not be less than 12N/mm².
- 11.6.8. **Holiday Test:** Porosity of coating shall be “zero” on 3 kV DC tester.
- 11.6.9. **Hardness:** Intrinsic Rockwell hardness shall be between 50 - 60, according to DIN EN ISO 2815.
- 11.6.10. **Impact resistance:** For applying of impact energy of 5 Nm on coating the cracks should not develop, when tested by 3 kV DC tester.
- 11.6.11. All above mentioned tests shall be carried out according to WIS 4-52-01, EN 14901, ISO 18468, BS EN ISO 4624 or DIN 30677.

11.7. TESTING

- 11.7.1. All check valves shall be individually pressure tested as per BS EN 1074 / BS EN 12266 for the following hydraulic pressure:
- Hydraulic test for Body - 24 Bar
 - Hydraulic test for Seat - 17.6 Bar
- 11.7.2. A factory test certificate shall be issued for each valve giving its serial numbers and shall be submitted to KAHRAMAA at the time of supply.
- 11.7.3. KAHRAMAA reserves the right to witness the hydraulic test and coating test of the valves at manufacturer factory/locally, coating test shall be carried out as per clause 11.7.

11.8. MARKINGS

- 11.8.1. All check valves shall have clearly marked in the casting of the body and Disc with the following information:
- A. Size of valve DN in mm.
 - B. Pressure rating PN in Bars.
 - C. Manufacturer name / logo.
 - D. Foundry name / logo.
 - E. Identification of Material type
 - F. Manufacturing Standards Number.
 - G. Year of manufacture.
 - H. Direction of Flow

11.8.2. All check valves shall have individual identification strip which shall be marked by engraving or embossing on a metal strip, the name of manufacturer, individual serial number, tender number and Year of manufacturing.

11.8.3. The metal strip shall be of minimum size of 100mm x 30mm and shall be fixed securely and permanently at appropriate location by glue of industrial grade with a melting point higher than 80°C and shall not be screwed or riveted.

11.9. PACKING

11.9.1. The packing shall be as per Section 1, Clause 1.7 of this specification.



Section - 12

Pressure Reducing/ Regulation/ Sustaining Valve

12.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

- 12.1.1 All valves shall be suitable for a maximum working pressure of 16 Bar.
- 12.1.2 All valves shall be suitable for use with water temperature up to 50°C in climate and soil conditions encountered in the State of Qatar.
- 12.1.3 All flanged valves shall be drilled to BSEN 1092-2, PN 16.
- 12.1.4 The valve must be capable of bubble tight sealing against 16 bar operating pressure unless mentioned otherwise.
- 12.1.5 The Pressure regulating and Pressure reducing valves shall be of the globe type, piston or diaphragm hydraulic operated.
- 12.1.6 All valves shall be of the pressure compensated globe type complete with external hydraulic relay system and designed to automatically control pressure immediately upstream/ downstream its position.
- 12.1.7 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.
- 12.1.8 The controlling pressure point can be at the valve at a point on the pipeline upstream or downstream from the valve.
- 12.1.9 The relay control system shall consist of a hydraulic relay valve unit and strainer block, pilot/ solenoid valves and interconnecting small bore piping.
- 12.1.10 The relay valve shall be manufactured completely in stainless steel 316, which shall consist of diaphragm, diaphragm guide, support piston, spindle, etc.
- 12.1.11 The strainer unit shall have body and internals of stainless steel.
- 12.1.12 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.
- 12.1.13 All necessary repairs to the valve shall be possible without removing the valve from the line.
- 12.1.14 The pressure setting shall be capable of being adjusted on site using an adjustment screw to alter the compression of the spring.
- 12.1.15 The strainer shall be on inline type to allow for maintenance without affecting the control valve.

12.1.16 The opening and closing speeds shall also be field adjustable by adjusting the flow regulation screw.

12.1.17 The valves shall be capable of being fully opened or fully closed by respective opening and closing of upstream and downstream ground cocks.

12.1.18 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.

12.2 MATERIALS OF PRESSURE REDUCING / REGULATING/SUSTAINING VALVES

12.2.1 The Pressure Reducing / Regulating/ sustaining Valves shall be of following properties as given in Table (24).

Table (24) Properties of Pressure Reducing / Regulating/ Sustaining Valves Sheet

Property	Data
Body	DI GGG- 40/50, DIN1693, BS EN 1563 :2011, Grade EN-GJS-400-15, Grade EN-GJS-500-7, ISO400-15, ISO500-7
Trims Ported guide & seat ring	Gunmetal to BS 1982
Sealing on Plunger	EPDM Rubber
Pilot valve	Stainless Steel 316/316L or A4
Pilot parts	Stainless Steel 316/316L or A4
Indicating rod	Stainless Steel 316/316L or A4
Fasteners	Stainless Steel 316/316L or A4
Spring	Stainless Steel 316/316L or A4

12.2.2 The wedge shall be completely vulcanized by EPDM and coupled to the valve stem by gunmetal or dezincification resistance brass nut slide into the specifically designed slot hole in wedge or rigidly fastened into the wedge body by forging before rubber vulcanization.

12.3.3 All component parts of the valve body i.e. bonnet, and stem seal housing shall be fastened together, where setscrews are used, the socket shall be provided with a PVC cap.

12.4 MATERIAL COATINGS & INTERNAL COMPONENTS

12.4.1 The entire body of valves shall be coated both internally and externally with either of the following:

- 300-micron Fusion bonded epoxy (Polymeric anticorrosion) coating as per GSK or WIS No. 4-52-01.

- 300-micron Electrostatic ally applied epoxy coating.
- 300-micron Fluidized bed epoxy coating.

12.4.2 In special cases, Rilsan coating with 300 microns can be approved.

12.4.3 The color of coating shall be “Blue”, Code RAL--5002/5005/5010/5012/5015/5017/5022.

12.4.4 All materials coating shall be WRC, DVGW, SGS, and DWI., KIWA, NSF 61 or other Worldwide Known Quality Body Certifiers in contact with potable water at +50°C.

12.4.5 All casting shall be properly finished, sand blasted and cleaned before coating

12.4.6 Coating shall be smooth, and mirror finish without any hairline cracks/ air bubble/ pinhole.

12.4.7 **Adhesion Test:** Adhesion of coating to metal shall not be less than 12N/mm² (BSI BS EN ISO 4624).

12.4.8 **Holiday Test:** Porosity of coating shall be “zero” on 3 kV DC tester.

12.4.9 **Hardness:** Intrinsic Rockwell hardness shall be between 50 – 60, according to DIN EN ISO 2815.

12.4.10 **Impact resistance:** For applying of impact energy of 5 Nm on coating the cracks should not develop, when tested by 3 kV DC tester.

12.4.11 All above mentioned tests shall be carried out according to WIS 4-52-01, EN 14901, ISO 18468, BS EN ISO 4624 or DIN 30677.

12.5 MARKING

12.5.1 It is mandatory that all valves shall have clearly marked in the casting of the body the following information;

- A. Size of valve DN in mm.
- B. Pressure rating PN in Bars.
- C. Manufacturer name / logo.
- D. Foundry name / logo.
- E. Identification of Material type
- F. Manufacturing Standards Number.
- G. Year of manufacture.

12.5.2 All valves shall have individual identification strip which shall be marked by engraving or embossing on a metal strip, the name of manufacturer, individual serial number, tender number and Year of manufacturing.

12.5.3 The metal strip shall be of minimum size of 100mm x 30mm and shall be fixed securely and permanently at appropriate location by glue of industrial grade with a melting point higher than 80°C and shall not be screwed or riveted.

12.6 PACKING

12.6.1 The packing shall be as per Section 1, Clause 1.7 of this specification.

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Section - 13

Flow Control Valves

13.2 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

13.1.1 All flow control valve valves shall be manufactured and tested in accordance with BS EN 1074-1 and 1074-5 or equivalent.

13.1.2 Flow control valve shall be designed for use with nominal pressure of 16 Bar.

13.1.3 All flow control valve shall be with flange ends on both sides, drilled according to BS EN 1092-2, PN16.

13.1.4 All valves shall be capable of bubble tight sealing against 16 bar operating pressure.

13.1.5 All valves shall have positioner.

13.1.6 Double flanged design. Face-to-face dimensions shall be as per BSEN 558-1, Basic Series 15.

13.1.7 The flow control valves shall be of Axial flow (Needle/ Plunger) non-diaphragm type (with manual hand wheel or with electrical actuator).

13.1.8 All flow control valve shall be suitable for use with water temperature up to 50°C in climate and soil conditions encountered in the State of Qatar.

13.1.9 The maximum allowable noise level shall be 70 DBA at 1-meter distance.

13.1.10 Relation of valve capacity close valve position with percentage (%) opened shall be linear with approximately 50% close valve position, 50% opened valve position and produce no cavitation throughout the operating range as specified in the data sheet.

13.1.11 The valve shall be manually operated with clockwise hand wheel closing. Pressure drop across the valve should not exceed 0.10 bar when fully opened at maximum specified flow rate.

13.1.12 The valve shall have positioned indicating 0, 25, 50, 75 and 100% opened.

13.1.13 The control valves shall be electrically activated; accordingly, the actuator shall be modulating type and can be complete with a positioned.

13.2 MATERIALS OF NEEDLE/ PLUNGER TYPE VALVES

13.2.1 Needle/ Plunger type flow control valve construction materials shall be as per below table (25).

Table (25) Valve Data Sheet

Property	Data
Body	DI GGG- 40/50, DIN1693, BS EN 1563 :2011, Grade EN-GJS-400-15, Grade EN-GJS-500-7, ISO400-15, ISO500-7.
Piston	Stainless Steel AISI 316/316L (1.4401/1.4404)
Piston Ring	Stainless Steel AISI 316/316L (1.4401/1.4404)
Spindle	Stainless Steel AISI 316L (1.4404)
Cage (Cavitation ring)	Stainless Steel AISI 316L (1.4404)
Cage ring	Stainless Steel AISI 316L (1.4404)
Stem	Stainless Steel AISI 316L (1.4404)
Piston rod	Stainless Steel AISI 316L (1.4404)
Guide bushing	Stainless Steel AISI 316L (1.4404)
Seat retaining bush	Stainless Steel AISI 316L (1.4404)
Fasteners	Stainless Steel AISI 316/316L (1.4401/1.4404)

13.3 MATERIAL COATINGS & INTERNAL COMPONENTS

13.3.1 All casting shall be properly finished, sand blasted and cleaned before coating.

13.3.2 Coating shall be smooth, and mirror finish without any hairline cracks/ air bubble/ pinhole.

13.3.3 The entire body of valves shall be coated both internally and externally with either of the following:

- 300-micron Fusion bonded epoxy (Polymeric anticorrosion) coating as per GSK and WIS No. 4-52-01.
- 300-micron Electrostatic ally applied epoxy coating.
- 300-micron Fluidized bed epoxy coating.

13.3.4 In special cases, Rilsan coating with 300 microns can be approved.

13.3.5 The color of coating shall be “Blue”, Code RAL-- 5002/5005/5010/5012/5015/5017/5022.

13.3.6 All materials coating shall be WRC, DVGW, SGS, and DWI., KIWA, NSF 61 or other Worldwide Known Quality Body Certifiers in contact with potable water at +50°C.

13.3.7 **Adhesion Test:** Adhesion of coating to metal shall not be less than 12N/mm².

13.3.8 **Holiday Test:** Porosity of coating shall be “zero” on 3 kV DC tester.

13.3.9 **Hardness:** Intrinsic Rockwell hardness shall be between 50 - 60, according to DIN EN ISO 2815.

13.3.10 **Impact resistance:** For applying of impact energy of 5 Nm on coating the cracks should not develop, when tested by 3 kV DC tester.

13.3.11 All above mentioned tests shall be carried out according to WIS 4-52-01, EN 14901, ISO 18468, BS EN ISO 4624 or DIN 30677.

13.4 TESTING

13.4.1 All valves shall be subject to hydrostatic pressure test as per BS EN 1074 / BS EN 12266 for the following hydraulic pressure:

- Hydraulic test for Body - 24 Bar
- Hydraulic test for Seat (Disc strength) - 17.6 Bar

13.4.2 KAHRAMAA reserves the right to witness the hydraulic test and coating test of the valves at manufacturer factory/locally, coating test shall be carried out as per clause 7.3.

13.5 MARKING

13.5.1 All valves shall have clearly marked in the casting of the body and Disc with the following information:

- A. Size of valve DN in mm.
- B. Pressure rating PN in Bars.
- C. Manufacturer name / logo.
- D. Foundry name / logo.
- E. Identification of Material type
- F. Manufacturing Standards Number.
- G. Year of manufacture.
- H. Arrow for direction of flow

13.5.2 All flow control valves shall have individual identification strip which shall be marked by engraving or embossing on a metal strip, the name of manufacturer, individual serial number, tender number and Year of manufacturing.

13.5.3 The metal strip shall be of minimum size of 100mm x 30mm and shall be fixed securely and permanently at appropriate location by glue of industrial grade with a melting point higher than 80°C and shall not be screwed or riveted.

13.6 GEAR BOX

13.6.1 All gear box shall be suitable for use with water temperature up to 50°C.

13.6.2 The coating shall be as per clause 13.3

13.6.3 Fasteners shall be Stainless Steel 316/316L or A4.

13.6.4 Open and Close position indicators shall be marked over the gear box body for physical identification.

13.6.5 The properties of the gearbox shall be as given in Table (27).

Table (27) Properties of the Gearbox Data Sheet

Property	Data
Body & body cover	Ductile Iron GGG40/GGG50/SG/EN GJS 400-15/500-7/ ISO 400-15/ ISO 500-7
Worm Wheel	Ductil Iron EN-GJS-500-7 of any or Any High Carbon Steel
Worm gear-shaft	Ductil Iron EN-GJS-500-7 , Steel C40 / Carbon steel
Gear	SG Iron, BS EN 1563 Grade 700-2, GGG 50 or AISI 1045
Bearing	Steel
Stem nut	Aluminum Bronze / Steel / DZR Brass

13.6.6 A metal strip/Name plate for gear box details such as manufacturer details, torque details etc. shall be fixed securely and permanently over the gear box.

13.7 MOTORIZED ACTUATOR

13.7.1 Actuator shall be non-intrusive type, designed for valve in accordance to EN 15714-2:2010.

13.7.2 Electric type actuators shall include the motor, operator unit gearing, limit switches, torque switches, de clutch lever, auxiliary hand wheel, forward reversing and off position switches for local valve operation, local position indicator, local and remote selector switch, terminal for remote control, valve status and position indications (as specified below).

13.7.3 The actuator motor and all electrical enclosure shall be waterproof (IP68) according to EN 60529 against submersion up to 8 m head of water for 96 hours. Motor shall

be totally enclosed non ventilated construction with class F insulation with temperature rise limited to class B according to IEC 85.

- 13.7.4 Motors shall be of the totally enclosed non ventilated type (TENV), motors shall be protected by 3 thermal contacts, which are embedded in the motor windings.
- 13.7.5 Motors must be totally separated from the lubricant-filled gearing of the actuator, allowing replacement of motor without losing any lubricant regardless of mounting position.
- 13.7.6 Actuator shall be suitable for operations in ambient temperature up to 50°C and capable of prolonged operations in a sand laden atmosphere. Available torque shall be at least two times the valve manufacturer's maximum torque requirements. The motor shall be designed especially for use on valve operation, having high torque capacity coupled with low inertia. Motor shall be of sufficient size to open or close a valve against the maximum specified differential pressure when the voltage drop at the motor is 10% of the nominal voltage.
- 13.7.7 Limit and torque switches to be operated by counter gear driven cams, which are mechanically linked to the driving devices, without slip-clutches. Battery backed limit sensing shall not be used to avoid malfunction of the actuator in case of power failure or dead battery.
- 13.7.8 Actuator shall be equipped with both mechanical indicator and blinking indicator which continuously shows the valve travel from fully open to fully close and vice versa.
- 13.7.9 Electrical power to the motor shall be 3 phase, 50 Hz, 415 V or subject to project requirement. Heater and thermostats shall be provided for high humidity condition.
- 13.7.10 The power gearing shall be consisting of helical gears of heat-treated steel and worn gearing of hardened alloy steel. All power gearing shall be lubricated with high speed parts on anti-friction bearing. It shall be possible to remove the motor/actuator from the valve without taking the valve out of service.
- 13.7.11 Provision shall be made for the incorporation of 4-20 mA position transmitters, powered internally to transmit the valve position remotely. The actuator shall be provided at least or minimum with following normally open/close dry contacts for monitoring following status remotely:

Open, Close, Healthy/Available, Failed, In Remote and Local.

Also following provision to control actuator from remotely through NO/NC potential free contact.

Open & Close (In Desired Position), Stop

13.7.12 The integral motor controls shall include solid state contacts (thyristors) for modulating duty actuators.

13.7.13 Whenever LCD display is provided in actuator lockable protection cover must be provided.

13.7.14 OEM/Agent should be available locally for round the clock service support.

13.7.15 An anti-condensation heater must be installed inside the actuator, suitable for continuous operation. Actuator must provide an alarm signal in case of failure of the anti-condensation heater.

13.8 MOTORIZED ACTUATOR SPARE PARTS

13.8.1 The following spare parts shall be provided, but not limited to the following:

1. 2No. of complete set of Motorized valve actuators of each model and rating should be supplied as spares.
2. 2No. of OEM Tool kit, that of high quality and housed in a suitable, lockable metal box.

13.9 PACKING

13.9.1 The packing shall be as per Section 1, Clause 1.7 of this specification.

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Section - 14

Flap Valves

14.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

14.1.1. All Flap valves shall be manufactured in accordance with BSEN 16447 or equivalent.

14.1.2. All Flap valve flanges shall be drilled to BSEN 1092-2 PN16.

14.1.3. The nominal pressure is PN16 bar.

14.1.4. All material shall be suitable for use with potable water at a temperature of 50° C

14.1.5. The design of the flap valve body shall be such that there is adequate clearance around the back of the door to minimize jamming by rags and debris.

14.2 MATERIALS OF FLAP VALVE

14.2.1 The Flap Valve shall be conforming to the following specifications given in Table (29).

Table (29) Valve Data Sheet

Property	Data
Body / bonnet, weight and hinge	DI GGG- 40/50, DIN1693, BS EN 1563:2011, Grade EN-GJS-400-15, Grade EN-GJS-500-7, ISO400-15, ISO500-7, or Stainless Steel 316/316L or A4.
Flap	DI GGG- 40/50, DIN1693, BS EN 1563:2011, Grade EN-GJS-400-15, Grade EN-GJS-500-7, ISO400-15, ISO500-7, or Stainless Steel 316/316L or A4.
Bush	Dezincification resistant brass CZ 132 / Gunmetal
Bonnet Gasket	Elastomer EPDM
Shaft	Duplex Stainless Steel 416 or 420 or Stainless Steel 316/316L or A4.
Built-in Fasteners	Stainless Steel 316/316L, A4 or Bronze and shall be protected against corrosion

14.3 MATERIAL COATING AND INTERNAL COMPONENTS

14.3.1 The entire body of flap valves shall be coated both internally and externally with either of the following:

- 300-micron Fusion bonded epoxy (Polymeric anticorrosion) coating as per GSK or WIS No. 4-52-01.
- 300-micron Electrostatic ally applied epoxy coating.
- 300-micron Fluidized bed epoxy coating.

14.3.2 In special cases, Rilsan coating with 300 microns can be approved.

14.3.3 The color of coating shall be “Blue”, Code RAL 5002/5005/5010/5012/5015/5017/5022.

14.3.4 All materials coating shall be WRC, DVGW, SGS, and DWI., KIWA, NSF 61 or other Worldwide Known Quality Body Certifiers in contact with potable water at +50°C.

14.3.5 The internal and external surfaces of the flap valve and the disc shall be blast cleaned to SA 2.5, ISO 8501 standards and coated with fusion bonded epoxy coating system to a dry film thickness of 300mm.

14.3.6 All casting shall be properly finished, sand blasted and cleaned before coating.

14.3.7 Coating shall be smooth, and mirror finish without any hairline cracks/ air bubble/ pinhole.

14.3.8 **Adhesion Test:** Adhesion of coating to metal shall not be less than 12N/mm².

14.3.9 **Holiday Test:** Porosity of coating shall be “zero” on 3 kV DC tester.

14.3.10 **Hardness:** Intrinsic Rockwell hardness shall be between 50 - 60, according to DIN EN ISO 2815.

14.3.11 **Impact resistance:** For applying of impact energy of 5 Nm on coating the cracks should not develop, when tested by 3 kV DC tester.

14.3.12 All above mentioned tests shall be carried out according to WIS 4-52-01, EN 14901, ISO 18468, BS EN ISO 4624 or DIN 30677.

14.4 MARKINGS

14.4.1 All flap valves shall have clearly marked in the casting of the body and Disc with the following information:

- Size of valve DN in mm.
- Pressure rating PN in bars for flange.
- Manufacturer name / logo.
- Foundry name / logo.
- Identification of Material type
- Manufacturing Standards Number.
- Year of manufacture.

14.4.2 All flap valves shall have individual identification strip which shall be marked by engraving or embossing on a metal strip, the name of manufacturer, individual serial number, tender number and Year of manufacturing.

14.4.3 The metal strip shall be of minimum size of 100mm x 30mm and shall be fixed securely and permanently at appropriate location by glue of industrial grade with a melting point higher than 80°C and shall not be screwed or riveted.

14.5 PACKING

14.5.1 The packing shall be as per Section 1, Clause 1.7 of this specification.

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Section - 15

Split Case Pumps

15.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

15.2 GENERAL REQUIREMENTS:

- 15.2.1 The pump covered by this specification shall be suitable for the specified operation conditions and shall be designed and manufactured for a minimum service of 20 years plus minimum of three years of uninterrupted continuous operation or 25,000 hours' operation, whichever is later.
- 15.2.2 Pumps shall be Single stage, double suction, horizontal shaft, centrifugal split case design, suction and discharge connections shall be located on opposite sides of the lower casing, allowing removal of the rotating assembly without disturbing the system piping connections.
- 15.2.3 The pump shall be suitable for variable speed operation, pressure control and generally satisfactory operation.
- 15.2.4 The pump maximum speed shall be 1500 RPM and the minimum operating speed shall not be more than 50% of the maximum speed and not be less than 600 RPM. accordingly, the pump motor shall be suitable for this range.
- 15.2.5 The pump operation range shall be located between minimum allowable flow specified by pump supplier and the maximum allowable flow of 120 % of best efficiency point at all pump operating speeds.
- 15.2.6 The minimum flow for each pump shall not exceed 40% of the BEP (duty point) flow point as standard value for all KAHRAMAA projects to avoid any dispute during the commissioning phase and any misinterpretation.
- 15.2.7 The maximum flow for each pump shall not be less than 110% of the rated flow at best efficacy point at rated speed.
- 15.2.8 The pump capacity at run-out conditions shall not be less than 130% of the duty point unless specifically mentioned otherwise.
- 15.2.9 The optimum efficiency of the pump shall not be less than 85% at rated duty point and shall be designed for parallel operation of duty pumps. The minimum efficiency shall not be less than 70% at any other operating point located within specified pump operation range.

- 15.2.10 The head-capacity curve of the pumps shall be stable at all flow rates. The curve shall be of a continuously rising type, right up to shut-off.
- 15.2.11 The required net positive suction head (NPSHR) at rated flow shall be at least 1.5 meters less than the available net positive suction head (NPSHA).
- 15.2.12 The contractor shall verify the NPSHA value prior to ordering of pumps.
- 15.2.13 The combined noise level of pump-drive system and motor shall not exceed “85dbA” at 1-meter distance from equipment unless mentioned otherwise.
- 15.2.14 The selected duty impeller should not exceed 95% of the r maximum impeller diameter.
- 15.2.15 Water velocity in pump suction and discharge nozzles shall not exceed 4 and 5 m/s respectively at maximum operating condition within pump operation specified range.
- 15.2.16 Low maintenance cost, reliability and trouble-free operation shall be a prime consideration when selecting pumps.
- 15.2.17 The rated speed of and submitted pump shall be not less than 1500 mm approximately unless the motor speed was less due to motor number of poles and the duty point shall be based on this maximum speed. Providing duty point at less speed is not permitted.
- 15.2.18 The pumps and associated equipment shall include all necessary provisions to prevent contamination of the drinking water being pumped.
- 15.2.19 The pumps shall be designed for continuous duty at rated parameters and shall be capable of pumping the flow ranges specified above.
- 15.2.20 The rated capacity and head of each pump shall be as specified on relevant particular specifications.
- 15.2.21 Pumps shall have their main dimensions within the appropriate tolerances in accordance with the standard EN 735

15.3 DESIGN CONSIDERATIONS

- 15.3.1 The pumps and associated equipment shall be designed and be suitable for operation in the climatic conditions of state of Qatar.
- 15.3.2 The Conditions under which the pumps are required to operate is tropical weather, with excess heat dust and humidity at time.
- 15.3.3 The pumps shall be conforming to the following specifications for the climatic conditions to be considered at site as given in table (30):

Table (30) Specifications for the climatic conditions

Descriptions	Data
Maximum ambient temperature:	+50 °C
Minimum ambient temperature:	5 °C
Maximum metal temperature under the sun:	85 °C
Maximum ambient relative humidity:	100%
Minimum ambient humidity:	20%
Design wind velocity	150 km/hr.
Yearly rainfall	80-150 mm
Under certain climatic conditions, considerable condensation may take place.	
A considerable amount of salt is contained in atmosphere, which together with the relative high ambient humidity, can produce severe corrosion problems.	

15.4 PUMP CONSTRUCTION REQUIREMENTS:**15.4.1 Casing**

- 15.4.1.1 The casing of pumps shall exhibit good strength, corrosion resistance, abrasive-wear resistance;
- 15.4.1.2 Material of pump casing shall be ductile iron ASTM SL6 close grained cast iron to EN BS 1561 or BS 1452 Grade 260, ASTM A48 CL30 or equivalent and be free of any blow holes and sand pockets resulting from imperfect and defective castings unless specifically mentioned otherwise.
- 15.4.1.3 Inner surfaces of casing which are in contact with the fluid shall be ideally shaped to match the streamlines and be finished so that minimum head loss and favorable efficiency could be attained.
- 15.4.1.4 The casing shall be provided with vent and drain connections, screwed type, and fitted with removable cocks.
- 15.4.1.5 The material of construction for the removable cocks vent and drain pipes shall be stainless steel 316.
- 15.4.1.6 all screw or bolt and nut seating in the casing shall be machined and the joint face of the pump casing shall be sealed by means of flat gasket and bolted together.
- 15.4.1.7 Pump feet shall be casted as an integral part of the lower casing.
- 15.4.1.8 Casing shall be hydrostatically tested at 150% the pressure developed by the pump at shut-off.

- 15.4.1.9 Flanges shall be drilled to BS EN 1092-1 PN 16 rating.
- 15.4.1.10 All pump casings shall have a minimum corrosion allowance of 3 mm.
- 15.4.1.11 Sufficient clearance shall be provided between the drain opening and base plate, to allow for assembly of pipes and fittings, as required without dismantling the pump.
- 15.4.1.12 All auxiliary piping connected to the casing shall be made of stainless steel 316L.

15.4.2 IMPELLER

- 15.4.2.1 The impeller of pump shall be double entry suction manufactured from duplex stainless steel (Ferritic-Austenitic Grade) with Number Code 1.4517 (GX2CrNiMoCuN-25-6-3-3) as per EN 10283 and EN 10213 or equivalent standard ASTM 890.
- 15.4.2.2 They shall be machined where practicable and made as smooth as possible elsewhere.
- 15.4.2.3 The vanes of each impeller shall be identical as regards form and dimensions to ensure hydraulic balance in operation.
- 15.4.2.4 The impellers together with shaft shall be statically and dynamically balanced to ensure a smooth and free of vibration running throughout its operating range.
- 15.4.2.5 The impeller shall be keyed to the shaft using one-piece key.
- 15.4.2.6 Impellers shall be fixed to the shaft such that they do not loosen or become detached when the pump is rotating in the wrong direction by reverse flow or reversed motor connections.

15.4.3 Shaft

- 15.4.3.1 The shaft of pumps should exhibit high tensile strength, endurance limit and corrosion resistance.
- 15.4.3.2 Material of pump shaft shall be of duplex stainless steel 416 or 420 or equivalent.
- 15.4.3.3 Sealing of shaft is made by means of mechanical seals.
- 15.4.3.4 Shafts shall be provided with suitable hard-faced sleeves.
- 15.4.3.5 Shaft Sleeve shall be renewable and not be in contact with water anywhere.
- 15.4.3.6 Shaft sleeves material shall be stainless steel grade 316Ti (320S31/1.4571).
- 15.4.3.7 The uni-shaft or combined assembly (shaft and impeller) are not acceptable.

15.4.4 Wearing Rings

- 15.4.4.1 The pump shall have wearing rings at casing and impeller.
- 15.4.4.2 Material of renewable rings shall be stainless steel 316Ti (320S31/EN 1.4571).
- 15.4.4.3 Clearance within the rings shall be acceptable and according to manufacturer standard.
- 15.4.5 Wearing rings shall be of renewable type and should be easily replaceable.
- 15.4.6 The hardness of wearing rings shall be less than casing and impeller.

15.4.7 End Bearings & Bearing Housing

- 15.4.7.1 Both radial and thrust bearings shall be of antifriction maintenance free type.
- 15.4.7.2 Bearings shall be self-alignment type.
- 15.4.7.3 Bearings shall be sized to offer a minimum L10 life of 100000 hours when operating at any flow rate.
- 15.4.7.4 Bearings shall be greased or oil lubricated and protected from water ingress by appropriate means.
- 15.4.7.5 Bearing housing shall be of close-grained cast iron to EN BS 1561 or BS 1452 Grade 260, ASTM A48 CL30 or equivalent and be free of any blow holes and sand pockets resulting from imperfect and defective castings unless specifically mentioned otherwise.
- 15.4.7.6 Bearing supports shall not be bolted type and shall be part of lower half pump casing only.

15.4.8 Mechanical Seal

- 15.4.8.1 The shaft seals shall be of the mechanical type.
- 15.4.8.2 The seals shall be designed and suited for both intermittent and continuous running under all operating conditions.
- 15.4.8.3 Lubricating and cooling water for the seals shall be drawn from connections on the pump casings.
- 15.4.8.4 The sealing construction and design should be enabled for easy inspection and removal of the seals without disturbing the pumps.
- 15.4.8.5 The seal chamber size should be proper for all the well-known mechanical seals.
- 15.4.8.6 An inline filter must be used in the flush line to prevent any foreign material from entering the seal chamber.

15.4.8.7 No component seals shall be provided, only cartridge shall be accepted.

15.4.8.8 16.4.8.8 The part number of OEM shall be engraved over the mechanical seal.

15.4.9 Bearings

15.4.9.1 Pumps bearing shall be Ball or roller bearing of anti-friction maintenance free standard type provided in accordance with the pump manufacturers recommendations.

15.4.9.2 The bearings shall be easy to replace and available from manufacturer's normal stocks.

15.4.9.3 In the design of bearing assemblies, due consideration must be given to the ambient temperatures.

15.4.9.4 The bearings shall be protected against ingress of dust and moisture by effective seals.

15.4.9.5 If the bearing housing brackets and/or gland bowls are not integral with the pump casing, they must be positively located by stainless steel dowel pins to ensure correct repositioning of the brackets in the event of the joints being distributed.

15.4.9.6 Bearing supports shall not be bolted type and shall be part of pump casing lower half only.

15.4.9.7 Where pump bearings are pressure lubricated, they shall be supplied complete with the associated lubricating oil system.

15.4.9.8 Bearing shall have an ISO L10 life of 100,000 hours as minimum.

15.4.10 Vents & Drains

15.4.10.1 An air-release priming cock shall be fitted at the top of the top of the volute casing on each pump and the discharge piped to one of the shaft gland bowls.

15.4.10.2 The gland and body drains shall be collected in a drip-tray and the final discharge shall be piped individually from each pump to the drainage channel in the pump house.

15.4.10.3 The drain pipes shall be in 25mm nominal size heavy wall copper or stainless-steel tube fitted with couplings as to facilitate removal of any possible blockages.

15.4.10.4 Pump case flushing tubing, drain line and associated fittings shall be SS316/316L material.

15.4.11 Nozzle & Flanges

- 15.4.11.1 Suction and Discharge connections shall be suitable to be connected to PN 16/25, EN 1092-1/2 flanges as provided in relevant tender document unless mentioned otherwise.
- 15.4.11.2 The suction nozzles shall be designed for the same pressures as the discharge nozzles.
- 15.4.11.3 The suction nozzle size shall be selected to keep the suction velocity low, as to avoid cavitation.
- 15.4.11.4 Flanges shall be raised face, drilled to PN 16/25, EN 1092-1 unless mentioned otherwise.

15.5 ACCESSORIES

15.5.1 Driver (Electric Motor)

- 15.5.1.1 The pumps shall be driven by suitably rated electric motor, conforming to applicable specifications and to relevant tender document.
- 15.5.1.2 The motor shall be designed with over-rating factors to take the below mentioned conditions into consideration:
- An over-rating of 15% higher than the maximum power required at point of 110 % of the best efficiency point. Of Q-H curve.
 - Temperature de-rating for the motor +50°C and above.

15.5.2 Variable speed drive

- 15.5.2.1 Variation of speed shall be achieved by frequency converters.
- 15.5.2.2 The variable speed pumping system shall be designed to operate over the entire range of operation.
- 15.5.2.3 The combination of pump and drive shall be designed to operate under changing loads without getting overloaded and/or tripped.
- 15.5.2.4 The offered Variable Speed Drive System (V.S.D.S.) shall comply to relevant specifications and data sheets.

15.5.3 Couplings

- 15.5.3.1 The pump shall be coupled to the motor via flexible coupling.
- 15.5.3.2 The flexible couplings shall be of rigid maintenance free type and shall be of an approved design.
- 15.5.3.3 The type of coupling offered shall be submitted for KAHRAMAA approval.

15.6 MATERIAL COATING & INTERNAL COMPONENTS

15.6.1 The entire body of the pump shall be coated both internally and externally with either of the following:

- 300-micron Fusion bonded epoxy (Polymeric anticorrosion) coating as per GSK or WIS No. 4-52-01.
- 300-micron Electrostatic ally applied epoxy coating.
- 300-micron Fluidized bed epoxy coating.

15.6.2 In special cases, Rilsan coating with 300 microns can be approved.

15.6.3 The color of coating shall be “Blue”, Code RAL-- 5002/5005/5010/5012/5015/5017/5022.

15.6.4 All materials coating shall be WRC, DVGW, SGS, and DWI., KIWA, NSF 61 or other Worldwide Known Quality Body Certifiers in contact with potable water at +50°C.

15.6.5 All casting shall be properly finished, sand blasted and cleaned before coating

15.6.6 Coating shall be smooth, and mirror finish without any hairline cracks/ air bubble/ pinhole.

15.6.7 **Adhesion Test:** Adhesion of coating to metal shall not be less than 12N/mm².

15.6.8 **Holiday Test:** Porosity of coating shall be “zero” on 3 kV DC tester.

15.6.9 **Hardness:** Intrinsic Rockwell hardness shall be between 50 - 60, according to DIN EN ISO 2815.

15.6.10 **Impact resistance:** For applying of impact energy of 5 Nm on coating the cracks should not develop and shall be tested by 3 kV DC tester.

15.6.11 All above mentioned tests shall be carried out according to WIS 4-52-01, EN 14901, ISO 18468, BS EN ISO 4624 or DIN 30677.

15.7 TESTING

15.7.1.1 Hydrostatic pressure tests for the casing, body, and seating of pumps at 1.5 times of the design pressure plus the suction pressure if the operating pressure is above 5 bars or as per the relevant code. If the design pressure is below 5 bars, the test pressure shall be the shut off pressure plus the suction pressure.

15.7.2 A factory test certificate shall be issued for each pump giving its serial numbers and shall be submitted to KAHRAMAA at the time of supply.

15.7.3 KAHRAMAA reserves the right to witness the Performance tests for each pump coupled to its own motor in accordance with ISO 9906 part 1&2, dimensional, functionality and coating tests of the pumps at manufacturer factory/locally.

15.8 SPARE PARTS, TOOLS AND ACCESSORIES

- 15.8.1 The Manufacturer/supplier should include all necessary and required spare parts for pump and relating special of standard tools and accessories.
- 15.8.2 Spare parts shall suitably be packed and labeled as to the related apparatus for long storage under the climate conditions prevailing in Qatar.
- 15.8.3 The minimum spare parts required shall be comprised as given in Table (31):

Table (31) Minimum Required Spare Parts

N o.	Spare part Name	Number of pumps including stand by pumps					
		1	2	3	4	5	6
1	Impeller (each)	1	1	1	2	3	3
2	Impeller wear ring(set)	1	2	4	6	8	8
3	Casing wear rings (set)	1	2	4	6	8	8
4	Shaft with key and nut (set)	1	1	2	3	4	4
5	Shaft protection sleeves (set)	1	2	4	6	8	8
6	Pumps bearings & washers (set)	1	2	4	6	8	8
7	Mechanical seals (each)	1	2	3	6	8	8
8	O-rings, V-rings, and gaskets (set)	4	4	8	12	16	16
9	Pump/motor coupling	1	1	1	2	2	2
10	Bearing housing	1	1	1	2	2	2

15.9 NAMEPLATES, MARKING & LABELING

- 15.9.1 All pumps shall be identified by marking and labeling.
- 15.9.2 A stainless-steel nameplate shall be provided for each pump including complete information: pump identification, manufacturers name, type & size, serial No., speed, rated flow, rated head, maximum casing pressure, weights of pump /motor & base plate in kilograms.
- 15.9.3 Details in nameplate shall be for the BEP features not to the duty point since power rating & shaft power are defined for the nominal efficiency not for any other operating point in the Pump's curve.
- 15.9.4 The direction of rotation shall be clearly indicated, and engraved on the pump body, otherwise on the name plate.
- 15.9.5 The plate shall be securely riveted or screwed in a readily accessible position on the pump. If screwed, heads are to be deformed to prevent removal, and on no account shall the method of fixing involve drilling into the wall of a pressure part.
- 15.9.6 The name plate dimensions shall be according to DIN 825 standard.

15.10 PACKING

- 15.10.1 The packing shall be as per Section 1, Clause 1.7 of this specification.



Section - 16

submersible Pumps

16.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

- 16.1.1 Free-standing, close coupled electric motors driven pumping units used for handling floor drainage shall be located as specified throughout the Works.
- 16.1.2 The units shall be compact and robust, easily removable and simple to install and handle.
- 16.1.3 Shall be specifically designed for both intermittent and continuous service, and suitable for prolonged operation in the "dry" state.

16.2 CONSTRUCTION

- 16.2.1 The pump shall be capable of passing a sphere of not less than 30 mm in diameter.
- 16.2.2 The impeller shall be of heavy construction and filed smooth so that rags and stringy matter will not adhere to them.
- 16.2.3 The pump shall be capable of working for long periods without cleaning or attention, and special precautions shall be taken to avoid wear on working surface due to grit.

16.3 MATERIAL CONSTRUCTION DETAIL

- 16.3.1 Casing: Cast iron- EN BS 1561 or BS 1452 Grade 260, ASTM A48 CL30
- 16.3.2 Impeller and cutter: Cast Iron of same above type or Duplex Stainless Steel.
- 16.3.3 Shaft: SS420 minimum or Duplex Stainless Steel EN1.4462.

16.4 COATING

- 16.4.1 All external and internal parts of pump body must be coated with 300 micron of suitable epoxy resin coating.

16.5 ACCESSORIES

- 16.5.1 Pipe works within the building shall be in convenient lengths connected with unions.
- 16.5.2 The non-return valves shall be fitted in the delivery branches immediately below the sluice valves.
- 16.5.3 UPVC pipes might be used in underground installation outside the building.
- 16.5.4 17.5.5 Strainer to be provided on the water duct to filter the unwanted objects entering to the pit.
- 16.5.5 Lifting facility shall be provided on the pump/motors.

16.6 DRIVING MOTOR

- 16.6.1 Motor shall be suitable for continuous operation when immersed in the specified medium in an ambient temperature of 50°C.
- 16.6.2 Motor shall be of the squirrel-cage, close coupled submersible electrical motor pump, induction type complying with the requirements of the Electrical Specifications and capable of up to 15 starts per hour.
- 16.6.3 The motor installation shall be class F and the degree of protection shall be IP68.
- 16.6.4 Terminal box shall be water tight and the motor shall be supplied with an adequate length of multi core heavy duty flexible cable with tough rubber outer sheet.
- 16.6.5 The cable shall pass through a water tight gland on entry into the motor body. The motor and impeller assembly shall be dynamically balanced at the duty point.
- 16.6.6 Motor cables to be bunched separately for easier maintenance in case of changing the motor.
- 16.6.7 Motor cables to be terminated in a suitable industrial socket/junction Box for easier maintenance.

16.7 CONTROL

- 16.7.1 All such dewatering pumps shall be in duplicate (duty and stand-by) and automatically controlled using float switches or stainless-steel probes arrangement (L, H, HH) with the lowest sensed level unit at that of the top of the pump Volute chamber.
- 16.7.2 At the end of every duty cycle, the duty / standby mode shall change automatically.
- 16.7.3 Both pumps shall be started automatically at HH level and in case any failure of one pump. Other should start automatically during normal operation.
- 16.7.4 Minimum followings items shall be provided in sump pump control panel:
 - a. A manual / off / auto selector switch.
 - b. Main isolator/MCCB.
 - c. Indication lamp for pump trip, running stop, available for duty & standby or pump no 1 & 2 as well as low, high & high-high level indication.
 - d. Lamp test bottom
 - e. Ammeter for duty & standby of pump 1 & 2
 - f. Voltmeter
- 16.7.5 Sump pump trip & HH level indication shall be connected with wall mounted screen LED system & SCADA.

16.7.6 Pumps should change over for alternate operation.

16.7.7 Pumps greater than 2.2 KW; the mechanical seal shall be monitored by the monitoring equipment to detect the following (Alarm indication shall be transmitted to the control panel):

- Moisture within the oil chamber.
- Moisture/water/oil in the motor casing.
- Temperature rise on the hydraulic driven end bearing.
- Loss of oil in the oil chamber.

16.8 PUMP PERFORMANCE AND NUMBER

16.8.1 Dual pumps shall be installed at each location, one duty and the other as standby. Each pump shall give 5 l/s at 15 m Total Head at speed not exceed 3000 r.p.m.

16.8.2 Necessary spare parts/sets for the complete servicing/replacement of the equipment shall be provided.

16.8.3 A complete set of sump pump (1 no) to be supplied along with important spares from Sump Pump Control Panel.

16.9 NAMEPLATES, MARKING & LABELING

16.9.1 All pumps shall be identified by marking and labeling.

16.9.2 A stainless-steel nameplate shall be provided for each pump including complete information: pump identification, manufacturers name, type & size, serial No., speed, rated flow, rated head, maximum casing pressure, weights of pump /motor & base plate in kilograms.

16.9.3 Details in nameplate shall be for the BEP features not to the duty point since power rating & shaft power are defined for the nominal efficiency not for any other operating point in the Pump's curve.

16.9.4 The direction of rotation shall be clearly indicated, preferably on the pump, otherwise on the name plate.

16.9.5 The plate shall be securely riveted or screwed in a readily accessible position on the pump. If screwed, heads are to be deformed to prevent removal, and on no account shall the method of fixing involve drilling into the wall of a pressure part.

16.9.6 The name plate dimensions shall be according to DIN 825 standard.

16.10 PACKING

16.10.1 The packing shall be as per Section 1, Clause 1.7 of this specification.

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Section - 17

Surface Boxes and Manhole Covers

17.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

- 17.1.1 Surface boxes shall be manufactured and tested according to BS-5834 - Part 2 and manhole covers shall be manufactured and tested according EN 124-Part 2.
- 17.1.2 Surface boxes and manhole covers shall be made from ductile cast iron conforming to BS EN 1563.
- 17.1.3 Surface boxes and manhole covers shall be class D400.
- 17.1.4 The shape and sizes shall be as per table 1.
- 17.1.5 All parts shall be casted without defects and irregularities and shall be visibly free from air holes, sand holes, cold shuts, chill, voids, whether due to shrinkage, gas inclusions or other causes.
- 17.1.6 Surface boxes and manhole covers shall be coated with a cold applied black bitumen solution in accordance with BS-3416 or black epoxy coated.
- 17.1.7 All manhole covers shall be kite marked.
- 17.1.8 Lifting keys of malleable cast iron with loop handles or “T” handle as appropriate suitable for all surfaces box and manhole covers and shall be supplied One (1) set per Twenty (20) surface boxes.
- 17.1.9 All surface boxes and manhole cover shall have bounding ribs on the base frame.
- 17.1.10 All covers shall have open keyways and prising slot in frame.
- 17.1.11 All covers shall have graving letters as per table (32). Water/W, GV for gate valve or AV for air valve or BV for butterfly valve or SC for stopcock and ferrules or FH for fire hydrant or WO for washout or FM for Electromagnetic flow meter or OF for Fibre Optic etc.

Table (32): Carved symbol on the covers

Carved Symbol	Material description
Water/W	All covers
GV	Cover for gate valve
AV	Cover for Air valve
BV	Cover for butterfly valve

SC	Cover for stopcock and ferrule
FH	Cover for fire hydrant
WO	cover for Washout
FM	Cover for Electromagnetic flow meter
OF	Cover for Fibre Optic

17.1.12 Surface boxes and manhole covers shall have a height and depth of raised for recessed pattern, Letters, Symbols and KAHRAMAA logo with minimum of 5mm raised (See Appendix III).

17.1.13 All covers shall be fitted with security chains.

17.2 SIZES OF SURFACE BOXES AND MANHOLE COVERS

17.2.1 The sizes of surface boxes and manhole covers described below in table (33):

Table (33): Surface Boxes and Manhole Covers Description

Material Description	Frame Depth (mm)	Clear Opening	Shape
Surface boxes	100	150 x 150 mm	Square type with single cover or with double triangular covers
	100	380 x 230 mm	Rectangular type with single cover
Manhole covers	100	750 x 750 mm	Square type with double triangular covers
	100	1000 x 1000 mm	Square type with double triangular covers

17.3 MARKING

17.3.1 Surface box and manhole covers shall be marked with the following:

- The number of this standard
- The appropriate grade/ or class (e.g. Grade A /D 400)
- The name and/or identification mark of the manufacturer;
- KAHRAMAA Logo
- The year of manufacture
- Any markings relating to the intended application/identity of the user;
- The mark of a certification body, when applicable;
- The product identification (name and/or model number);
- Refer to standard detail in the attachments.

17.4 PACKING

17.4.1 The packing shall be as per Section 1, Clause 1.7 of this specification.



Section - 18

Marker Posts and Indicator Plates

18.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

18.2 MARKER POST

18.2.1 Marker post shall be manufactured from steel channel as detailed in the standard drawing No. 1/49/C (See Appendix III).

18.2.2 Each post will be supplied with a steel backing plate use for GV, AV and FH, and Each post will be supplied with:

A) Six (6) Nos. of M-8 x 30mm long counter sunk bolts with hexagon drive.

B) Four (4) Nos. of M-6 x 30mm long slotted round head bolts with nuts and spring washers.

18.2.3 All posts and backing plates are to be grit blasted prior to the application of a suitable three stages epoxy paint system. The color shall be light aircraft gray color Code RAL 7035, 7038

18.2.4 All post & backing plates shall have identification metal strip (i.e. name or logo of the manufacturers).

18.3 INDICATOR PLATE

18.3.1 Indicator plates and tiles will be from the 'F' range. The Engineer will notify Numbers and letters in Arabic and English to be shown on the tiles.

18.3.2 Fire hydrant plates will have the letter 'H' cross and commas be empty of tiles and have a plastic backing plate.

18.3.3 Gate valve and air valve plates will have the Arabic 'Water' 'T' cross and commas, be empty of tiles and have a plastic backing plate.

18.4 ALUMINUM INDICATOR PLATE

18.4.1 All aluminum indicator plate shall be designed as per the standard drawing No. NDS-SD-902 (See Appendix III).

18.4.2 Aluminum Plate Thickness: 3mm

18.4.3 Type of Coating: Electrostatic powder coating

18.4.4 International coating cooler code: RAL 5019 (Blue)/ RAL 3002 (Red)

18.4.5 Coating thickness: 100 microns

18.4.6 Depth of engraved letters: 0.8mm

18.4.7 Coating UV resistance: ASTM G 154 (UVB- 131) cycle at 50C UV and 4 hours at 40C condensation, no chalking, excellent gloss retention & color stability after 1000 hours testing. Series: 1307, Gloss: 77 ± 7 , Finish: smooth.

18.5 PACKING

18.5.1 The packing shall be as per Section 1, Clause 1.7 of this specification.

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Section - 19

Copper Tubes for Service Connection

19.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

19.1.1 The copper tubes shall have certification for no influence on water intended for human consumption according to EN 15664.

19.1.2 The copper tubes shall be manufactured and tested according to BS EN 1057

19.1.3 The copper tube grade shall be CU-DHP (Number CW024A).

19.2 COPPER TUBES PROPERTIES

19.2.1 The copper tubes dimensions and material condition shall be as given in Table (34):

Table (34): Copper Tubes Dimensions and Materials

Nominal outside diameter (mm)	Nominal wall thickness (Table Y) (mm)	Material condition
22	1.2	R220 (Annealed)
28	1.2	R220 (Annealed)
42	1.5	R250 (Half Hard) or R290 (Hard)
54	2.0	R250 (Half Hard) or R290 (Hard)

19.2.2 The copper tubes shall be complying with the following mechanical properties as given in Table (35):

Table (35): Mechanical Properties of Copper Tubes

Material condition	Minimum Tensile Strength (MPa)	Minimum Elongation (%)	Hardness (Vickers)
R220 (Annealed)	220	40	40 to 70
R250 (Half Hard)	250	30	75 To 100
R290 (Hard)	290	3	Min. 100

19.2.3 The form of delivery as per Table (36):

Table (36) —Form of delivery

Form of delivery	Nominal outside diameter (mm)		Nominal Length (m)	Material condition
	From	up to and including		
Coils	22	28	25 or 50	R220 (Annealed)
Straight lengths	35	54	5 or 6	R250 (Half Hard) or R290 (Hard)

19.3 PLASTIC COVERING

19.3.1 The copper tubes shall be externally covered over their entire length with continuous seamless polyethylene sheathing according to EN 13349.

19.3.2 The color shall be Green/Blue as per standard BS 1710.

19.3.3 The standardized overall thicknesses of plastics coverings are given in Table (37).

Table (37) — Dimensions and tolerances for plastic covering

Nominal outside diameter (mm)		Nominal thickness of the covering (mm)	Tolerance on nominal thickness
From	up to and including		
22	28	1.0	± 0.1
42	54	1.5	± 0.15

19.4 TESTS

19.4.1 **Hydrostatic test:** Copper tubes of sizes up to 54 mm shall be subjected to at least a water pressure of 35 bars for a minimum period of 10 seconds without evidence of leaking according to EN 1057.

19.4.2 **Eddy Current Test:**

19.4.2.1 Signals produced by reference standard tubes set the sorting limits for acceptance or rejection. Tubes containing defects which produce signals equal to or greater than the sorting limit shall be rejected.

19.4.2.2 Test shall be as standard BSEN1971.

19.4.3 **Pneumatic Test:**

19.4.3.1 The tube under test shall be connected to a source of pressurized air. Air pressure at 4 bar (0,4 MPa) shall be maintained in the tube.

19.4.3.2 The tube shall be completely immersed in water for a minimum period of 10 s and inspected for the issue of bubbles from the tube. Should any bubbles be observed then the tube shall be rejected. If no bubbles are observed, then the tube shall be accepted

19.5 MARKING AND FORM OF DELIVERY

19.5.1 Copper Tubes shall be permanently marked at repeated distances at least every meter along their length. The height of the characters shall be at least 4 mm. The Marking shall be legible and not water soluble and shall follow the following sequence:

- a. Number of standards
- b. Copper tube nominal cross-sectional dimensions: outside diameter × wall thickness,

- c. Copper wall thickness,
- d. Identification for material condition,
- e. Manufacturer's identification mark,
- f. Form and length,
- g. Date of production.

19.5.2 The manufacturer shall provide inspection test certificate in accordance with EN 10204 for the supplied copper tubes.

19.6 PACKING

19.6.1 The packing shall be as per Section 1, Clause 1.7 of this specification.

19.6.2 The coiled tubing is to be secured against uncoiling during transit, the straight lengths to be supplied in wooden boxes and is to be fitted with end caps to prevent damage during transit.

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Section - 20

Fittings for Service Connection

20.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

20.1.1 The compression fittings shall be manufactured to EN 1254.

20.1.2 The compression fittings shall be manufacturing as:

- a. Type B: Requires forming of the tube at its end, and in which the joint is made by compressing the formed portion of the tube against the formed end of the fitting or a loose ring or sleeve within the fitting/tube.
- b. Type A: end that requires no preparation of the ends of the tube other than that they are cut square and deburred, or chamfered when specified, and in which the joint is made by the compression of a ring or sleeve onto the outside wall of the tube with or without additional sealing elements and with or without an internal tube support.

20.1.3 Copper and copper alloys Plumbing Fittings shall conform to the two (2) parts as standard EN1254:

- a. Part 1: Fittings with ends for capillary soldering or capillary brazing to copper tubes as EN 1254-1,
- b. Part 2: Fittings with compression ends for use with copper tubes as EN 1254-2,

20.1.4 All the above fittings shall be suitable for use with copper tube to BS EN 1057:2006 + A1:2010, Part 1, Table 'Y'/ EN 1057 R-220-250/290, shall also be suitable for underground use with potable water and shall be wrapped by lubricated tape.

20.1.5 All nuts on these fittings shall be hexagonal or octagonal.

20.1.6 All Fittings must be new, clean, and recently manufactured.

20.1.7 All Gaskets to be supplied with fittings shall be suitable for use with potable water.

20.2 MATERIALS

20.2.1. All fittings shall be as following tables:

Table (38) — Material of Gunmetal/DZR Brass Fittings

Designation			Standard
Material	Symbol	Number	
Gunmetal	CuSn5Zn5Pb5-C	CC491K	BSEN 1982
DZR Brass	CuZn36Pb2As	CW602N	BSEN 12164

Table (39) — Mechanical Properties of Gunmetal Fittings

Mechanical Properties	Unit	Value
Tensile Strength	N/mm ²	270

Proof/Yield Strength	N/mm ²	112
Elongation	%	36
Hardness	microns	70

Table (40) Physical Properties of Gunmetal Fittings

Physical Properties	Unit	Value
Density	g/cm ³	8.8

20.3. SWIVEL FERRULE

- 20.3.1. The ferrule shall be screw down pattern and suitable for connecting copper service pipes.
- 20.3.2. The ferrules shall be suitable for insertion under-pressure using a normal under-pressure-tapping machine, as well as for normal dry installation.
- 20.3.3. The ferrules shall be manufactured throughout in 'gunmetal' (CC491K) to BSEN 1982 including the inner plug and the top plug.
- 20.3.4. The ferrule shall be designed as a main stem with a 360° swivel outlet at 90° with control of water flow via the threaded inner plug.
- 20.3.5. The following inlet/outlet connection will be required as per given in Table (41):

Table (41) The Inlet / Outlet connection

Size of ferrule	Type of outlet connection
¾" x 22mm	Copper compression, EN 1254-2, Type 'A and 'B
1" x 28mm	Copper compression, EN 1254-2, Type 'A and 'B
1½" x 42mm	Copper compression, EN 1254-2, Type 'A and 'B
2" x 54mm	Copper compression, EN 1254-2, Type 'A and 'B

20.4. STOPCOCKS (CRUTCH HEADS TYPE)

- 20.4.1. For underground application Stopcock shall be manufactured from gunmetal (CC491K) to BSEN 1982 and BS 5433.
- 20.4.2. Stopcock materials are to be suitable for use with potable water at a normal temperature of 50° C.
- 20.4.3. Stopcocks shall be suitable for use with compression fittings type 'B'.

20.5. LOCKABLE VALVE OR GATE VALVE WITH LOCK SHIELD

- 20.5.1. The Lockable valve shall be manufactured in accordance with BS EN 12288: 2010 (Formerly BS 5154: 1991)

20.5.2. The Lockable valve shall be made of gunmetal (CC491K) to BS EN 1982, DZR brass (CW602N) or brass to BS EN 12164.

20.5.3. The Lockable valve shall be pressure-rated at PN 16 bars and suitable for use with potable water at a normal temperature of 50° C.

20.5.4. The Lockable valve shall be female threaded.

20.6. SADDLES

20.6.1. Saddle strap shall be manufactured from 'Gunmetal' (CC491K) to BSEN 1982 with bolts size suitable for ferrule connections up to 54mm, (2 Inches).

20.6.2. The saddle shall be of two parts fitted with EPDM sealing gasket in a groove on the underside of the flat boss.

20.6.3. All bolts, nuts and washers shall be stainless steel grade 316/316L/A4 or A4L.

20.6.4. The saddles shall be suitable for use with ductile iron pipes to BSEN 545 / ISO 2531.

20.7. MARKING

20.7.1. All fittings shall have engraved or casted the following:

- a) The manufacturer's name or Logo.
- b) Standard Number.
- c) The size of the fitting in mm.
- d) Type of material

20.8. PACKING

20.9.1 The packing shall be as per Section 1, Clause 1.7 of this specification.

20.9.2 All compression fittings must be individually packed in transparent protective bags indicating its type and size.

20.9.3 All compression fittings must be packed in cartoon boxes.

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Section - 21

Stainless Steel Repair clamps

21.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

21.1.1 The repair clamps shall be manufactured from high grade Stainless Steel AISI 316/316L.

21.1.2 The repair clamps shall be suitable for use with Ductile Iron pipes manufactured to BS EN 545 / BS ISO 2531. All pipe diameters being metric.

21.1.3 The repair clamps shall be suitable for a working pressure of 16 bars.

21.1.4 The repair clamps unit shall be supplied with all parts and accessories and ready for use.

21.1.5 All units are to be supplied of Two (02) bands segments for easy handling during installation.

21.1.6 All units are to have 'Finger' lugs to ensure bolt guidance and alignments of units during installation.

21.1.7 In the case of under pressure drilling tees, the method of jointing the branch to the main clamp body shall also be set out in the offer. In the case of welded joints, the method and standards of welding and preparation shall be set out.

21.1.8 The packing of all units shall provide protection from damage during transit and be suitable for storage once delivered.

21.2 MATERIALS OF CONSTRUCTION

21.2.1 The repair clamps shall be of the following properties as given in Table (42).

Table (42) Properties of repair clamp Data Sheet

Property	Data
Skin/ Locking Plate/Bridge Plate/Lugs/Flats	Stainless Steel 316/316L
Rubber lining	EPDM rubber type WA to BS EN 681-1, hardness EDK-70
Flanged Outlets for Repair Clamp with Flange Branch	Stainless Steel AISI 316/316L
Fasteners	Stainless Steel 316/316L or A4/A4L and shall be protected against corrosion

21.3 LENGTHS OF THE CLAMP

21.3.1 Lengths of the repair clamp shall fall within the ranges as given in Table below (43).

Table (43) The length of the repair clamp

Type	Minimum Length	Maximum Length
A	300 mm	450 mm
B	500 mm	600 mm
C	750 mm	1000 mm

21.4 FLANGES

21.4.1 The flanges fitted to the branch outlet the repair clamp shall be drilled to BS EN 1092-1, PN-16.

21.5 MARKING

21.5.1 Repair camps shall be marked with the following information: -

- Manufacturer's name or logo.
- Size of pipe for which the repair clamp is manufactured for.
- Direction of rotation.
- Size of the flanged branch
- Grade of stainless steel.

21.6 PACKING

21.6.1 The packing shall be as per Section 1, Clause 1.7 of this specification.

21.6.2 The packing of all units shall provide protection from damage during transit and be suitable for storage once delivered.

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Section - 22

uPVC Duct

22.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

22.1.1 All uPVC Duct should be manufactured, and test according to BS EN 1401-1.

22.1.2 The Color of uPVC Duct pipes shall be orange brown (approximately RAL 8023) or dusty grey (approximately RAL 7037) in color.

22.1.3 All Dimensions of uPVC Duct pipes shall be in millimeters as given in Table (44):

Table (44) The Dimension of the uPVC Ducts Pipe.

Nominal Size (DN/OD)	Nominal Outside Diameter (d _n)	Mean Outside Diameter		Wall Thickness SN4 SDR 41	
		d _{em,min}	d _{em,max.}	e _{min}	e _{max.}
110	110	110.0	110.3	3.2	3.8
160	160	160.0	160.4	4.0	4.6

22.1.4 All Ducts should be supplied in 4 meters or 6 meters in length.

22.1.5 The external and the internal surface of the pipe shall be smooth, clean, and free from grooving, blistering, impurities and any other surface irregularity.

22.1.6 Pipe ends shall be cleanly cut and the ends of the pipes shall be square to their axis.

22.2 MARKING

22.2.1 uPVC Duct should be supplied with a center guideline printed on the middle of the duct, where the marking consists of the following:

- Number of Standard. (e.g. EN 1401)
- Manufacturer name and/or trademark.
- Nominal Size.
- Minimum wall thickness or SDR

22.3 PACKING

22.3.1 The packing shall be as per Section 1, Clause 1.7 of this specification.



Section - 23

GRP District Water Meter Cabinet

23.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

- 23.1.1 The GRP cabinet shall be of the shape and dimensions as shown in drawing in Appendix III.1 and consists of main cabinet and its door.
- 23.1.2 GRP Cabinets shall have 'KAHRAMAA' logo in both Arabic and English of appropriate size and to be located at the top portion of the cabinet door.
- 23.1.3 The GRP Cabinets must have clear-wired glass window for reading the meter registration on EDU/transmitter

23.2 MATERIAL:

- 23.2.1 Glass-fiber reinforced polyester, color: white fire-retardant gelcoat and fire retardant isophthalic polyester resin and the glass fiber shall be 20 – 40%.
- 23.2.2 Cabinets shall be produced by an experienced manufacturer with both sides smooth with cold press or RTM (resin transfer molding)

23.3 PROTECTION:

- 23.3.1 Capable to protect flow meter's Electronic Display Unit (Secondary Device) and other associated electrical equipment's from effect of direct sunlight temperature and other harsh weather conditions.
- 23.3.2 The GRP cabinet shall be designed to IP65.

23.4 FLAMMABILITY:

- 23.4.1 Fire retardant material GRP

23.5 OPERATING CONDITIONS:

- 23.5.1 The operating Conditions shall be up to + 85°C.

23.6 ENCLOSURE DESIGN:

- 23.6.1 Enclosures shall protect the Electronic Meter's display unit and associated electrical equipment's & cables against environmental exposure, resistance to all conceivable climatic influences without need for frequent maintenance and touch-up works.
- 23.6.2 Cabinet shall be ventilated by stainless steel louvers marine grade at sides making air circulation and forcing warm air out through the vents and avoiding any condensation inside. Side vents shall be protected by stainless steel insect proof mesh (vermin screen).
- 23.6.3 One-door access and 2 or 3 hinges on right-hand side and having a security master lock. Cabinet also shall be of detachable enclosure, where top roof, base and vertical four

sides (front, rear and 2 sides) are of detachable for easy installation and maintenance.

Single body construction (roof, 4 vertical sides and base cast together)

23.7 THE GRP DISTRICT CABINET DOOR SPECIFICATION

- 23.7.1 A clear wired glass window for reading 10cm x 10cm with outer frame and inner frame to slide for replacement and a locking screw.
- 23.7.2 3 Nos. reinforcing ribs of 4mm thickness and 6cm wide at the inner surface of the door for more rigidly.
- 23.7.3 2 Nos. Stainless Steel 316 hinges marine grade.
- 23.7.4 2 Nos. of locks (8mm Triangular Lock) with adjustable grip tool head and non-unique key as per manufacturers catalogue. There will be an L-angle lip at lock tongue at the edges at two locations of the lock, to make the locking arrangement strong.
- 23.7.5 The door is having a rigid frame all round closing on the cabinet lip where there is a neoprene gasket.
- 23.7.6 At the center of the door is embossed the logo of KAHRAMAA 18cm x 9cm with space for customer number plate.

23.8 THE GRP DISTRICT CABINET ACCESSORIES

- 23.8.1 At the back of the inner surface embedded in the material 4 bolts 8mm dia. x 5cm long for fixing a GRP board 8mm thickness (51cm width x 60cm height) for equipment installation.
- 23.8.2 At the two sides there are ventilation grills Stainless Steel with 5 slots with dimensions 12cm x 12cm and inside there is a Stainless Steel 316 wire mesh 2mm x 2mm frame for insect protection.
- 23.8.3 At the base there are two opening holes of 5cm for PVC ducts.
- 23.8.4 At the two sides of the base are riveted with 4 rivets angles for anchoring the box with 3 holes of 8mm dia.
- 23.8.5 All rivets to have inner washer support.
- 23.8.6 The cabinet shall be supplied with backboard fixings made of 8mm fiber sheet and aluminum frames as provision for future installation of transmitter, terminal box, Isolator switch etc. The 8mm fiber backboard sheet shall be fixed at rear side of cabinet so that the GRP rear surface of cabinet will not be screwed/modified while fixing any devices inside the cabinet.
- 23.8.7 At bottom of cabinet, two access holes with 2" uPVC duct shall be kept as entry of 'Electronic Flow Meter's Sensor Cable' and 'A.C Power Supply cable' (from

KAHRAMAA electricity network or from existing KAHRAMAA electrical installation).

23.8.8 As this cabinet will be placed on top of 50cm plinth concrete foundation, these two bottom holes shall correspond to two holes made with 2" uPVC duct at bottom 50cm plinth concrete foundation, as both cable & wire would travel from underground towards the cabinet.

23.9 PACKING

23.9.1 The packing shall be as per Section 1, Clause 1.7 of this specification.

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Section - 24

Aluminum Water Service Cabinet

24.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

24.1.1 Water service cabinet shall be manufactured from Aluminum sheet thickness 3 ± 0.2 mm.

24.1.2 Coating shall be white color and minimum thickness 100 microns.

24.1.3 All Cabinet shall contain the following:

- Georgian wired glass for meter reading facility.
- KAHRAMAA logo with number plate.
- Louvered ventilation stainless steel screen as per drawings in Appendix III.1
- Neoprene gasket between door and cabinet.
- Two (02) Allen Lock (8mm Triangular Lock).
- Holes with rubber bush to allow smaller size pipes 22-54 mm (inlet-outlet)
- Plastic end caps.
- Internal handle to lift cabinet door easily.
- AMR compartment.

24.2 STANDARD WATER SERVICE CABINET SIZES

24.2.1 Water service cabinet (Wall Mounted type) overall size shall be Width 300 x Hight 830 x Depth 230 As per drawing No. NDS/SD/01/2012 in Appendix III.1

24.2.2 Water Service cabinet (Surface Mounted type) overall size shall be Width 300 x Hight 830 x Depth 200 As per drawing NDS/SD/09/11 in Appendix III.1

24.3 BULK WATER SERVICE CABINET SIZES

24.3.1 Bulk service cabinet for 2-inch diameter, overall size shall be Width 750 x Hight 650 x Depth 300 for electronic flow meter (remote type) As per drawings NDS/ SD/30/02 in Appendix III.1

24.3.2 Bulk service cabinet for 2-inch diameter, overall size shall be Width 750 x Hight 650 x Depth 300 for electronic flow meter (integral type) As per drawings NDS/SD/30/03 in Appendix III.1

24.4 MULTI-DOMESTIC WATER SERVICE CABINET SIZE

24.4.1 Multi-domestic water service cabinet, overall size shall be Width 1100 x Hight 850 x Depth 200 As per drawings NDS/SD/02/2012 and NDS/SD/03/2012 in Appendix III.1

24.5 MARKING

24.5.1 A nameplate shall be securely attached to the cabinet, in a clearly visible and accessible location. The nameplate shall be made of a material not affected by weather conditions. The following data shall be engraved on the plate:

- A. Name of manufacturer or brand (trade) name;
- B. Serial number
- C. Size;
- D. Year of manufacture;

24.6 PACKING

24.6.1 The packing shall be as per Section 1, Clause 1.7 of this specification.



Section - 25

Electromagnetic Flow Meters District

25.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

- 25.1.1 Electromagnetic flow meters shall be of a robust construction; generally, with the requirements of EN ISO 20465:2017.
- 25.1.2 Materials of construction of flow meter and transmitter shall be durable, have a high level of corrosion resistance, and, be resistant to degradation by sunlight.
- 25.1.3 The water meter should be suitable for use in ambient temperatures up to +70°C and relative humidity up to 100%. the temperature of exposed metal to sunlight can exceed 85°C.
- 25.1.4 The water meter should be suitable for use with potable water temperature ranges 5°C to 50°C: class MAT 50 as per ISO 4064.
- 25.1.5 Original Equipment Manufacturer (OEM) clearance shall be obtained for flow meter installation drawings with respect to its performance for the full range of the selected size.
- 25.1.6 The installation shall be powered from a UPS power supply, in-case the UPS not available a regulated power supply supported by battery/Solar shall be used upon KM approval.
- 25.1.7 Magnetic flow meters shall have flanged connections PN 16 (Material: Carbon Steel) to project specification and requirements (whichever higher).
- 25.1.8 Original Equipment Manufacturer (OEM) shall provide all accessories and fittings necessary for earthen / grounding Electromagnetic flow meters for a noise-free signal;
- 25.1.9 The clean Instrument earthing shall be checked and ensured it is less than 1 ohm. (Two earthing rings shall be provided and installed for each flow meter as mandatory).
- 25.1.10 The upstream and downstream straight lengths required for the offered Magnetic flow meters are to be furnished along with bid for the full range of the flow meter with required accuracy.
- 25.1.11 The criterion for location of piping reducers, valves, tees, bends etc. shall be checked by Consultant/Contractor/ Original Equipment Manufacturer (OEM) according to the above recommendations.

25.2 FLOW SENSOR AND TRANSMITTER

- 25.3.1 The transmitter shall incorporate a display indicating a four-digit flow rate.
- 25.3.2 Connections and sensors shall be suitable for use with nominal pressure PN16 bars.
- 25.3.3 All connections, sensors and transmitters shall be water tight IP68 NEMA 6P for submersible installation in chamber and metering pits that are prone to flooding, IP67 could be acceptable for transmitter only, if installed with KM approved sun shade/cabinet.
- 25.3.4 The flow meter shall be bi-directional.
- 25.3.5 The sensor housing/tube shall be constructed of stainless-steel grade 316L and coated with a certified epoxy coating (Minimum 300 micron).
- 25.3.6 The material of flow Sensor Electrode shall be HASTELLOY C-276 (or better).
- 25.3.7 The Flow Meter interning liner material shall withstand 1 ppm of Chlorine (Cl₂) or chlorine dioxide (ClO₂) in water network.
- 25.3.8 The Original Equipment Manufacturer (OEM) should install only the manufacture Flow meter sensor cable for better accuracy and special cable shall be armored. The length of the cable shall be as per site/project requirements.
- 25.3.9 The special cable potting must be done at site in a recommended temperature environment.
- 25.3.10 The electrical connection should be 20 mm armored IP68 glands.
- 25.3.11 The Flow sensor Terminal Box shall be of stainless steel with IP68 protection.
- 25.3.12 The sensor shall be to IP68 rated for permanent submergence up to 5 meters.
- 25.3.13 The transmitter shall have background illumination with a three buttons menu driven at least alphanumeric 3 lines,
- 25.3.14 The main display shall have all information such as flow rate, totalized values, faults and alarms continuously available.
- 25.3.15 The transmitter power supply shall be suitable for both 240Vac and 24Vdc.
- 25.3.16 The flow meter (transmitter and/or any additional required HART modules) shall have at least the following outputs:
 - 4 digital Configurable alarms (Fault, Low Flow Alarm and High Flow Alarms, Empty pipeline detection alarm),
 - It shall include RS 485 Modbus-RTU protocol and/or HART interface,
 - 4-20 mA analogue signal for flow rate into 800 ohms max.
 - Pulse / Frequency by open collector transistor.

- 25.3.17 The totalizer value must be independently stored either in the sensor or in the transmitter.
- 25.3.18 The user interface shall be possible via handheld (HART) and via Asset Management System. Required hardware and software tools shall be supplied with license.
- 25.3.19 The Signal interface shall be traditional I/O, Modbus and HART.
- 25.3.20 The totalizer shall be configurable through Pulses/Modbus/HART communication.
- 25.3.21 Accuracy shall be 0.2% at 0.5 m/s and 0.5% at 0.2 M/S velocity of actual flow.
- 25.3.22 Each flow sensor shall be wet calibrated with the relevant/Paired transmitter and all the calibration information and factory settings matching the sensor/Transmitter shall be stored integrally within the converter's non-volatile memory.
- 25.3.23 At initial commissioning, the flow meter shall commence measurement without any initial programming.
- 25.3.24 The certificate of calibration shall be provided with each flow meter (having both flow sensor and transmitter details).
- 25.3.25 The Original Equipment Manufacturer (OEM) /OEM shall submit the fingerprint of the flow meter along with calibration certificate.
- 25.3.26 The signal converter/ Transmitter shall have the facility to replace a new signal converter/ Transmitter to upload all previous settings and resume measurement without any need for reprogramming or rewiring.
- 25.3.27 The offered bid price shall cover the manufacturer review of installation drawings, approval and their physical presence during site installation to confirm their recommendation for the minimum upstream and downstream installation requirements and other vital criteria for stable measurement.
- 25.3.28 The proposed Flow meter sensor / transmitter preferable to have wet calibration facility in Qatar or Middle East.
- 25.3.29 The Original Equipment Manufacturer (OEM) should submit minimum 5-point calibration certificate for each Flow meter with 0.2 m/s, 0.3 m/s ,0.4 m/s ,0.5m/s and 1 m/s Velocity points as Mandatory and the calibration certificate should have upstream and downstream distance details in the certificate.
- 25.3.30 During FAT KAHRAMAA Representative will check the 5-point calibration for each Flow meter type (as per Pipe Size).
- 25.3.31 The Original Equipment Manufacturer (OEM) shall submit the Calibration facility details with its accredited certificate during material submittal stage.
- 25.3.32 The facility shall be certified to conduct calibration as specified above.

25.3.33 The Original Equipment Manufacturer (OEM) shall provide the calibration certificate validity as follows:

- On shelf,
- After site installation.

25.3.34 The Flow Transmitter should have in-built self-diagnostic and Verification facility (internally in-built or externally with special tools & software) to cross check the function of the Transmitter & Sensor to print out the Certificate for audit purpose.

25.3.35 In-case the Original Equipment Manufacturer (OEM) /supplier choose a material with external verification feature, then he shall provide 5 years free of cost verification service to the KAHRAMAA, these five years shall be start after the successful test and completion date, each flow meter shall be verified twice per year (biannually).

25.3.36 The verification should be supported by necessary verification software and shall be able to be printed as a certificate to prove that the meter is within the limits of all parameters as the fingerprint.

25.3.37 The self-calibration method shall be stated in detail to demonstrate the elements under calibration.

25.3.38 The software and the special tools shall be provided to KAHRAMAA for future maintenance and trouble shooting.

25.3.39 The Original Equipment Manufacturer (OEM) should do yearly in-situ verification for the installed flow meter till the end of contract maintenance period.

25.3.40 The flow meter shall have the facility to link any further monitoring & data acquisition systems such AMR (Automatic Meter Readings), SCADA ... etc.

25.3.41 Provision of service passwords for security should be an essential feature of the transmitter to prevent tampering of the transmitter configuration. Write access should be prevented by an internal switch.

25.3.42 The transmitter shall have a simulation mode wherein simulation for Velocity, Q, Q%, I out, Pulse, Logic2 / Pulse 2, Logic 3 and HART can be carried out (internally / externally through source).

25.3.43 The sensor shall have minimum four electrodes, two electrodes to be used for empty pipe detection and two electrodes for measurements.

25.3.44 Self-cleaning feature for sensor (mechanical) shall be available.

25.4 FLOW METER REQUIREMENTS

25.5.1 Fluid characteristics:

- Velocity range,
- Pressure range,
- Conductivity,
- Temperature.

25.5.2 The flow meter hook-up (Certified by OEM) shall be submitted for KAHRAMAA for approval.

25.5.3 Testing & commissioning shall be conducted & certified by OEM flow meter commissioning expert.

25.5.4 Following Performance verifications shall be conducted in presence of KAHRAMAA staffs

- In-site verifications (fingerprint verifications),
- Flow rate and flow total verifications through reservoir volume displacement method.
- Original manuals (data sheet, catalogues, installation instruction, maintenance manual etc.) shall be supplied (hard copy and softcopies).

25.6 GROUNDING REQUIREMENTS

25.6.1 The electromagnetic flowmeter is sensitive to the electrical noise and static electrons that is present in most piping systems and it must be grounded for better performance of the electromagnetic flowmeter. Instructions on the optimum grounding method of the electromagnetic flowmeter are provided with the installation manual.

25.7 PACKING

25.7.1 The packing shall be as per Section 1, Clause 1.7 of this specification.



Section - 26

Electronic water meter (Domestic) DN 20mm to DN 40mm

26.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

- 26.1.1. Water meters shall comply with requirements of ISO 4064:2017 and Latest version of OIML R49 and MID.
- 26.1.2. The flow meter shall have the facility to link any future monitoring & data acquisition systems such Acquisition Metering Infrastructure (AMI)/ Automatic Meter Reading (AMR) or SCADA.
- 26.1.3. The supplied Meters must be supplied incorporate, in the design, both a strainer and non-return valve, integrated within the meter body.
- 26.1.4. A pair of meter end connections, comprising of a nut and a union, along with a washer fitted at outlet end and shall be included with each water meter.
- 26.1.5. A Strainer suitable for stopping particulate greater than 2.5 mm shall also be supplied with the water meter to be installed at the inlet end of each water meter.
- 26.1.6. The manufacturer should provide details regarding the guideline installation of water meter.
- 26.1.7. The water meter should be suitable for use in ambient temperatures up to +55°C and relative humidity up to 100%. the temperature of exposed metal to sunlight can exceed 70°C.
- 26.1.8. The water meter should be suitable for use with potable water temperature ranges 1°C to 50°C: class MAT 50 as per ISO 4064:2017.
- 26.1.9. Maximum Admissible Pressure: MAP16.
- 26.1.10. Pressure loss, Pressure loss class, maximum ΔP 63.
- 26.1.11. At Q₄: Pressure loss ≤ 1 bar with strainer and non-return valve.
- 26.1.12. The water meter, sensor (primary device) and transmitter (secondary device) shall be of IP 68 rated according to IEC529/EN 60529.
- 26.1.13. The Electronic water meter shall be of “Non-Moving Parts” with potting component complying ambient temperature.
- 26.1.14. Measuring principle shall be ultrasonic solid state
- 26.1.15. The meter must not suffer internal damage due to airflow passing through the meter.
- 26.1.16. The water meter shall be 100% Maintenance Free with no moving parts within the measuring chamber.

26.2 METER BODY AND CONNECTIONS:

26.2.1 The length of water meter body with respect to different size of meters shall follow Table (45) water dimensions of ISO 4064-1:2017 or equivalent as per discretion of the KAHRAMAA, as follows:

Table (45) The Length of Water Meter Body

Meter Size	Length of meter body	Thread G
20mm (3/4")	190 mm	G 1"
25mm (1")	198 mm	G 1"1/4
32mm (1"1/4)	260 mm	G 1"1/2
40mm (1"1/2)	200 /300 mm	G 2"

26.2.2. Sizes of water meter shall be suitable for use with KAHRAMAA water cabinet refer to Appendix III-1

26.2.3. Meter Body: plastic or better material capable to withstand against harsh weather conditions.

26.2.4. Meter and its connections parts shall have possibility to insert protection (seal).

26.2.5. Material of meter tube, connection fittings and thread shall be DZR brass, stainless steel or Gunmetal.

26.2.6. Internal Materials in contact with water shall be according to clause 26.2.5 and suitable for use with conditions of water of Kahramaa (Chlorine, Chlorine di-oxide...), should be single tube.

26.2.7. Connection type (thread) shall be clarified BSP, NPT, NPS or other.

26.2.8. All material of water meter shall be anti-corrosion and UV resistance.

26.2.9. The meter shall have Sensor of water temperature

26.3 TESTS:

26.3.1. Tests should be done as per latest standard of OIML R49 and ISO 4064-2:2017:

26.3.2. The meter shall be capable to withstanding the following test pressures without leakage or damage:

- 24bars (1.6 times the maximum admissible pressure) for 15 minutes,
- 32 bars (2 times the maximum admissible pressure) for 1 minute.

26.4 MEASUREMENT AND METROLOGICAL REQUIREMENTS

26.4.1. The meter must not require accuracy adjustment over a 15 years' period.

26.4.2. The meter must not lose accuracy with water borne particulate passing through meter and specially when air pass through it.

26.4.3. The measurement and meteorological properties mentioned in below Table (46) and Table (47):

Table (46) The Measurement and Meteorological Properties of the Flow Meter

Meter Register	Digital
Fixing Positions	the meter to be operated in all positions (vertical, horizontal position and oblique).
Measuring range	$R = Q_3/Q_1 \geq 400$
Class (Accuracy class)	Class I or Class II.
Method of Measurement	Volumetric Solid State

Table (47) Permanent Flow Rate Q_3 of the Flow Meter

Meter Size (DN)	Q_3 (m³/h)
20mm	4
25mm	6.3
32mm	10
40mm	16

$$R = Q_3/Q_1$$

$$Q_2/Q_1 = 1,6.$$

$$Q_4/Q_3 = 1,25.$$

26.5 DISPLAY AND MEMORY

26.5.1. Meter display shall indicate totalizer volume (m³) and other alarms (battery percentage, leakage alarm, back flow and empty pipe).

26.5.2. Alarm and data access should be locked. Only to be used for maintenance purpose with mandatory optical reader and other facilities to get the data.

26.5.3. Display shall be protected with proper cover as a part of meter.

26.5.4. Digit No. for m³ (minimum 5 digits); Digit No. for decimal (liter) (minimum 3 digits).

26.5.5. Display Type (Electronic) & details of Display (LCD) full digit including zero, unit (m³).

- 26.5.6. Data of daily consumptions, alarm and events can be store for minimum 180 days and able to download.
- 26.5.7. Memory storage should be accessible and capable to store data in a non-volatile memory during battery failure, tampering, etc. for a minimum retention of 18 months.
- 26.5.8. Capability to register the latest reading and date in internal memory of meter if it is stop working or stop registering the consumption for any causes.
- 26.5.9. Time Stamp shall be as per Calendar Day. (Real time) and to be record in the memory of meter.
- 26.5.10. Alarm of low battery, profile of water consumption & other facilities & alarm to be described.
- 26.5.11. Water temperature recording shall be stored along with flowmeter data.

26.6 MARKING

- 26.6.1. Meter serial number format shall be approved by KAHRAMAA.
- 26.6.2. All meters shall be marked in faceplate in accordance with 4064-1:2017 or equivalent as following:
- Unit of measurement: meter cube (m³),
 - Meter size
 - Value of Q₃, Q₃/Q₁, Q₂/Q₁ (if not equal to 1.6), and the pressure loss class,
 - Name or Logo of the manufacturer,
 - Meter serial number: Factory letter code, Year of manufacture and serial number (as near as possible to the indicating device),
 - Direction of flow shown on both sides of the body,
 - Maximum Admissible Pressure MAP16,
 - Temperature rating,
 - Kahramaa Logo,
 - Accuracy Class.
 - RF ID shall be unique for all meter supplied to the state of Qatar and linked to KAHRAMAA serial number,
 - RF frequency,
 - Communication Protocol,
 - QR code/Bar code,
 - OIML approval in details,
 - MID approval in details,

26.7 BATTERY

- 26.7.1. The water meter manufacturer shall ensure that the indicated lifetime of the battery guarantees that the meters shall function correctly for at least one year longer than the operational lifetime of the meter.
- 26.7.2. If powered with a high-capacity built-in battery, then minimum operational life shall be at least 15 years.
- 26.7.3. Manufacturer to state type/category of battery and its maximum life span.
- 26.7.4. Battery life (minimum 15 years) (warranty certificate from manufacturer) 24 index / day / meter at 55 °C
- 26.7.5. No replaceable battery, the battery compartment shall be capable of being secured by potting component from tampering and fraud.
- 26.7.6. Optical port for configuration and downloading of meter data.
- 26.7.7. Built-in battery shall not be visible.

26.8 REMOTE COMMUNICATION

- 26.8.1. The water meter can be networked and integrated with the AMI system as per mentioned 26.1.2
- 26.8.2. In addition to 'Direct Read from its register' the meter shall have Remote Communication facility, such as provision of a socket to insert a data retrieval port to monitor readings through an 'Automatic Meter Reading (AMR)' system in the future.
- 26.8.3. Remote Communication: Meter shall have facility for remote communication to transmit all meter data.
- 26.8.4. Low Battery or Battery lifetime indication local and remote (to AMR) is provided.
- 26.8.5. Communicator shall be built in as compact type and shall not be detachable.
- 26.8.6. Wireless M-Bus communication port type/standard.
- 26.8.7. Wireless M-Bus should support OMS protocol as per EN 13757-2, and as per EN 13757-4. Wireless meters should operate in frequency band 868 MHz
- 26.8.8. Data Logging for diagnostics via optical port or local RF.
- 26.8.9. Remote Vandalism/Tamper detection feature provided.
- 26.8.10. The meter shall support AES-128-bit encryption on wireless M-Bus where all meters shall have one unique security key.
- 26.8.11. The module shall support T1 modes as per EN13757. Wireless M-Bus telegram structure will be defined by KAHRAMAA.
- 26.8.12. The meter shall be record data for every 30 min and the sending frequency to AMI center shall be once per day from the meter.
- 26.8.13. The communication shall utilize inbuilt battery power supply of the meter.

26.8.14. The following registers as a minimum data to be transferred for remote communication:

- 1- Forward volume
- 2- Reverse volume
- 3- Net Volume
- 4- Flow rate
- 5- Pressure
- 6- Temperature
- 7- KAHRAMAA Sr. No.
- 8- Battery percentage.
- 9- Operating hours
- 10- Error status and Alarms: leakage, back flow, empty pipe and etc.

26.9 MATERIALS APPROVAL AND TESTS

26.9.1. All Metrologic certificates shall be submitted.

26.9.2. MID approval certificate shall be submitted.

26.9.3. Declaration conformity of water meters shall be according to OIML (International Organization of Legal Metrology).

26.9.4. Each water meter shall have a calibration certificate submitted to KAHRAMAA identified by serial number/ part number of the water meter.

26.9.5. Provide installation, operation and service manuals in both hardcopy and softcopy.

26.9.6. All associated accessories intended to be used for any project must be approved by the Materials Standards Section of Kahramaa, prior to place order for purchase.

26.9.7. Water meters shall be tested locally as per KM requirements.

26.9.8. KAHRAMAA have the right to test any materials before they leave the manufacturer's premises or after delivery to the site.

26.9.9. KAHRAMAA have the right to reject any non-compliant materials after delivery to the site, notwithstanding any preliminary test approval of the materials at the manufacturer's premises.

26.10 PACKING

26.10.1 . The packing shall be as per Section 1, Clause 1.7 of this specification.

26.10.2 . Each meter shall be individually packed in a primary carton with respective meter Serial Number marked on the outside of the carton along with Contract Number. Such cartons shall be packed in secondary wooden/ appropriate boxes with successive serial

numbers of meters in each box. Each wooden box shall also show on the outside the serial numbers of meters packed in it.



Section - 27

Electronic water meter (Bulk \geq DN50mm)

27.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

- 27.1.1 Each flow metering system shall comply with ISO 20456: 2017, latest version of OIML R49 and ISO 4064:2017 Part 1 or equivalent and comprise a flow sensor (primary device) mounted in the flow line and a separate Signal Converter or Electronic Display Unit (EDU) (secondary device).
- 27.1.2 The water meter shall have flange to-flange length (lay length) to ISO 20456:2017 and ISO 4064:2017 standard for electromagnetic meter up to DN400mm. Above DN400mm depends on projects requirements.
- 27.1.3 The flow meter should be a new technology Microprocessor based, electronic flow meter to measure & monitor a Bi-directional volumetric flow rate (Actual Flow rate, Totalizer, sum Totalizers and etc..), for full filled pipe pipelines flow conditions and high accuracy for billing / revenue purpose only.
- 27.1.4 The flow meter shall have the facility to link any future monitoring & data-acquisition systems such Acquisition Metering Infrastructure (AMI)/ Automatic Meter Reading (AMR) or SCADA.
- 27.1.5 The Electronic flow meter shall be Electromagnetic type with an optimum accuracy, long-term stability, and automatic zero error averaging.
- 27.1.6 The water meter should be suitable for use in ambient temperatures up to +55°C and relative humidity up to 100%. the temperature of exposed metal to sunlight can exceed 70°C.
- 27.1.7 The water meter should be suitable for use with potable water temperature ranges 1°C to 50°C.
- 27.1.8 End connection for sensor shall be drilled to PN 16, BS EN 1092 or equivalent ISO/DIN standards.
- 27.1.9 The flow meter body shall have coating of 300 micron and internal coating / internal components shall be tested and approved by World Worldwide Known Quality Body Certifiers (see Appendix Clause No. IV).
- 27.1.10 Coating shall be smooth, and mirror finish without any hairline cracks.

- 27.1.11 Flow meters shall be of 'Remote/separate type' (primary and secondary devices are connected by a cable) shall be suitable for installation at various site conditions (In consideration of high humidity / temperature and harsh weather in Qatar)
- 27.1.12 The system accuracy shall be a maximum at normal operating flow with an error of not more than + 0.5% of the reading. Minimum of measuring range $R=Q3/Q1 \geq 250$ for meters up to DN300mm. For meters > DN300mm, $R=Q3/Q1 \geq 200$ else shall be as per project requirements. The class accuracy shall be of Class II.
- 27.1.13 Nominal pressure 16 bar. A factory test certificate shall be issued for each meter giving its serial number. This certificate shall be submitted to KAHRAMAA at the time of supply, if necessary.
- 27.1.14 The flow meter shall have the facility to do insitu verification (Internal / External) from the manufacturer.
- 27.1.15 Calibration Certificate: The manufacturer shall submit Five points calibration certificates with every single flow meter by which the Serial Number/Part No. of the water meter shall match the calibration certification certificate as per the requirements of latest version of OIML R49 and ISO 4064:2017.
- 27.1.16 The meter performance shall be verified on a fully traceable test facility that is internationally accepted. Laboratory traceability packs shall be submitted as a part of the submittal.
- 27.1.17 The meter shall be capable of leak detection, data logging, internal memory storage, self - diagnosis software and error self-detection. Otherwise, for meter not equipped by built-in data logger, the meter can be used with external datalogger and this is as per project requirement and specification.
- 27.1.18 Installation requires distance $0 \times D$ (Diameter) inlet to and outlet of the sensor.

27.2 MATERIAL

- 27.2.1 Material of meter shall be as mentioned in below Table (48):

Table (48) Materials of Bulk Electronic Flow Meter

Designation	Materials
Body / Flow Tube	Stainless Steel, Carbon Steel or Higher quality metal.
Sensor Electrode	Hastelloy C-276 or High quality
Fasteners	Stainless Steel: 316/316L/A4/A4L

27.3 COATING

27.3.1 The coating quality shall conform to the following tests as per the relevant specifications given below:

- Adhesion of coating to metal shall not be less than 12N/mm². (DIN/ISO - 4624). (Adhesion Test).
- Porosity of coating shall be “zero” on 3 kV DC tester. (Holiday Test) .
- Intrinsic Rockwell hardness shall be between 50 - 60, according to DIN EN ISO 2815 (Hardness) .
- For applying of impact energy of 5 Nm on coating the cracks should not develop, when tested by 3 kV DC tester. (Impact resistance).

27.4 TESTS

27.4.1 Tests shall be done as per latest standard of OIML R49-2 and R49-3 and certificate shall be submitted.

27.4.2 The meter shall be capable to withstanding the following test pressures without leakage or damage:

- 25.6 bars (1.6 times the maximum admissible pressure) for 15 minutes,
- 32 bars (2 times the maximum admissible pressure) for 1 minute.

27.4.3 Submit MID approval certificate.

27.4.4 Submit other types of test certificates

27.5. BATTERY AND POWER

27.5.1 Battery shall be possible to be changed onsite and shall incorporate in battery management system to ensure there is no interruption to flow measurement during battery changeover.

27.5.2 The flow meter shall be battery powered (integrated and/ or external) with a minimum of 10 years' operating time with Acquisition Metering Infrastructure (AMI)/ Automatic Meter Reading (AMR) or SCADA requirements and replaceable in the field. (Note: A battery life to be considerate of Harsh & High weather condition in Qatar with humidity 100% and maximum temperature 55°C).

27.5.3 Meter shall have both options with AC power and battery power and when AC supply is not available, the meter shall be suitable for operation from long life lithium batteries or solar power supply module with backup batteries that provide an operating life of at least 3 years. It shall be possible to change the batteries onsite and shall

incorporate in battery management system to ensure there is no interruption to flow measurement during battery changeover.

27.6 FLOW MEASURING SENSOR (PRIMARY DEVICE)

- 27.6.1 Flow sensor shall comprise of meter a tube assembly containing all necessary electrodes, housing and terminations suitable for operation without loss of accuracy when totally submerged to a depth of 3 meters. The flow sensors including connection of communication cable shall be rated to IP68 (NEMA 6) according to IEC529/EN 60529 and be suitable to indefinite submergence of above depth.
- 27.6.2 The lining material shall extend from the bore of the tube to fully cover the face of the tube flanges and shall comply with clause 27.1.9
- 27.6.3 All the Flow meters shall be supplied with two ground rings.

27.7 ELECTRONIC DISPLAY UNIT (SECONDARY DEVICE)

- 27.7.1 This will be kept aboveground with a service cabinet or inside covered meter room and shall be of IP66 rated. In case of underground installation inside a flow chamber of areas subject to flooding, then it shall be of IP 68 rated.
- 27.7.2 Any EDU supplied as spare part shall have a serial number as per the format mentioned in clause 27.10.1
- 27.7.3 High contrast, illuminated graphics LCD screen, temperature compensated and excellent readability which shall indicate the following:
 - a) Digit No. for m³ (minimum 5 digits); Digit No. for decimal (liter) (minimum 3 digits).
 - b) The following registers as a minimum data to be displayed:
 - 11- Forward volume
 - 12- Reverse volume
 - 13- Net Volume
 - 14- Flow rate
 - 15- Battery percentage.
 - 16- Error status and Alarms: leakage, back flow, empty pipe and etc..
- 27.7.4 Data shall be access by maintenances person with password or locking facilities.
- 27.7.5 The flow sensor shall be intelligent such that any associated signal converter or electronic display unit can be connected to it without subsequent programming or configuration, with optional capability to store data in a non-volatile memory for a minimum retention of 5 years.

- 27.7.6 Flow meter preferable to have features for alarm during empty pipe, maximum and minimum flow rates and meter status, with a configurable low-flow cut-off.
- 27.7.7 The meter software shall incorporate password protection to prevent inadvertent or fraudulent programming or units of measurement changes.
- 27.7.8 Input & output (current, pulse, alarms) signals shall be galvanically isolated from input & output circuits.
- 27.7.9 The secondary device (Transmitter) Shall have an extensive self-diagnostic mechanism & error tracking capability (function) in such forms (alphanumeric messages, signal over an output contacts)
- 27.7.10 Meter with Built-in communication shall have integrated 4G(LTE) as a minimum requirement, support for 3GPP Rel 13+ for LTE-Mx/NB-IoT NBx is highly desirable communication module support/slot. OR Meter without Built-in communication shall have serial communication port i.e., Modbus (RS485).
- 27.7.11 The meter shall be record data for every 30 min and the sending frequency to AMI center shall be once per day from the meter.
- 27.7.12 The meter without built-in communication shall be sending the data between meter and external datalogger to transfer meter data to AMI center shall be once per day from the meter.
- 27.7.13 Locally Data Logging for diagnostics via optical port for downloading of daily consumption, events and alarm with password protection.
- 27.7.14 Remote Vandalism/Tamper detection feature provided
- 27.7.15 Battery Statues by % or Battery lifetime indication local and remote (to AMR / AMI) shall be provided
- 27.7.16 Data Logging for diagnostics via remote access and optical port.

27.8 CABLING BETWEEN EDU & FLOW METER SENSOR

- 27.8.1 The cable connection box shall be potted or sealed in accordance with the IP 68 rating referring to point 27.6.1.
- 27.8.2 Where necessary the cables shall be terminated adjacent to the flow head in an IP68 rated polycarbonate enclosure or equivalent.
- 27.8.3 The cable screening and earthing requirements shall be strictly adhered to manufactures' recommendations.
- 27.8.4 The length of the Communication cable shall be as per project requirements.

27.9 DOCUMENTATION AND TRAINING MEASURING TOOLS AND DEVICE

- 27.9.1 Provide original installation, operation, and service manuals in both hardcopy & softcopy format.
- 27.9.2 Official training program should cover the following flow meter aspects of Calibration, Installation, Operation, Configuration and Maintenance and as requested by Kahramaa.
- 27.9.3 Any recommendation for healthiness of meter check on field for every 3 years.
- 27.9.4 The manufacturer shall handover and describe all necessary equipment, tools, software's and portable handheld devices and PCs for testing, configuration and data downloading related to Meter 's facilities.

27.10 MARKING

- 27.10.1 All meters shall be marked in accordance with ISO 4064-1:2017 or equivalent as following:
- Unit of measurement: meter cube (m³),
 - Name or Logo of the manufacturer,
 - Year of manufacturing.
 - Direction of flow shown on both sides of the body,
 - Maximum Admissible Pressure or MAP16 and head loss.
 - Temperature Rating.
 - Nominal Flow rate, maximum and minimum flow rate.
 - KAHRAMAA Logo.
 - Meter serial number for both EDU and Sensor shall be identical: Factory letter code, Year of manufacture and serial number (as near as possible to the indicating device).
 - Order Code

27.11 PACKING

- 27.11.1 The packing shall be as per Section 1, Clause 1.7 of this specification.



Section - 28

Fasteners for Flanges (Bolts, Nuts and Washers)

28.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

28.2 MILD STEEL (HOT DIP GALVANIZED)

- 28.2.1 Bolts, Nuts & Washers connected to flanges shall be made of Mild Steel (Low Carbon) electro plated with hot dipped zinc galvanized, with minimum coating thickness 70 micron (BS EN ISO 10684).
- 28.2.2 Bolts, Nuts & Washers shall be full threaded or partial threaded and as per EN ISO 4016/4017/4018, EN ISO 4034 and EN ISO 7091
- 28.2.3 Low-carbon (Mild Steel) fasteners specifications including mechanical and physical properties, chemical composition and tests shall be defined as per the standard BS EN ISO 898, BS EN ISO 6892-1, minimum Strength Class 4.6.
- 28.2.4 Bolts Head & Nuts shall have hexagonal dimensions BS:3692
- 28.2.5 Size shall be according to project requirement

28.3 MARKING

- 28.3.1 Bolts and Nuts shall be marked as follows standard BS EN ISO 898-1:
 - a) Manufacturer's identification mark.
 - b) Property class (Grade).

28.4 TESTING

- 28.4.1 Materials shall be tested according to BS EN ISO 898, BS 3692 and BS EN ISO 6892 as per the following tests:
 - a) Physical or Dimensional Measurements
 - b) Mechanical Properties (Tensile Strength Test, Stress under Proof Load, Thread Slipping, Elongation and Hardness, etc.)
 - c) Chemical analysis (Chemical composition).
 - d) Coating Thickness Test.
- 28.4.2 The manufacturer shall provide inspection documents (test reports) type F2.2, F3.1 and F3.2 as per BS EN ISO 16228

28.5 STAINLESS STEEL

- 28.5.1 Bolts, Nuts & Washers connected to flanges shall be full or partial threaded and made of Stainless Steel (austenitic group) grade A4 or A4L or AISI grades 316 and 316L or sub-grades (316S11/316S13) and (316S31/316S33) in accordance with BS EN ISO 3506-1 or as per BS 970 respectively.

- 28.5.2 bolts located inside the reservoir shall be coated SS316 with special coating to avoid corrosion.
- 28.5.3 Stainless Steel fasteners specifications including mechanical and physical properties, chemical composition and tests shall be defined as per the standard BS EN ISO 3506-1 Part 1 & Part 2, BS EN ISO 898-1 and BS EN ISO 6892-1 or equivalent.
- 28.5.4 Stainless steel bolts and nuts shall be a minimum property class 50 according to BS EN ISO 3506-1
- 28.5.5 Bolts and Nuts shall be supplied clean and bright.
- 28.5.6 Bolts Head & Nuts shall have hexagonal dimensions BS:3692
- 28.5.7 Size shall be according to project requirement

28.6 MARKING

- 28.6.1 Bolts and Nuts shall be marked as follows standard BS EN ISO 3506-1:
- a) Manufacturer's identification mark.
 - b) Steel Grade.
 - c) Property class.

28.7 TESTING

- 28.7.1 Materials shall be tested according to BS EN ISO 3506-1, BS EN ISO 898-1 or BS EN ISO 6892 as per the following tests:
- a) Physical or Dimensional Measurements
 - b) Mechanical Properties (Tensile Strength Test, Stress at 0.2% Permanent Strain, Thread Slipping, Elongation and Hardness, etc.)
 - c) Chemical analysis (Chemical composition).
- 28.7.2 The manufacturer shall provide inspection documents (test reports) type F2.2, F3.1 and F3.2 as per BS EN ISO 16228

28.8 PACKING

- 28.8.1 The packing shall be as per Section 1, Clause 1.7 of this specification.

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Section - 29

Gaskets for Pipeline Joints

29.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

29.2 GASKETS FOR FLANGED JOINTS

29.2.1 The gaskets shall be EPDM Rubber and manufactured according to the standard EN 1514 and EN 681-1:1996.

29.2.2 The materials used for the manufacture shall be flat sheet laminated ply or moulded:

- a) Rubber gasket with fabric or cotton reinforced double layer.
- b) Rubber gasket with embedded metal reinforcement.

29.2.3 The Gasket shall be of type WA (Cold potable water supplies up to 50 °C)

29.2.4 The physical properties of gaskets shall comply with Table 2 of EN 681-1:1996 and shall also comply with the relevant provisions in the same standard for effects on water quality and resistance to microbiological deterioration

29.2.5 Gaskets shall be Full Face (FF) type (with bolt holes), for use with type A (flat face) or type B (raised face).

29.2.6 The gasket thickness shall be not less than 3 mm

29.2.7 The hardness of Rubber Gasket shall be 70 ± 5 IRHD or shore A.

29.2.8 The Gaskets supplied by the manufacturer shall suit for PN 16.

29.3 MARKING

29.3.1 Gaskets shall be identified either individually or on the packaging containing the gasket(s) with the following information:

- a) Manufacturing Standards Number.
- b) 'S' if suitable for use only for pipes and fittings complying with EN 545
- c) Gasket type designation (Full Face FF);
- d) DN
- e) PN
- f) Type of application e.g. WA
- g) Thickness;
- h) Rubber type
- i) Manufacturer's name or logo.

29.4 GASKETS FOR FLEXIBLE JOINTS (TYTON /STANDARD TYPE)

29.4.1 The gaskets shall be made from vulcanized rubber and manufactured and tested according to the standard EN 681-1 and ISO 4633.

- 29.4.2 The Gasket shall be of type WA (Cold potable water supply (up to 50 °C)).
- 29.4.3 The physical properties of gaskets shall comply with Table 2 of EN 681-1:1996 and shall also comply with the relevant provisions in the same standard for effects on water quality and resistance to microbiological deterioration
- 29.4.4 The Tyton-Type Gasket shall be of hardness in the range 50 ± 5 IRHD or Shore A for sealing part (Bulb) and 80 ± 5 IRHD or Shore A for holding part (Heel).
- 29.4.5 The Standard – Type Gasket shall be of hardness in the range 70 ± 5 IRHD or Shore A
- 29.4.6 The Gaskets shall suitable for pressure rate PN16.

29.5 MARKING

- 29.5.1 The Gaskets shall be identified either individually or on the packaging containing the gasket(s) with the following information:
- a) Manufacturing Standards Number.
 - b) DN
 - c) PN
 - d) Type of application e.g. potable water (WA)
 - e) Rubber type (EPDM)
 - f) Manufacturer's name or Logo.

29.6 PACKING

- 29.6.1 The packing shall be as per Section 1, Clause 1.7 of this specification.

29.7 STORAGE

- 29.7.1 At all stages between manufacture and use, the Rubber Gaskets should be stored in accordance with the recommendations given in ISO 2230 as follows:
- a) the storage temperature should be below 25 °C and preferably below 15 °C;
 - b) the Rubber gaskets should be protected from light, strong sunlight and artificial light with a high ultra-violet content;
 - c) the Rubber gaskets should not be stored in a room with any equipment capable of generating ozone, e.g. mercury vapor lamps or high-voltage electrical equipment which may give rise to electrical sparks or silent electrical discharges;
 - d) the Rubber gaskets should be stored in a relaxed condition free from tension, compression or other deformation.



Section - 30

GRP Domestic and GRP Bulk Water Service Cabinet

30.1 GENERAL

These clauses shall be read in continuation of Section 1 of this specification.

- 30.1.1 Water service cabinet shall be manufactured from glass reinforced polyester (henceforth referred as GRP)
- 30.1.2 The service cabinet shall provide a protection degree of IP54, as per IEC 60529, to restrict the ingress of dust and water.
- 30.1.3 The service cabinet shall have mechanical protection of IK10 according to IEC 62262. The manufacturer to ensure proper ventilation for the service cabinet & maintain the IP class without derating of the specified values. The manufacturer shall prove these parameters through type testing.
- 30.1.4 The service cabinet color shall be finished as RAL 9003.
- 30.1.5 The service cabinet shall be retardant to heat, fire, and weathering in accordance with IEC 62208. This shall be proved by testing.
- 30.1.6 The cabinet wall thickness shall be 5mm. (The cabinet requires a minimum of 8mm of GRP at stress points of the cabinet corner and base)
- 30.1.7 The operating Conditions shall be up to + 85°C.
- 30.1.8 The minimum life expectancy of the service cabinet is 25 years
- 30.1.9 Installation conditions for Service Cabinet are Outdoor
- 30.1.10 The service cabinet shall be anti-corrosive, vermin proof, impact resistant, graffiti resistant, non-flammable, non-hygroscopic, fire retardant, minimum tensile strength 90 MPa, Halogen free, self-extinguishing in case of fire and light weight.
- 30.1.11 The service cabinet shall be coated with an epoxy coating to protect against ultraviolet/solar radiation damage and degradation and be scratch resistant. The surface shall be smooth, and no glass fiber shall appear at the outer surface. The coating shall be suitable to meet the 25-year service life required in this specification.
- 30.1.12 The service cabinets based on its types mentioned below, shall be suitable for mounting in a recess in the boundary wall of domestic premises, or occasionally free standing on a plinth.
- 30.1.13 Enclosures shall protect the Electronic Meter's display unit and associated equipment's against environmental exposure, resistance to all conceivable climatic influences without need for frequent maintenance and touch-up works.

30.2 THE GRP DOOR AND ACCESSORIES

- 30.2.1 The door shall be hinged on the side and have a secure locking mechanism. The door hinges bolts shall be Allen key locker washer type. Cabinet locking system shall have a hook which shall be lockable with 8mm padlock hasp, in addition to two 8 mm triangular socket locks.
- 30.2.2 All metallic parts (hinges, nuts, bolts, washers, door handles etc.) shall be made from stainless steel. The hinge shall be designed so that the door can remain fixed in the open position, when required, through rigid stopper system to withstand any inverted anti-closing force. The outdoor cabinets with all accessories and fittings shall withstand the effect of direct solar radiation at their installed locations.
- 30.2.3 The door hinges shall be easily removable from the outside and constructed in such a way that replacing the door does not require shutting down the service cabinet. Replacing the door shall be feasible only after the door is opened.
- 30.2.4 Cabinet door provided with louvers for ventilation shall be sealed to a higher level than the cabinet itself to ensure door seals are weather and vermin proof, conforming to IP54 and sealed to prevent the ingress of water and dust, using a high temperature resistant EPDM rubber seal.
- 30.2.5 Whether the louvers are molded along with the door or cut out and trimmed after molding process, the hole enclosure shall maintain IP54 protection. Also, the louver shall be protected with stainless steel vermin screen from inside of the cabinet door.
- 30.2.6 The Storage Pocket shall be a plastic polycarbonate or similar pocket used for storing documents inside the door, it shall be UV resistant.
- 30.2.7 All Cabinet shall contain the following:
- KAHRAMAA logo with number plate.
 - AMR compartment as per drawings
 - Louvered ventilation stainless steel screen as per drawings in Appendix III.1
 - Two (02) Allen Lock.
 - Holes with rubber bush to allow smaller size pipes 22-54 mm (inlet-outlet)
 - Plastic end caps.

30.3 STANDARD WATER SERVICE CABINET SIZES

- 30.3.1 Water service cabinet (Wall Mounted type) overall size shall be Width 300 x Hight 830 x Depth 230 As per drawing No. NDS/SD/01/2012 in Appendix III.1. The service cabinet shall include a flush flange along its outer edge for covering the gap between the service cabinet and the wall within which the service cabinet is installed.

30.3.2 Water Service cabinet (Surface Mounted type) overall size shall be Width 300 x Hight 830 x Depth 200 As per drawing NDS/SD/09/11 in Appendix III.1. The cabinet shall be free standing and it shall include a canopy.

30.4 BULK WATER SERVICE CABINET SIZE

30.4.1 Bulk service cabinet for 2-inch diameter, overall size shall be Width 750 x Hight 650 x Depth 300 for electronic flow meter (remote type) As per drawings NDS/ SD/30/02 in Appendix III.1.

30.4.2 Bulk service cabinet for 2-inch diameter, overall size shall be Width 750 x Hight 650 x Depth 300 for electronic flow meter (integral type) As per drawings NDS/SD/30/03 in Appendix III.1.

30.5 MULTI-DOMESTIC WATER SERVICE CABINET SIZE

30.5.1 Multi-domestic water service cabinet 02 up to 04 Water meter as per drawings Appendix III.1

30.6 INSPECTION, TESTING AND DELIVERY

30.6.1 The Manufacturer shall submit as part of the quality assurance control a list of tests and inspections which are to be carried out prior to dispatch which shall demonstrate, to the satisfaction of KM, that the specification requirements have been met.

30.6.2 Provision of test schedules and a program of testing is the responsibility of the manufacturer which shall be approved by KM prior to any inspection or testing taking place.

30.6.3 During the manufacturing process, at all stages, inspections shall be made to check the physical and dimensional parameters, for verification of compliance to the standards.

30.6.4 KM or authorized representative reserve the right to be given access to the manufacturer's factory and for inspection of factory, materials, at any stage of manufacturing and for all or parts of testing.

30.6.5 Authorized KM nominated personnel shall have the right to witness all inspection and tests for contracts or any other products supply to KM.

30.6.6 A quality audit of the manufacturing process, machinery and Quality Management System of the manufacturer and their outsourcing suppliers may be performed by KM during prequalification process and before, during and/or after awarding of the contract.

30.6.7 No service cabinet can be dispatched for delivery until routine factory and sample test reports are approved by KM.

30.6.8 The Manufacturer shall carry out type tests in accordance with relevant standards covered by this specification. Tests shall take place at an internationally recognized testing station or in manufacturer's own laboratories, witnessed and certified by an internationally recognized and

KM accepted certification body/laboratory. All costs for testing and 3rd Party witness shall be borne by the manufacturer / supplier.

30.6.9 Type test may also be carried out according to other international standards with additional KM conditions or requirements which will be discussed before carrying out any tests and will be mutually agreed between manufacturer and KM. KM has the right to add/alter/modify any tests maintaining the KM right in order to ensure reliability and safety concerns.

30.6.10 The manufacturer shall provide type test certificates as per following tests:

Table (49) Test Type Certificates

Tests	Standard	Acceptance criteria
Static load test	IEC 62208	clause 9.4: The enclosure to withstand weight of 1,25 times the permissible load
Thermal stability test	IEC 62208	clause 9.9.1 (including IEC 60068-2 - Environmental testing, Dry heat): The enclosure shall show no crack visible to normal or corrected vision without additional magnification
Resistance to normal heat test	IEC 62208	clause 9.9.2: Verified either by reference to the insulation temperature index (determined e.g. by the methods of IEC 60216 series), or by compliance to IEC 60085.
Retardant to abnormal heat and fire test	IEC 62208	clause 9.9.3: The specimen is considered to have withstood the glow-wire test if: - there is no visible flame and no sustained glowing, - flames and glowing of the specimen extinguish
Resistance to UV radiation test	IEC 62208	clause 9.12: Samples shall not show cracks or deterioration visible to normal or corrected vision without additional magnification.
Resistance to corrosion test	IEC 62208	clause 9.13
Protection against external mechanical impacts test	IEC 62262	clause 6 and 7
Degree of protection rating test	IEC 60529	clause 13 and 14: If no deposit of dust is observable inside the enclosure at the end of the test. After testing in accordance with 14.2, the enclosure shall be

30.7 MARKING

30.7.1 A name-plate shall be securely attached to the cabinet, in a clearly visible and accessible location. The name-plate shall be made of a material not affected by weather conditions. The following data shall be engraved on the plate:

- Name of manufacturer or brand (trade) name.
- Serial number
- Size.
- Year of manufacture.

30.8 STORAGE AND PACKING

30.8.1 The packing shall be as per Section 1, Clause 1.7 of this specifications.

30.8.2 The service cabinet shall be capable of being stored without deterioration within the temperature range -10°C to +50°C.

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APPENDIXES

I. Typical Drinking Water Quality .

II. Site Environmental Conditions.

III. Drawings.

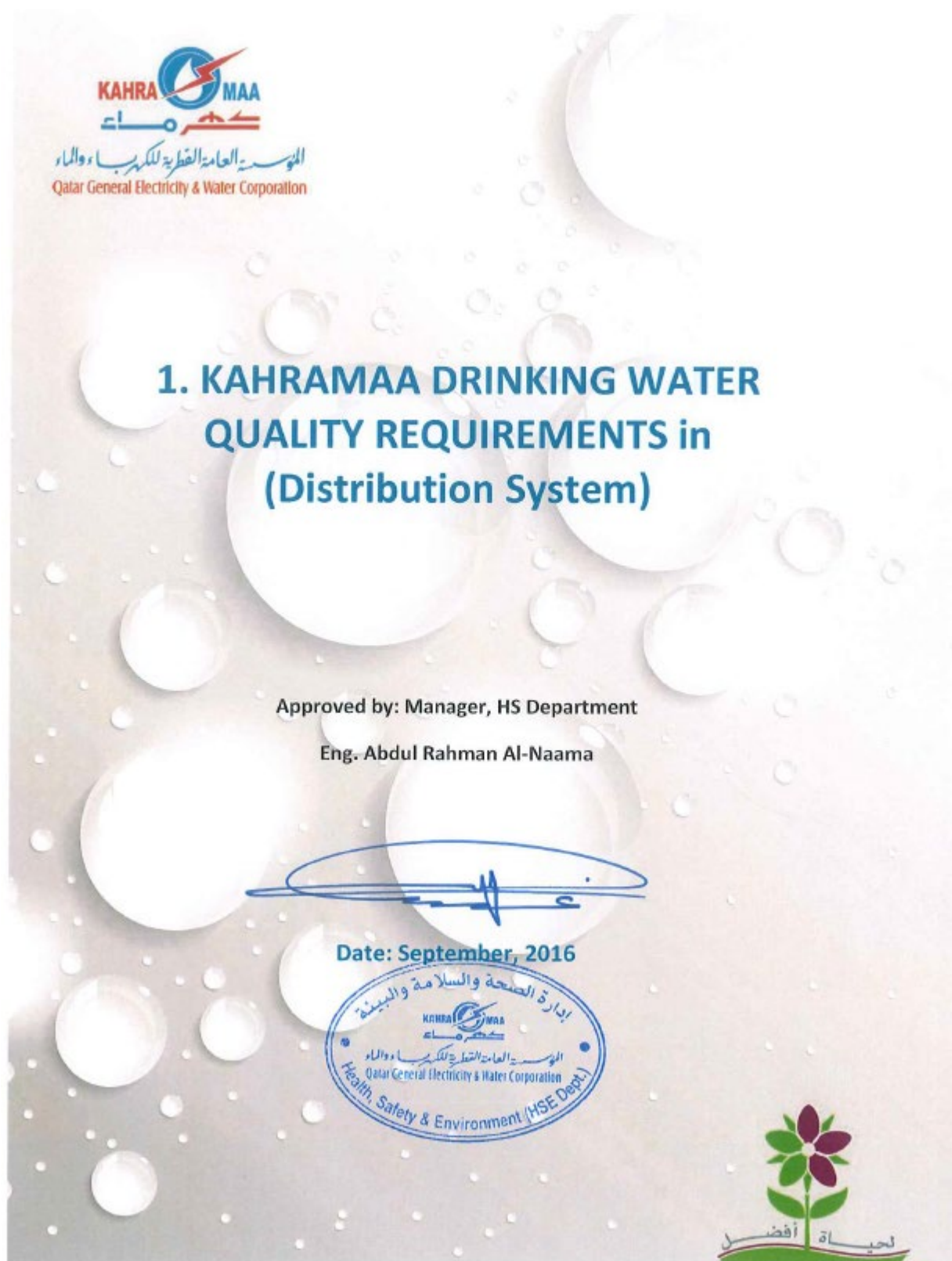
1. WATER METER SERVICE CABINET.
2. Marker Post, Backing Plates, and Plate.
3. Surface Box & Manhole Cover

IV. Worldwide Known Quality Body Certifier.

V. Pre - Arrangement Inspection.

VI. Meters Highly Acceleration Life Testing (HALT)

I. TYPICAL DRINKING WATER QUALITY



KAHRAMAA Water Quality Requirements in Distribution System

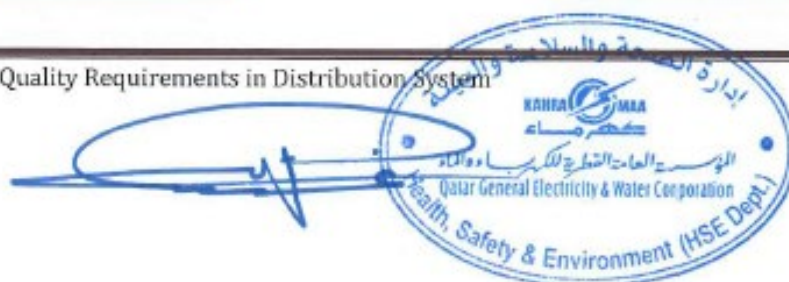
KAHRAMAA (KM) Water Quality Requirements are applicable for water at entry point into distribution system and & until the customer connection point. The Potable Water is regulated to meet KM Requirements on its characteristics, constituents and ionic ratio as listed in the following tables. If any parameter is not listed in the below tables, then the latest edition of the WHO Guidelines for Drinking Water Quality shall be used as a reference for that Maximum Contamination level (MCL) permitted value. The Latest edition of GSO Standard No. 149 for Un-bottled Drinking Water is adopted as Qatari Standard and is the minimum quality requirement that can be accepted at consumer tap or where no better alternative water supply is applicable or in emergency cases.

Table 1. Water Quality Parameters and their Maximum Permitted Levels as Indicated by HSE Department -KAHRAMAA & Regulated by GSO Standard No. 149/2014.

Parameter	GSO 149/2014 Standard For Un-Bottled Drinking Water MCL	KAHRAMAA Requirements for Water In Distribution System MCL
pH	6.5-8	6.5- 9.0
Taste	-	Acceptable
Odor	-	Acceptable
Temperature (°C)	-	Acceptable <45
Color (TCU)	-	15
Turbidity (NTU)	-	4.0
Conductivity (us/cm) or Salinity	-	150-500
TDS (mg/l)	100-1000	110-250
Total Hardness (mg/l as CaCO ₃)*	-	<150
Alkalinity (mg/l as CaCO ₃) *	-	120
Calcium (mg/l)	-	80
Magnesium (mg/l)	-	30
Potassium (mg/l)	-	12
Sodium (mg/l)	-	80
Chloride (mg/l)	-	80
Bromide (mg/l)	-	0.5
Fluoride (mg/l)	1.5	1.5

KAHRAMAA Water Quality Requirements in Distribution System

Page 2



Parameter	GSO 149/2014 Standard For Un-Bottled Drinking Water MCL	KAHRAMAA Requirements for Water In Distribution System MCL
Iron (mg/l)	-	0.3
Copper (mg/l)	2	1.0
Manganese (mg/l)	0.4	0.05
Zink (mg/l)	-	3.0
Aluminum (mg/l)	-	0.2
Lead (mg/l)	0.01	0.01
Mercury (mg/l)-Non organic	0.006	0.001
Nickel (mg/l)	0.07	0.07
Cadmium (mg/l)	0.003	0.003
Barium (mg/l)	0.7	0.7
Molybdenum (mg/l)	0.07	0.07
Cyanide (mg/l)	0.07	0.07
Chromium (mg/l)-Total	0.05	0.05
Antimony (mg/l)	0.02	0.02
Arsenic (mg/l)	0.01	0.01
Selenium (mg/l)	0.04	0.01
Beryllium (mg/l)	-	0.004
Silver (mg/l)	-	0.1
Thallium (mg/l)	-	0.002
Boron (mg/l)	2.4	1.0
Asbestos (Million fibers per liter)	-	7
Ammonia (mg/l)	-	0.5
Sulphate (mg/l)	-	50
Phosphate (mg/l)	-	0.01
Foaming agents	-	0.5
Nitrate (mg/l) as NO3	50	10
Nitrite (mg/l) as NO2	3	0.1

KAHRAMAA Water Quality Requirements in Distribution System

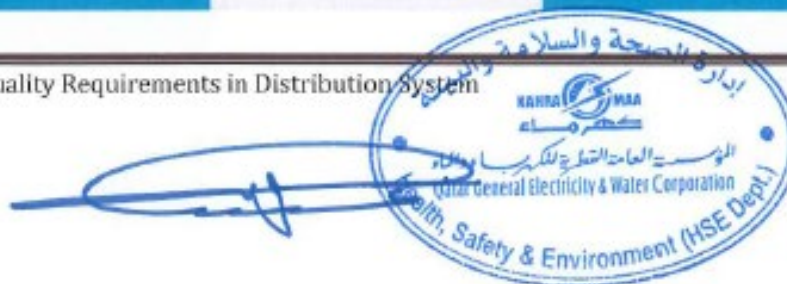
Page 3



Parameter	GSO 149/2014 Standard For Un-Bottled Drinking Water MCL	KAHRAMAA Requirements for Water In Distribution System MCL
Chlorine residual (mg/l)**	5	0.2-1.0
Chlorine Dioxide (mg/l) **	-	0.05-0.7
Sodium Di chlo-iso Cyanurate	50	50
Sodium Di chlo-iso Cyanurate as Cyanurate	40	40
Monochloramine (mg/l)	3	3
Chloroform (mg/l)	0.3	0.2
Chlorate (µg/l)	700	700
Chlorite (µg/l)	700	700
Bromoform (µg/l)	100	100
Bromodichloromethane (µg /l)	60	60
Dibromochloromethane (µg/l)	100	100
Dichloromethane (µg/l)	20	20
Total THM (µg/l)	1	The sum of the ratio of the concentration of the THM's compounds to their adopted guideline value <1, Total THM<100
Haloacetic Acid (mg/l)	DCA: 0.05, MCA: 0.02, TCA: 0.2	DCA: 0.05, MCA: 0.02 , TCA: 0.2
Bromate (mg/l)	0.01	0.01
Perchlorate (mg/l)	-	0.006
PAH (mg/l)	-	Total constituents 0.0007, any (0.0002)
Tolouene (mg/l)	0.7	0.7
Benzene (mg/l)	0.01	0.01
Ethylbenzene (µg/l)	300	300
Tributlin (mg/l)	-	0.001
Xylene (mg/l)	0.5	0.5
Alpha particles (Bq/l)***	WHO guidelines values	0.5
Beta particles (Bq/l)***	WHO guidelines values	1.0
Uranium (mg/l)	0.03	0.015

KAHRAMAA Water Quality Requirements in Distribution System

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Parameter	GSO 149/2014 Standard For Un-Bottled Drinking Water MCL	KAHRAMAA Requirements for Water In Distribution System MCL
Total Coli (Number/100ml)****	0 or <1	0 or <1
Fecal Coli or <i>E. coli</i> (Number/100ml)****	0 or <1	0 or <1
Heterotrophic Plate Count (HPC) cfu per ml	-	≤500
<i>Pseudomonas aeruginosa</i> (Number/100ml) ****	-	0 or <1
Yeast and Mold (Number/100ml) ****	-	0 or <1
<i>Enterococcus</i> (Number/100ml) ****	-	0 or <1
<i>Salmonellae</i> sp.(Number/100ml)****	-	0 or <1

* The water leaving the treatment plants should have Langelier Index 0 to+ 0.3 and CCPP number that does not cause corrosion or scaling problems in distribution system.

** Residual chlorine is applicable only if disinfection method used is based on chlorine gas or hypochlorite solution and Residual chlorine dioxide is applicable only if disinfection method used is based on chlorine dioxide. Also Mono-chloramine is applicable where used only. Both residuals chlorine and chlorine dioxides are applicable only if there is possible mixing of both in the distribution system due to mixing of water coming from different desalination plants using different disinfectants".

***: Parameters values indicated are for screening limits, if limits are exceeded then WHO guidelines to be consulted. The radiological parameters required by KAHRAMAA & the GSO standard are as indicated in WHO Guidelines.

****Number/100 ml: Absence, not detected or Nil reported by the method is considered Zero, <1 refer to below detection level reported by MPN method. Only the coliform tests are conducted routinely, other microbiological tests are conducted only in certain cases &where the microbial quality is suspected.

Organic compounds

The following table include a list of organic compounds with their maximum contamination level (MCL) permitted by HSE Department-KAHRAMAA and by latest GSO Standard No. 149 for Un-Bottled Drinking Water Quality.

Table 2. Organic pollutants as indicated in GSO Water Quality Standards and Required by HSED-KAHRAMAA.

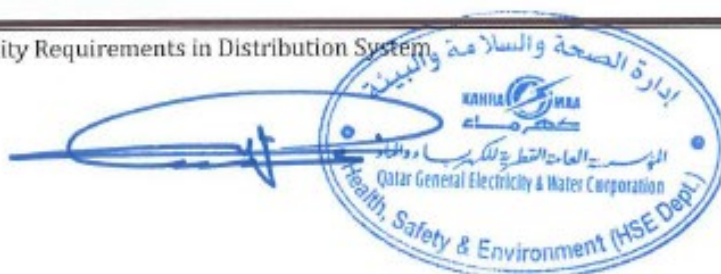
Organic Pollutants	MCL	Pesticides and Insecticides	MCL
Carbon tetrachloride (µg/l)	4	Alachlor (µg/l)	20
Diethylhexyl phthalate (µg/l)	8	Aldicarb (µg/l)	10
Dichlorobenzene, 1, 2 (µg/l)	1000	Aldrin and Dieldrin (µg/l)	0.03
Dichlorobenzene 1,4 (µg/l)	300	Atrazine (µg/l)	100
Dichloroethane 1,2 (µg/l)	30	Carbofuran (µg/l)	7



Organic Pollutants	MCL	Pesticides and Insecticides	MCL
Dichloroethene 1,1 (µg/l)	30	Chlordane (µg/l)	0.2
Dichloroethene 1,2 (µg/l)	50	Chlorotoluron (µg/l)	30
1,2 Dichloromethane or Methylene chloride (µg/l)	20	Cyanazine (µg/l)	0.6
Hexa chloro butadiene (µg/l)	0.6	2,4 dichlorophenoxy acetic acid (µg/l)	30
Nitrilotriacetic acid (µg/l)	200	2,4 D-B (µg/l)	90
EDTA (µg/l)	600	1,2 Di bromo,3 chloropropane (µg/l)	1
Pentachlorophenol (µg/l)	9	1,2 Dibromoethane (µg/l)	0.4
Styrene (µg/l)	20	1,2 Dichloropropane (µg/l)	40
Tetrachloroethene (µg/l)	40	1,3 Dichloropropene	20
Trichloroethene (µg/l)	20	Dichloroprop (µg/l)	100
Cyanogens chloride (µg/l)	70	Dimethoat (µg/l)	6
Dibromoacetone nitrile (µg/l)	70	Endrin (µg/l)	0.6
Trichloroplenol 2, 4,6 (µg/l)	200	Finoprop (µg/l)	9
Acrylamide (µg/l)	0.5	Isoproturone (µg/l)	9
Epichlorhydrine (µg/l)	0.4	Lindane (µg/l)	2
Benzoalphapyrine (µg/l)	0.7	MCPA (µg/l)	2
Phenyl chloride (µg/l)	0.3	Micoprope (µg/l)	10
Dichloroacetone nitrile (µg/l)	20	Methoxychlor (µg/l)	20
Dioxin 1,4 (µg/l)	50	Metolachlor (µg/l)	10
Pesticides for Health		Pentadimethalin (µg/l)	20
Permethrine (µg/l)		Simazine (µg/l)	2
Peroxyfen (µg/l)	300	2,4,5 T (µg/l)	9
Chloropyrifos (µg/l)	300	Terbutylazine (µg/l)	7
DDT (µg/l) and Byproducts	1	Trifluraline (µg/l)	20
Toxins			
Microstatin L-R (µg/l)	1		

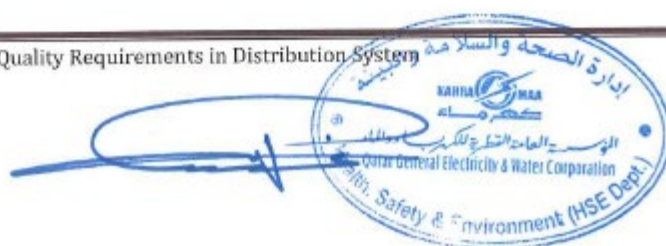
Table 3: Additional Water Quality Parameters with Maximum Guidance levels (MGL)

Organic Parameters	MGL		MGL
2- Chlorotoluene (µg/l)	140	1,2,4 Trichlorobenzene –total (µg/l)	70
4- Chlorotoluene or p-chlorotoluene (µg/l)	140	Naphthalene (µg/l)	100
p-Isopropyltoluene (µg/l)	70	Petrol in Water (mg/l)	<MDL
1,2,3- Trichloropropane (µg/l)	0.005	Kerosene in Water (mg/l)	0.1
Bromochloromethane or (Methylene bromochloride (mg/l)	0.5	TOC (mg/l)	4
1,1,2 -Trichloroethane (µg/l)	5	Lithium (mg/l)	0.05
Monochlorobenzene (µg/l)	70	Silica (mg/l)	0.05
Isopropylbenzene mg/l or n-propyl benzene (µg/l)	260	Strontium (mg/l)**	4



Organic Parameters	MGL	MGL
1, 2, 4-Trimethylbenzene (µg/l)	330	Cobalt (mg/l)**
1, 3, 5 -Trimethylbenzene (µg/l)	330	0.002
s-Butylbenzene (µg/l)	260	
T-butyl benzene (µg/l)	260	

Note: * = NO Guidance Level indicated by WHO for the above listed parameters. MGL's indicated are referenced to EPA/OEHHA levels.
MDL: Method detection limit.
**: Parameters radioactivity guidance level is as indicated in latest edition of WHO Guidelines.



II. SITE ENVIRONMENTAL CONDITIONS

State of Qatar is classified as being among the world's most arid and desert regions. The rainfall is concentrated in the Winter & Spring period (December to March) with an average of 50 – 80mm per annum. No discernible pattern in rainfall occurrence is apparent, but there is a tendency of rainfall to occur more often during February & March. Rainfall can be heavy with poor natural drainage resulting in surface flooding.

Month	Temperature Degrees Centigrade			Humidity %	
	Mean Max.	Mean Min.	Mean Daily	Mean Max.	Mean Min.
January	22.3	13.1	17.5	90.7	51.9
February	22.7	12.7	17.5	82.8	38.7
March	27.5	16.8	21.8	85.3	40.9
April	31.3	20.0	25.3	80.9	37.3
May	37.6	24.3	30.7	67.6	20.8
June	41.0	26.0	33.6	64.2	20.1
July	41.5	28.3	34.6	71.0	24.6
August	40.7	28.3	34.1	77.7	30.7
September	38.3	25.9	32.0	86.5	38.9
October	35.2	23.0	29.0	83.7	37.0
November	29.8	19.5	24.5	89.9	37.6
December	24.8	14.5	19.4	86.1	46.5

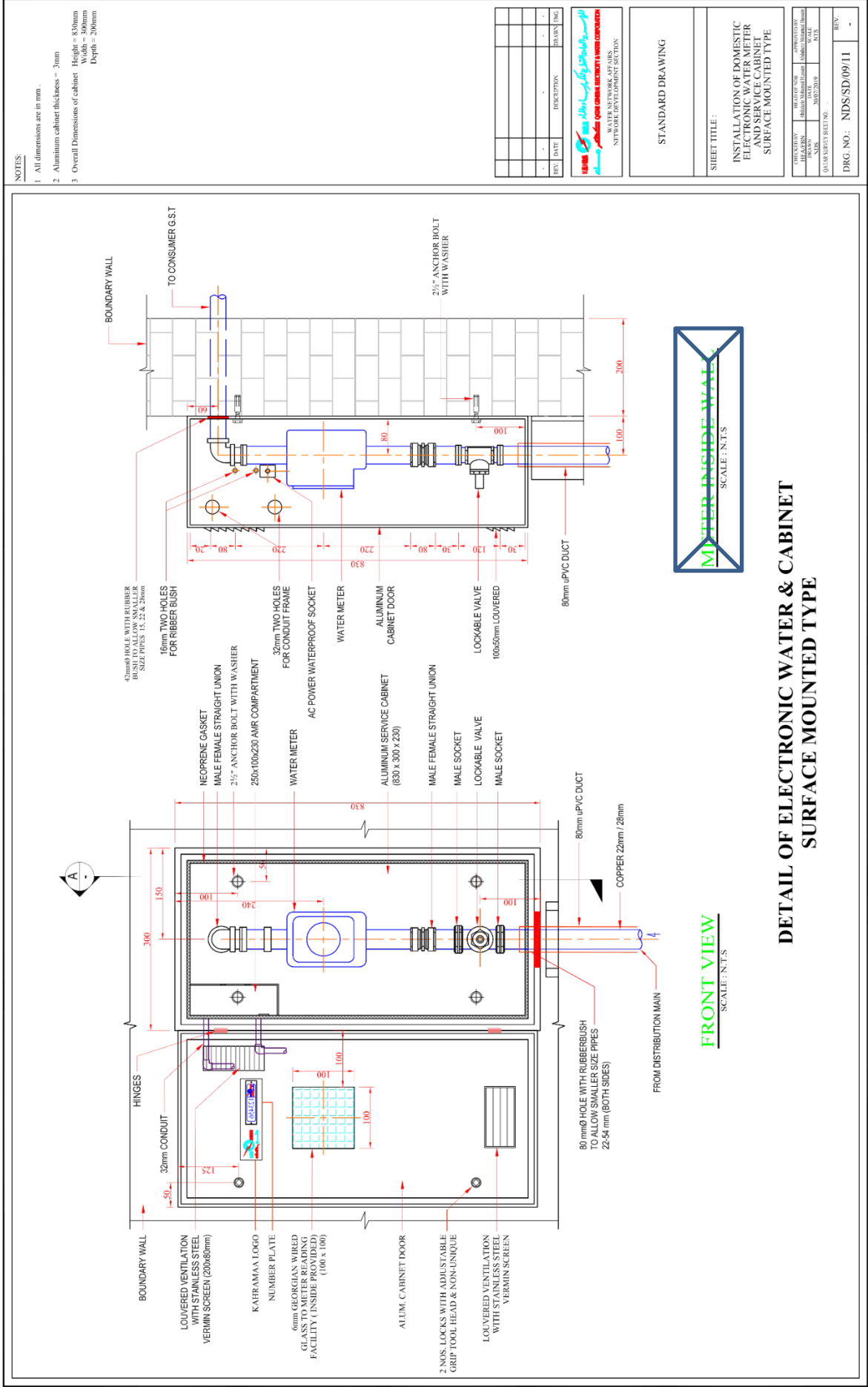
- Minimum-recorded related humidity is 100 %.
- Maximum recorded direct sunlight temperature is 75° C.
- Maximum recorded ambient shade temperature is 51° C.
- Minimum recorded ambient shade temperature is 0° C.
- Site elevation is 2 – 20 M AOD (State of Qatar).
- Prevailing winds are mainly Northerly occasionally with Southeasterly gusts up to 140 Km/h.
- Sandstorms though not severe, do occur and can persist for several days.
- The site is not subject to Industrial pollution, but due to being near the coast; the air can be salt laden with occasional fog. During the winter and spring periods, sever electrical storms with sheet and forked lightning can occur.

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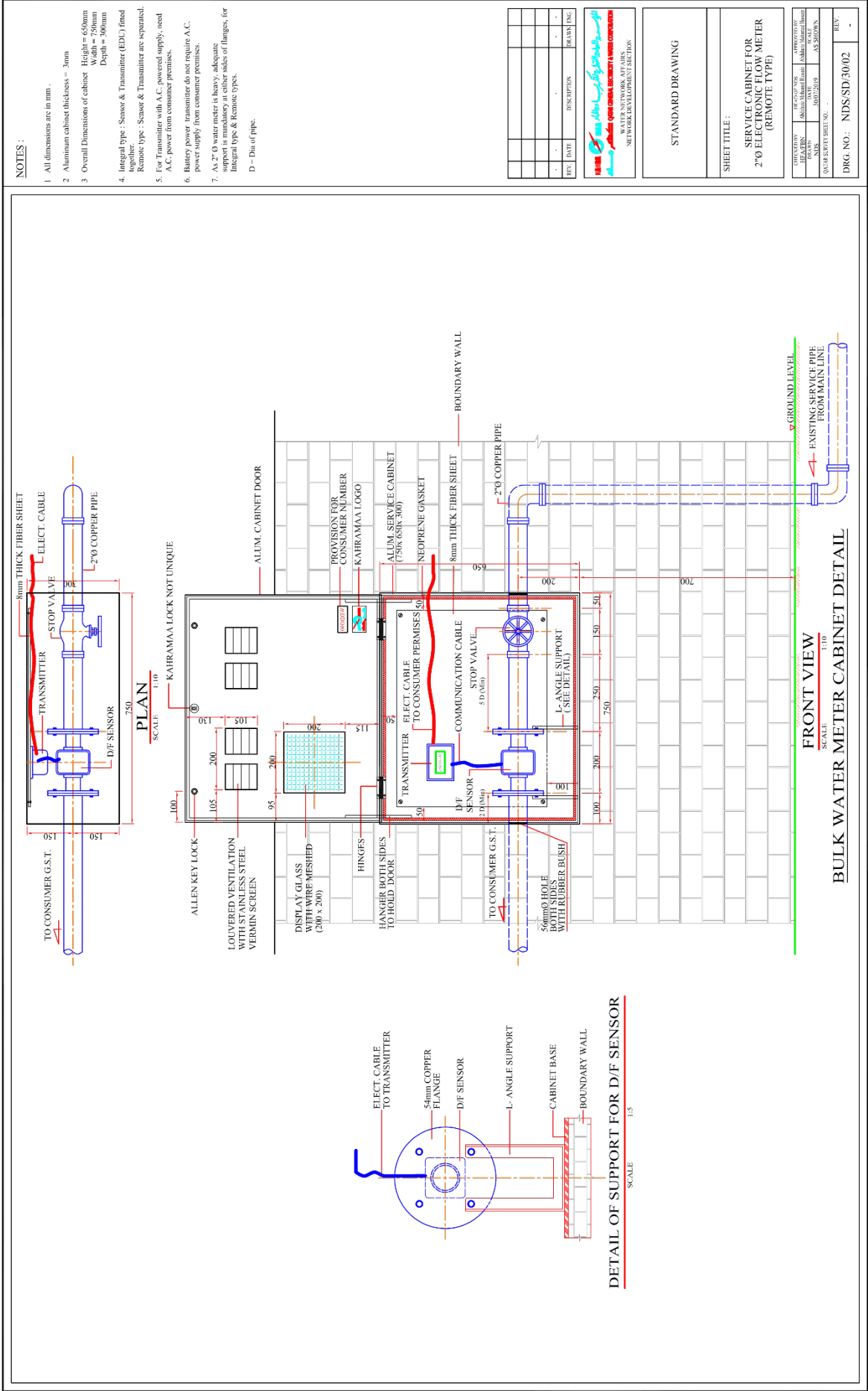
▪ **Standard Aluminume Service cabinet (Surface Mount type)**



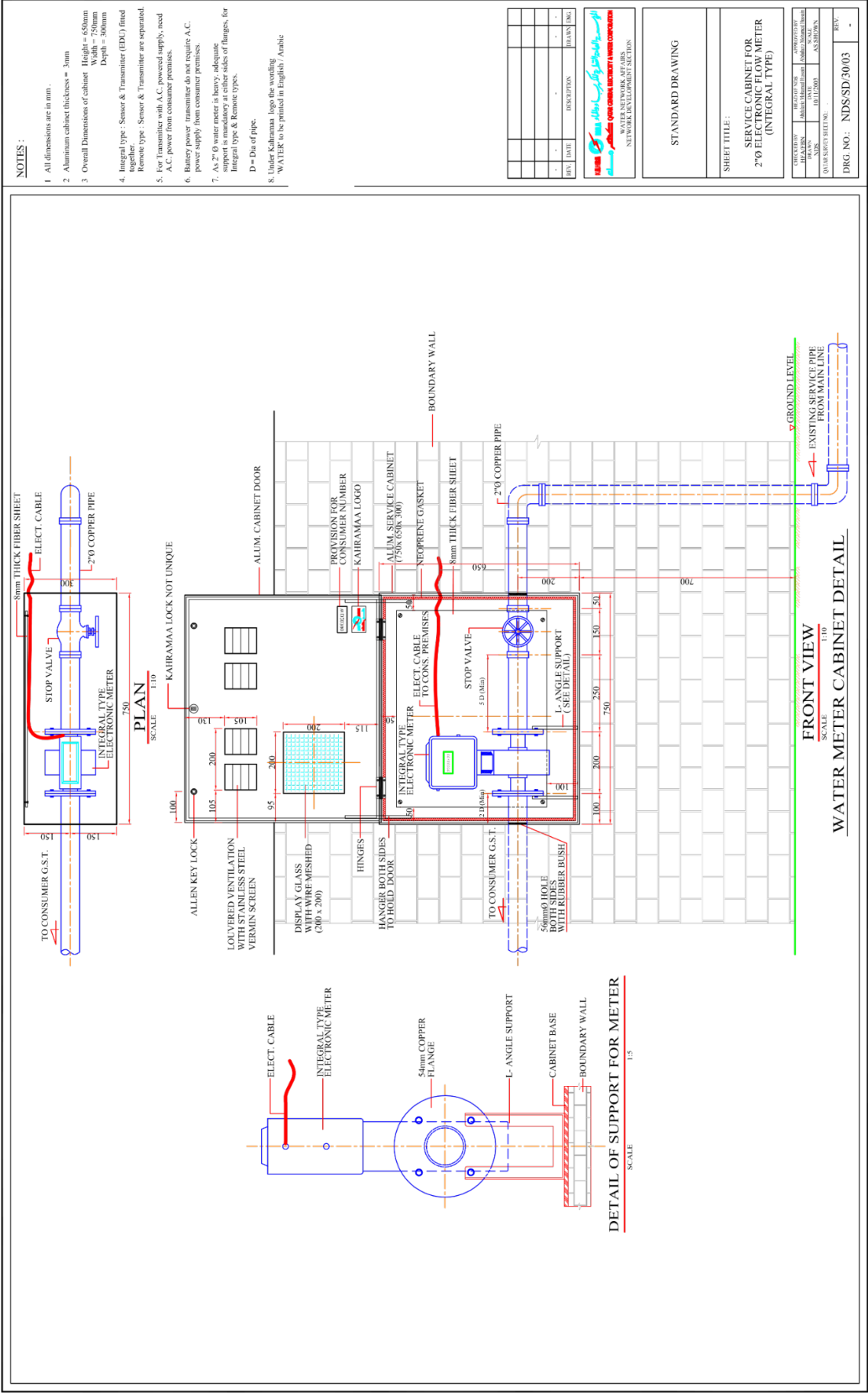
Standard Aluminume Service cabinet (Surface Mount type)



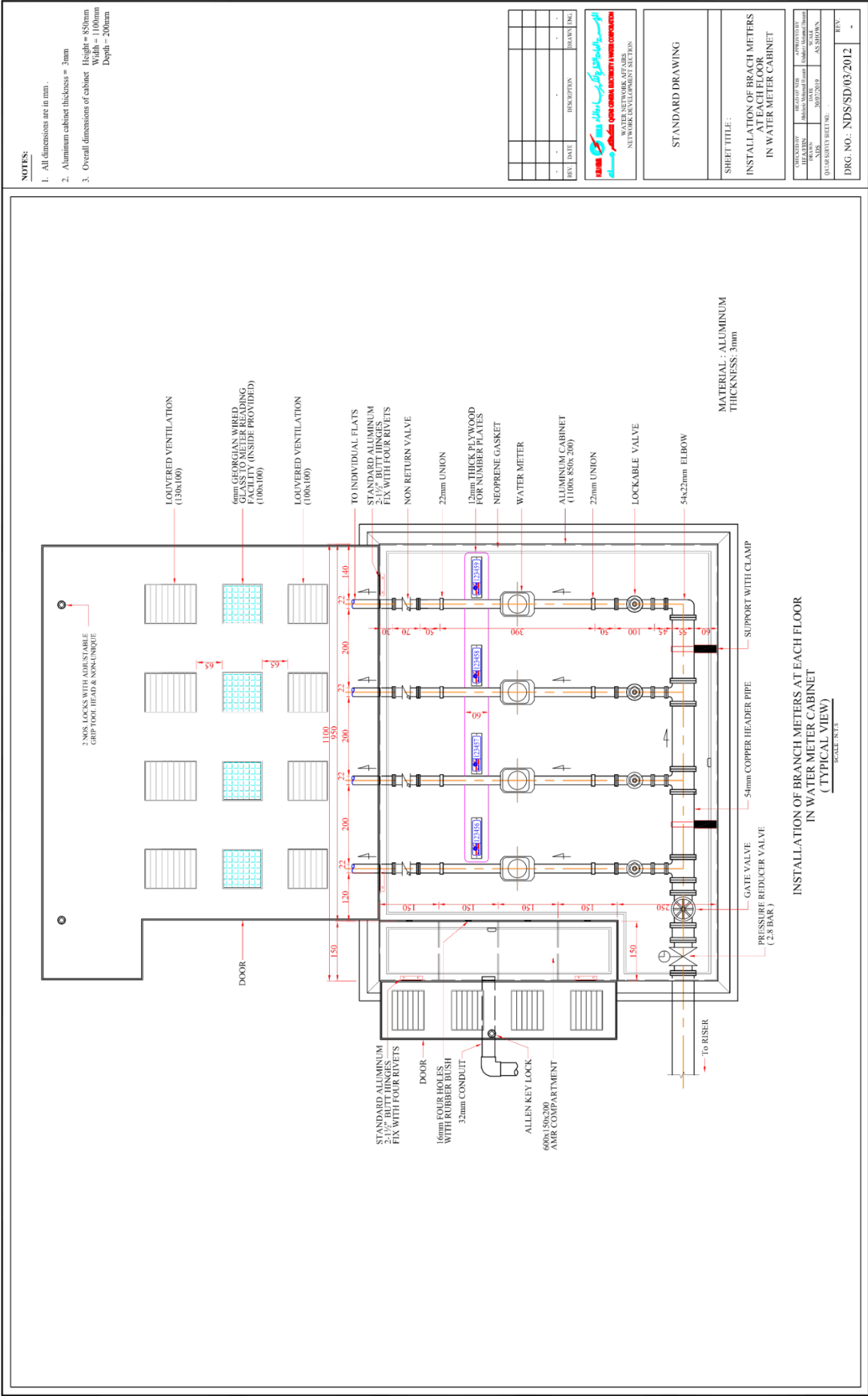
▪ Bulk Aluminume Service cabinet (Remote type)



▪ Bulk Aluminume Service cabinet (Integral type)

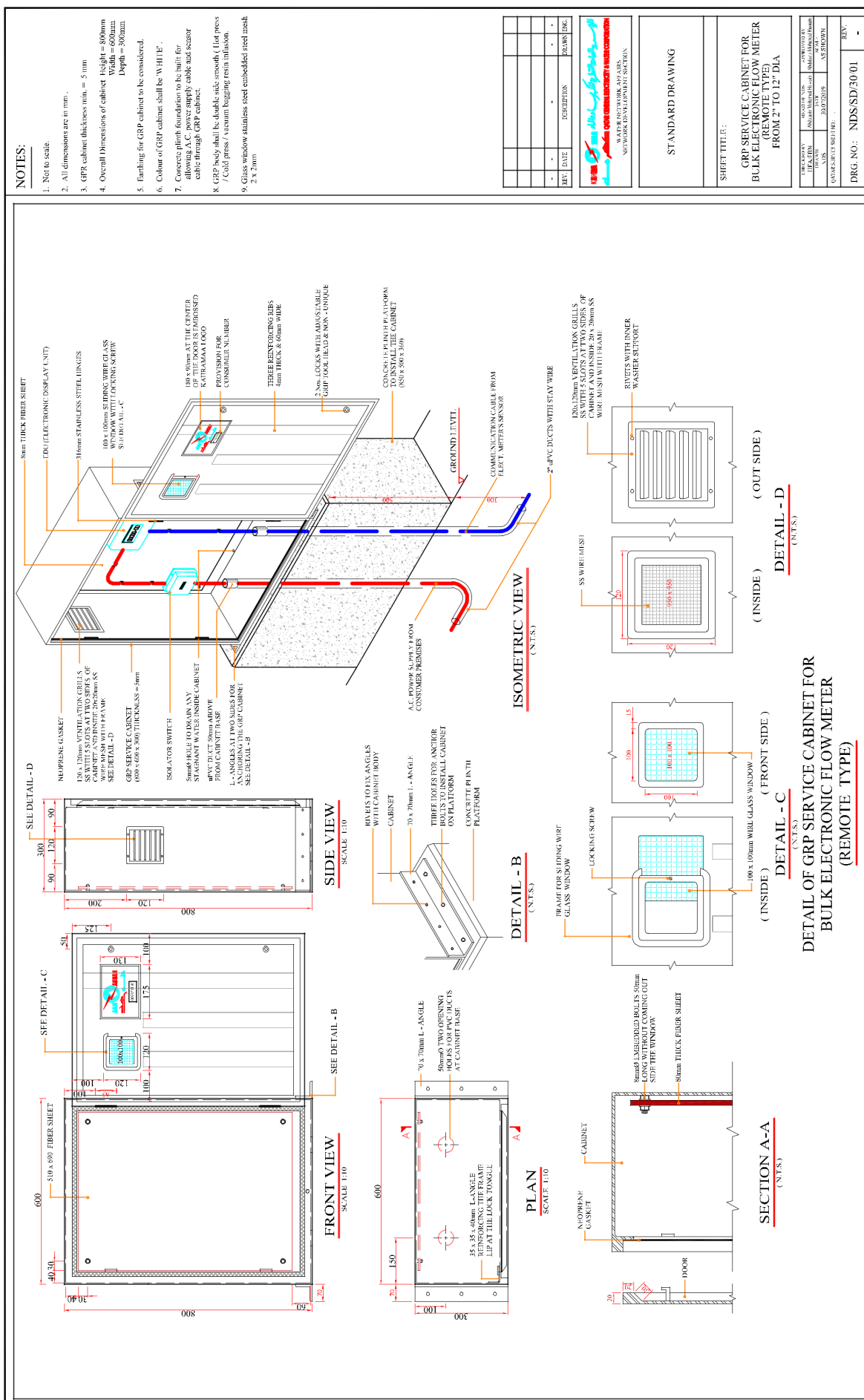


Multi Domestic Alumunume Service cabinet





- **GRP Water Meter cabinet**



NOTES:

1. All dimensions are in mm.
2. GRP cabinet thickness = 5mm (minimum)
3. Overall Dimensions of cabinet: Height = 830mm, Width = 300mm, Depth = 200mm
4. Colour of cabinet shall be light grey CRAPT
5. This drawing is to be read in conjunction with Drawing No. GSA-STD-418

DETAIL OF ELECTRONIC WATER GRP CABINET SURFACE MOUNTED TYPE

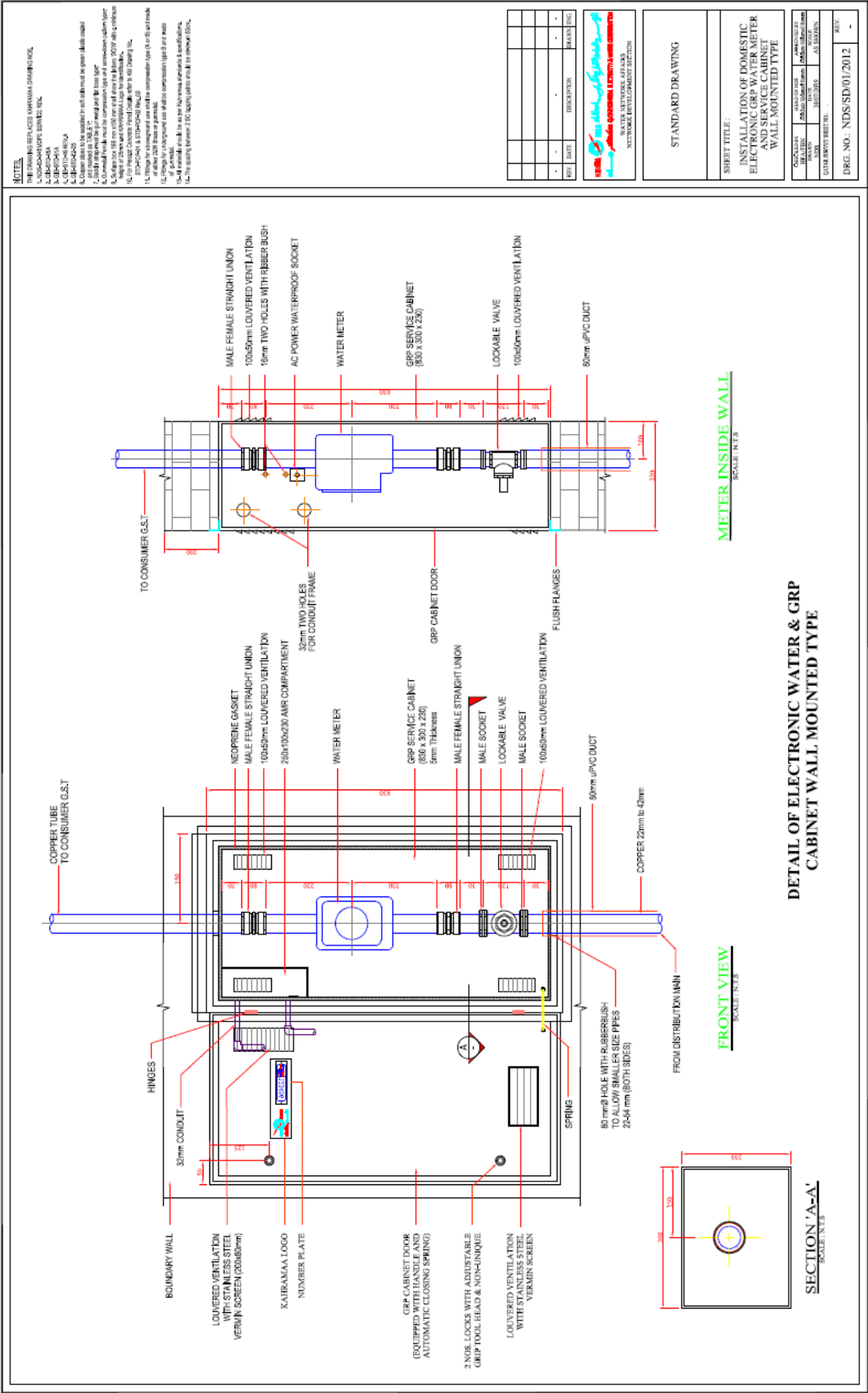
FRONT VIEW
SCALE: 1:1

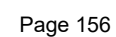
SECTION 'A-A'
SCALE: 1:1

METER INSIDE WALL
SCALE: 1:1

Labels and Dimensions:

- BOUNDARY WALL
- HINGES
- 32mm CONDUIT
- LOUVERED VENTILATION WITH STAINLESS STEEL VERMIN SCREEN (20x40mm)
- KAIRAMAA LOGO NUMBER PLATE
- GRP CABINET DOOR
- 2 NOS. LOCKS WITH ADJUSTABLE GRIP TOOL HEAD & NON-UNIQUE
- LOUVERED VENTILATION WITH STAINLESS STEEL VERMIN SCREEN
- 80mm PVC DUCT
- COPPER 22mm to 42mm
- FROM DISTRIBUTION MAIN
- 80mm PVC DUCT
- LOCKABLE VALVE
- MALE SOCKET
- MALE FEMALE STRAIGHT UNION
- GRP SERVICE CABINET (830 x 300 x 200)
- WATER METER
- 25% ANCHOR BOLT WITH WASHER
- NEOPRENE GASKET
- MALE FEMALE STRAIGHT UNION
- 45mm Ø HOLE WITH RUBBER BUSH TO ALLOW SMALLER SIZE PIPES 15, 22 & 28 to 42mm
- 15mm TWO HOLES FOR RUBBER BUSH
- 20mm TWO HOLES FOR CONDUIT FRAME
- AC POWER WATERPROOF SOCKET
- WATER METER
- GRP CABINET DOOR (830 x 300 x 200)
- LOCKABLE VALVE
- 100x50mm LOUVERED
- 25% ANCHOR BOLT WITH WASHER
- COPPER TUBE TO CONSUMER G.S.T
- BOUNDARY WALL

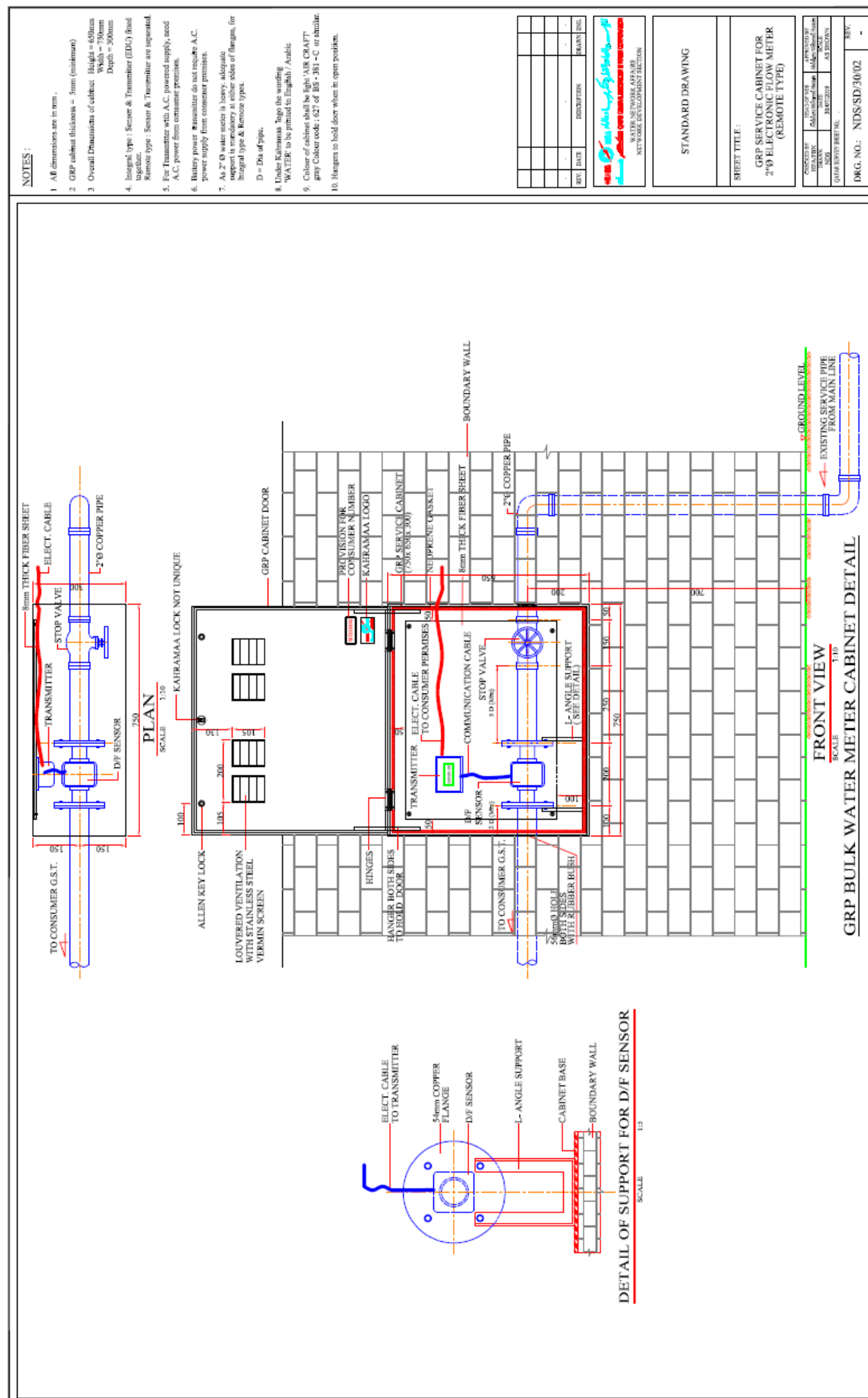


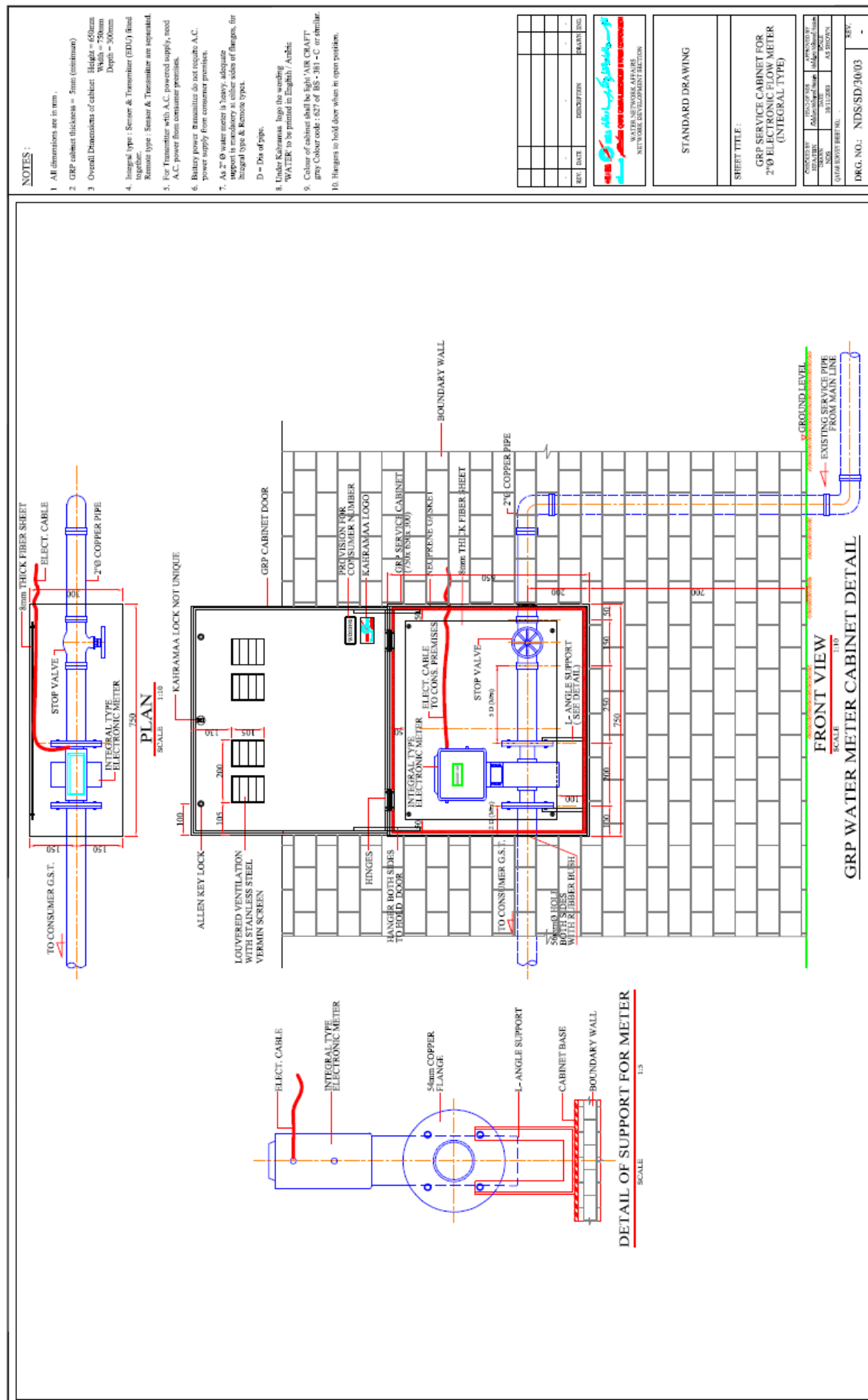




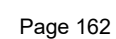








- **Fire Hydrant and Valves**



DO NOT SCALE **IF IN DOUBT ASK**

NOTES:

1. MARKER PLATES WILL CONSIST OF INDICATOR PLATES, BACKING PLATES AND TILES. ALL ITEMS ARE TO BE CAPABLE OF WITHSTANDING LOCAL ENVIRONMENTAL CONDITIONS WITHOUT DETERIORATION FOR A MINIMUM OF 10 YEARS. ALL ITEMS ARE TO BE CAST IN IMPACT RESISTANT PLASTIC TO GIVE PROTECTION AGAINST VULCAN DAMAGE. ALL DIMENSIONS, WEIGHTS AND LETTERS ARE TO BE INTEGRALLY CAST TO PROVIDE RESISTANCE AGAINST SCORING.
2. A REPRESENTATIVE SAMPLE OF ALL ITEMS IS TO BE PROVIDED FOR APPROVAL BY THE ENGINEER PRIOR TO SUPPLY.
3. ALL NUMERALS AND LETTERS TO BE INTEGRALLY CAST WITHIN THE TILES.
4. POST TO BE 125mm LONG, MADE OF 78 x 38 x 4.7 kg/m MILD STEEL CHANNEL.
5. POST TO HAVE 16mm x 16mm x 8mm MINIMUM PLATE WELDED TO BASE.
6. BACKING PLATES TO BE MADE OF 8mm THICK MILD STEEL PLATE DIMENSIONS AS DETAILED.
7. EACH MARKER POST IS TO BE SUPPLIED WITH 1 NO. M8 x 30mm LONG COUNTERSINK BOLTS WITH HEXAGON DRIVE. THE NUTS FOR THESE BOLTS ARE TO BE SPOT WELDED TO THE REAR OF THE MARKER POST AS SHOWN.
8. EACH MARKER POST IS TO BE SUPPLIED WITH 4 NO. M8 x 30mm LONG SLOTTED ROUND HEAD BOLTS WITH NUTS AND SPRING WASHERS.
9. ALL POSTS AND PLATES ARE TO BE GUT BLASTED TO MIN. SA 2.5 PRIOR TO THE SPRAYED APPLICATION OF A 10mm THICK COAT OF POLYURETHANE. SUCH ACTION REQUIRED, HEREIN, IS NECESSARY ON SIMILAR APPROVED BY THE ENGINEER.
10. MARKER POST TO BE SET IN 300 x 300 x 600 GRADE 30/35 CONCRETE.
11. ALL EXTERNAL ANGLES TO INSITU OR PRECAST CONCRETE TO HAVE R6 x 15mm CHAMFER EVEN WHEN NOT SPECIFIED. CHAMFER MAY NOT BE INDICATED ON THE DRAWINGS.
12. AFTER SATISFACTORY CURING ALL EXTERNAL SURFACES OF THE CONCRETE TO BE GUT BLASTED OR BRUSHED TO REMOVE ALL LOOSE PARTICLES OF MATERIAL. AFTER SUCH ACTION REQUIRED, HEREIN, IS NECESSARY ON SIMILAR APPROVED BY THE ENGINEER.

VALVE MARKER PLATES

VALVE MARKER PLATES TO CONSIST OF THE FOLLOWING ITEMS:

- a) INDICATOR PLATE, 200mm x 140mm NOMINAL, BLUE WITH INTEGRALLY CAST WHITE "T", COMMAS AND ARABIC "WATER".
- b) BACKING PLATE, 200mm x 140mm NOMINAL, TO SUIT a) FOR THE PURPOSE OF SECURELY JOINING THE NUMERALS TILES WITHIN THE INDICATOR PLATE.
- c) BLUE TILES WITH 10mm NOMINAL SIZE WHITE ARABIC NUMERALS 0 TO 9.
- d) BLUE TILES WITH 25mm NOMINAL SIZE WHITE ARABIC NUMERALS 0 TO 9.
- e) BLUE TILES WITH 40mm NOMINAL SIZE WHITE ARABIC NUMERALS 0 TO 9.
- f) BLUE TILES, BLANK, SUITABLE FOR ENGRAVING WITH 15mm NOMINAL SIZE FIGURES.
- g) BLUE TILES, BLANK, SUITABLE FOR ENGRAVING WITH 25mm NOMINAL SIZE FIGURES.
- h) BLUE TILES, BLANK, SUITABLE FOR ENGRAVING WITH 40mm NOMINAL SIZE FIGURES.
- i) BLUE TILES (46mm) WITH 2 ROWS OF WHITE REFERENCE NUMBERS. EACH ROW TO CONSIST OF 4 NO. 10mm NOMINAL SIZE ARABIC NUMERALS AS SPECIFIED BY THE ENGINEER.

BACKING PLATE FOR USE AT SLUICE VALVES, AIR VALVES AND WASHOUT VALVES

SECTION A-A

SPOT WELDED CAPTIVE NUT 76x38x6.7 kg/m STEEL CHANNEL

MILD STEEL BACKING PLATE 8mm THICK

PLASTIC BACKING PLATE 3mm THICK

DETAILS OF 10mm COUNTERSUNK SLOTS IN BACKING PLATES

CORNER DETAIL

FRONT ELEVATION

SIDE ELEVATION

VALVE STEEL MARKER POST AND PLATE

TITLE

REVISIONS

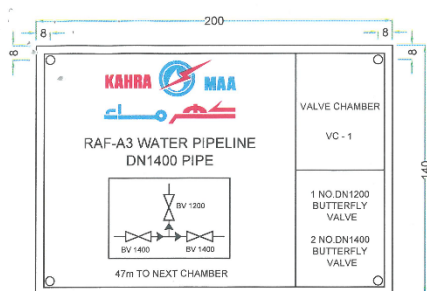
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APPROVED BY

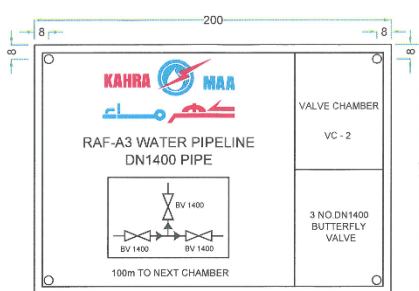
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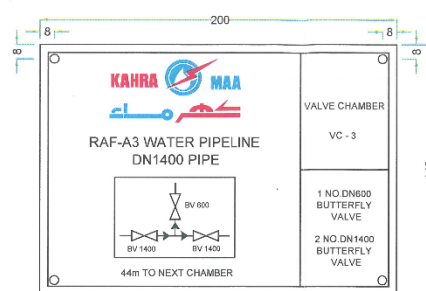
3. MARKER PLATE FOR VALVE CHAMBER



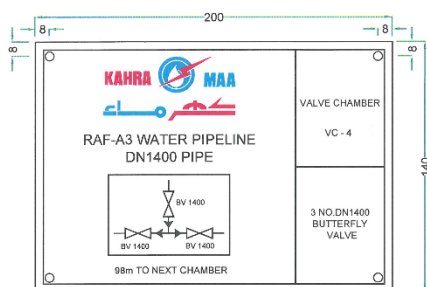
MARKER PLATE FOR
VALVE CHAMBER VC-1 (CH=0+247.10)



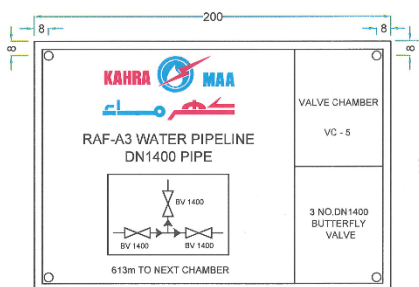
MARKER PLATE FOR
VALVE CHAMBER VC-2 (CH=0+545.00)



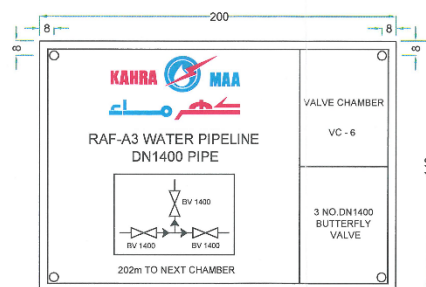
MARKER PLATE FOR
VALVE CHAMBER VC-3 (CH=0+731.00)



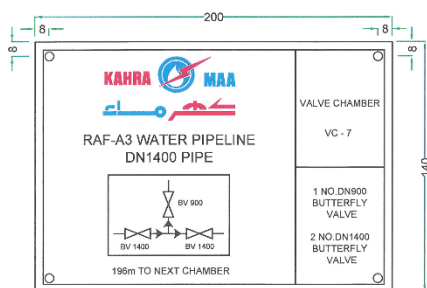
MARKER PLATE FOR
VALVE CHAMBER VC-4 (CH=1+039.11)



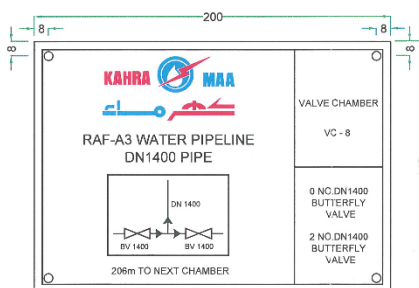
MARKER PLATE FOR
VALVE CHAMBER VC-5 (CH=1+137.34)



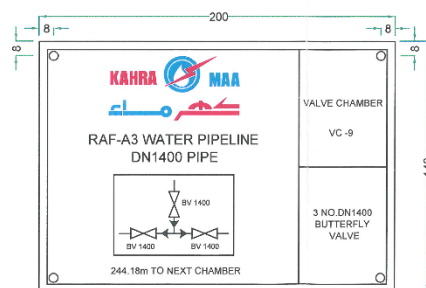
MARKER PLATE FOR
VALVE CHAMBER VC-6 (CH=2+272.66)



MARKER PLATE FOR
VALVE CHAMBER VC-7 (CH=2+548.31)



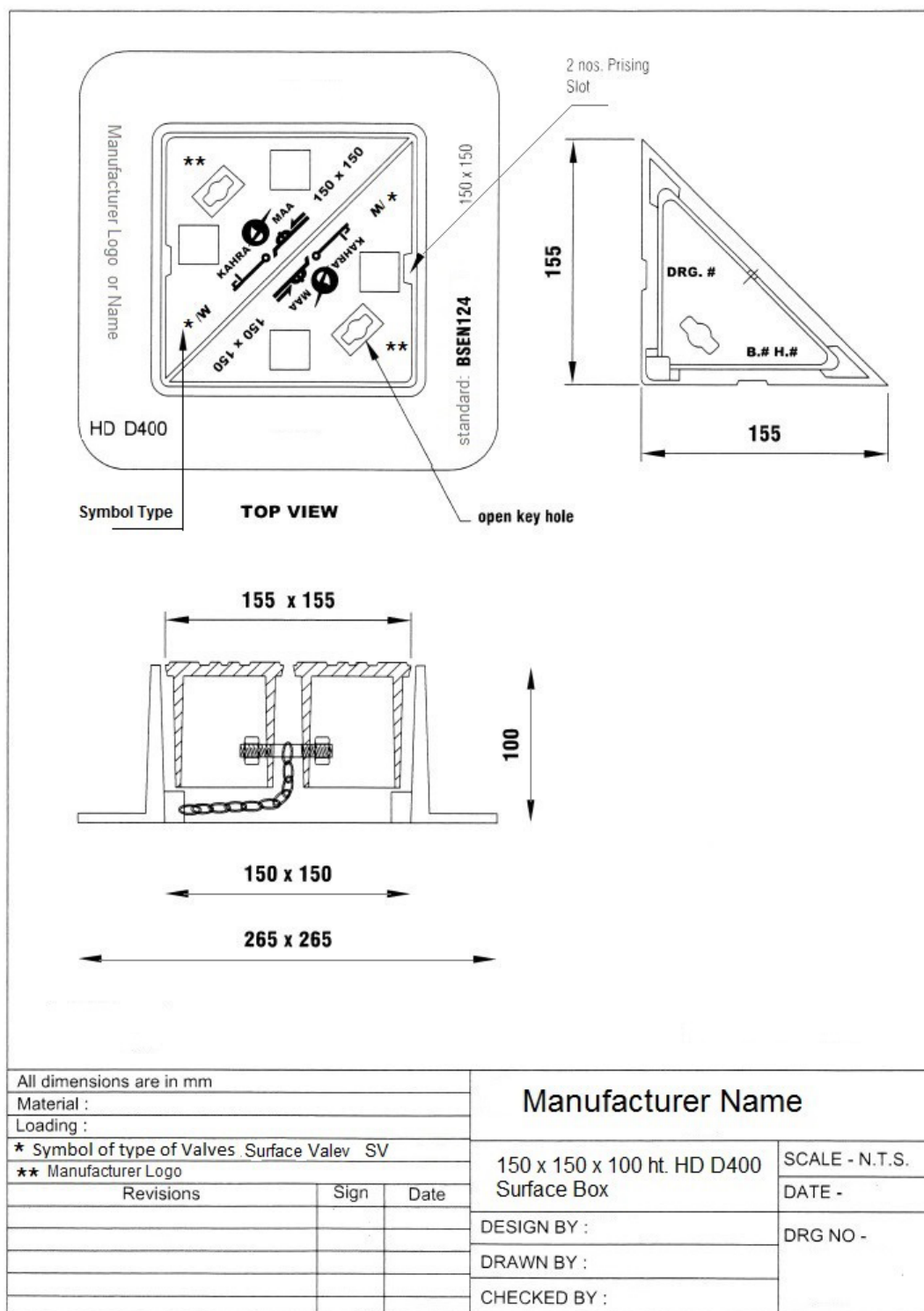
MARKER PLATE FOR
VALVE CHAMBER VC-8 (CH=3+677.05)



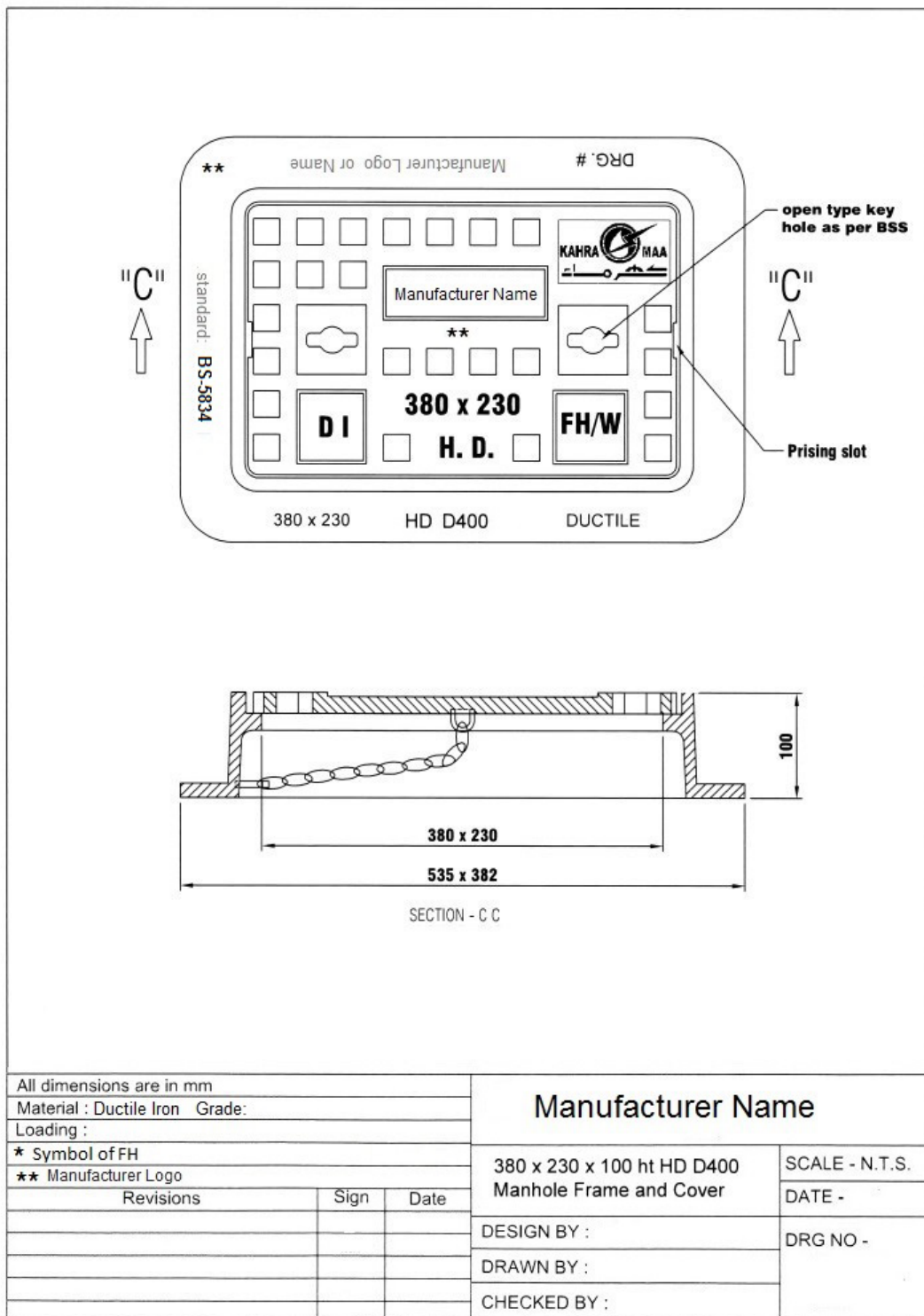
MARKER PLATE FOR
VALVE CHAMBER VC-9 (CH=4+755.82)

4. SURFACE BOX & MANHOLE COVER

▪ Surface Boxes



Fire Hydrant Surface Boxes



Manhole Covers

2 nos. key hole as per BSS Large

750 x 750

910 x 910

100

All dimensions are in mm			Manufacturer Name	
Material : Ductile Iron Grade:				
Loading :			750 x 750 x 100 ht. HD D400 Manhole Frame and Cover	
★ Symbol of type of Valves (BV, SV, AV and FH etc.)				
★★ Manufacturer Logo			SCALE - N.T.S.	
Revisions	Sign	Date	DATE -	
			DRG NO -	
			DESIGN BY :	
			DRAWN BY :	
			CHECKED BY :	

2 nos. key hole as per BSS Large

1000 x 1000

1150 x 1150

All dimensions are in mm			Manufacturer Name	
Material : Ductile Iron Grade:				
Loading :			1000x1000 x 100 ht. HD D400 Manhole Frame and Cover	
★ Symbol of type of Valves (BV, SV, AV and FH etc.)				
★★ Manufacturer Logo			SCALE - N.T.S.	
Revisions	Sign	Date	DATE -	
			DRG NO -	

IV. WORLDWIDE KNOWN QUALITY BODY CERTIFIER

- **WRc Evaluation & Testing Center,**
 - **WRAS "Water Regulations Advisory Scheme"**
 - Fern Close, Pen-y-Fan Industrial Estate
Oakdale, Gwent NP11 3EH, U.K.
Tel.: 44 - 01495 248454
Fax: 44 - 01495 249234
 - Website: <http://www.wras.co.uk>
E-mail: info@wras.co.uk
- **WRc-NSF**
 - Henley Road, Medmenham, Marlow
Bucks SL7 2HD, U.K.
Tel.: 44 – 01495 636500
Fax: 44 – 01495 636501
Website: [http:// www.wrcnsf.com](http://www.wrcnsf.com)
E-mail: wrcnsf@wrcplc.co.uk
- **LaboratoRI SpA**
Via Vitorchiano, 165/167
00189 Roma, Italy
Tel.: 0039 06 57992600
Fax: 0039 06 57992629
Website: [http:// www.laboratorispa.it](http://www.laboratorispa.it)
E-mail: soultion@laboratorispa.it
- **DVGW "The German Technical and Scientific Association for Gas and Water "**
Josef-Wirmer-Straße 1-3,
D-53123 Bonn, Germany
Tel.: 49-228-9188-5
Fax: 49-228-9188-990
Website: <http://www.dvgw.de>
E-mail: info@dvgw.de
- **TZW "DVGW-Technologiezentrum Wasser - the German Water Centre "**

Karlsruher Straße 84

76139 Karlsruhe, Germany

Tel.: +49 721 9678-0

Fax +49 721 9678-101

Website: <http://www.tzw.de>

E-mail: info@tzw.de

- **NSF "National Standard Foundation".**

P.O. Box 130140

789 N. Dixboro Road

Ann Arbor, MI 48113-0140, USA

Tel.: (+1) 734-769-8010

Toll Free (USA): 800-NSF-MARK

Fax: 734-769-0109

Website: [http:// www.nsf.org](http://www.nsf.org) [For Water System → <http://www.nsf.org/dwa/>]

E-mail: info@nsf.org

- **Aquacheck**

Aquacheck Ltd

Europa Business Park, Barcroft Street

BURY, Greater Manchester

BL9 5BT, U.K.

Tel.: +44 (0)161 7638777

Fax: +44 (0)161 7638788

Website: [http:// www.aquacheck.co.uk](http://www.aquacheck.co.uk)

E-mail: aquacheck@aquacheck.net

- **KIWA**

Kiwa Water Research

Groningehaven 7

3433 PE Nieuwegein

PO Box 1072

3430 BB Nieuwegein, Holland

Tel: +31 30 606 95 11

Fax: +31 30 606 11 65

E-mail: alg@kiwa.nl

- **SIRIM QAS International Sdn.Bhd**

1, Persiaran Dato Menteri, Seksyen 2, Peti Sural 7035

40911 Shah Alam

Seiangor Darul Ehsan, Malaysia

Tel: 60-3-5544 6400

Fax: 60-3-5510 9439

Website: [http: // www.sirim-qas.com.my](http://www.sirim-qas.com.my)

- **Australian Water Quality Center**

Hodgson Road, Bolivar, South Australia

Postal Address: Private Mail Bag 3, Salisbury SA 5108

Tel.: (08) 8259 0211 Fax: (08) 8259 0228

E-Mail: awqc@sawater.sa.gov.au

Website: <http://www.awqc.com.au>

- **Hygiene Institute**

Hygiene-Institute des Ruhrgebietes,

Abt. Wasserhygiene, KTW-Prüfung

Rotthausen Str. 19

D-45879 Gelsenkirchen
Tel: +49 (209) 92 42 210
Fax: +49 (209) 92 42 212
E-Mail: info@hyg.de
Website: <http://www.hyg.de>

▪ **DWI- Drinking Water Inspectorate**

Drinking Water Inspectorate
Area 7e
9 Millbank
c/o Nobel House
17 Smith Square
London
SW1P 3JR
Telephone: 0300 068 6400
E-mail: dwi.enquiries@defra.gsi.gov.uk

V. PRE - ARRANGEMENT INSPECTION**Pre-inspection arrangements for DI pipes, fittings, Valves, and Corrosion protection materials (Wrapping Tape, PE Sleeving, Putty, Primer):**

In order to facilitate the onsite inspection for Materials Specifications Engineers, these following points are to be followed:

1. Access road to the store should be safe (paved or compacted) and be accessible from the surrounding streets.
2. The ground of the store should be flat and compacted or aggregate/gravel.
3. Items that are recommended to be stored in a temperate location shall be stored in the air-conditioned store provided at site.
4. For materials inspection (DI Fittings & valves, etc....), the items shall be stored and segregated by part, type and diameter on different pallets, since placing the materials directly on the ground not accepted. Do not store on unstable or sloping ground
5. Ductile Iron pipes and fittings shall be stocked appropriately above timber battens and elevated above the ground surface is not less than 100mm.
6. Stack the pipes on top of each other without exceeding the maximum heights or number of bundles/layers that indicated and recommended by the manufacturers in order to preserve the integrity of the products.
7. There shall be appropriate spaces between the pallets so that the engineer/inspector can freely go around them and inspect the materials thoroughly.
8. Access shall be maintained to each item / location.
9. Staking the materials all over each other & in one corner is strictly not allowed.
10. All valves shall be kept under the shade away from direct sun light and shall have wooden pallets (timber battens) underneath them.
11. The epoxy coated materials (e.g.: Flange Adaptor, Dismantling Joint, D.I. Fittings, etc.) shall be kept under the shaded area away from direct sunlight.
12. Corrosion protection materials (Heat shrink, PE Sleeving, Putty, and Primer) shall never be kept under direct sunlight or exposed to harsh site environment. They shall be stored inside the site warehouse.
13. Material (Wrapping Tape) that are recommended to be stored in a temperate less than 30 degree shall be stored in the air-conditioned store provided at site.
14. If the items in one pallet are more than 10 do not arrange it on top of the others and provide space in between to inspect easily.

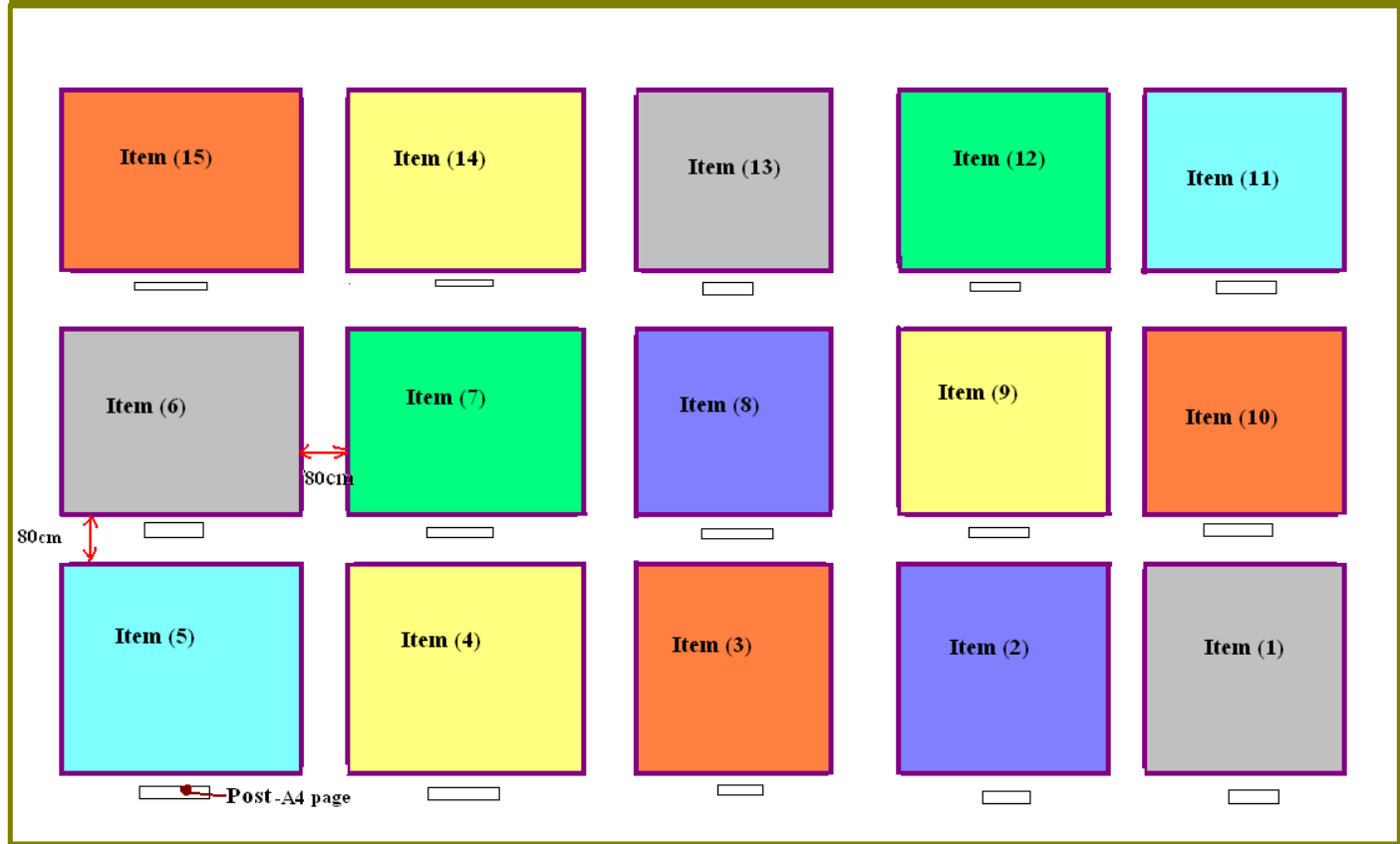
15. Small item (e.g.: Rubber Gasket, Warning Tape, etc.) shall be in segregated compartments on shelves inside the warehouses.
16. Each pallet should have a sign post on an A4 page, that includes a clearly visible and written description of the items. (attached)







Pre-Inspection Arrangements For D.I. Pipes, Fittings, Valves and Corrosion Protection Materials...



**Serial Numbers as per the
list of materials inspection
request.**

Project No.

**Description of the Items Clearly Written
(material type, size, manufacturer name)
Quantity**

VI. METERS HIGHLY ACCELERATION LIFE TESTING (HALT)

A HALT certificate that is carried by a third-party laboratory shall be for as per the following:

- KAHRAMAA is in the process of short-listing smart water flow meters and smart electricity meters.
- The meters are to be pre-qualified and installed on site in various ways of installations for two years' time, during this time site observations and analysis will be carried out by KAHRAMAA.
- In addition to site investigations; The following is a description to one of the mandatory tests before accepting the meter as short-listed.
- All water and electricity meter types supplied to KAHRAMAA are subject to a Factory acceptance Test that may be attended by KAHRAMAA before dispatching, where Kahramaa to be notified in advance before any planned Factory acceptance Tests (FAT).
- In addition to the FAT programs suggested by manufactures, Kahramaa is requesting a Highly Accelerated Lifetime Testing (HALT) that is to be carried by a third-party laboratory.
- Kahramaa realize that (HALT) is a stress testing methodology to simulate the ageing of the equipment under test in extreme environmental condition of use and that the below described test is a destructive test and meters cannot be used after the HALT is concluded on site. The intention is to identify meter break points (LCD, Accuracy and communication) for each type of meters in order to consider selecting the Top-Of-Range for short listing.

Before Start of HALT:

- All HALT subject meters shall be FAT tested before running the HALT; records shall be kept safe with a copy sent to KAHRAMAA showing result/serial numbers etc.

HALT Specification

- Using a certified climatic chamber; Kahramaa specified the following conditions:

1st Test (Kahramaa shall accept the chamber certificates prior to any test):

- Temperature: 85 deg C constant. Humidity: 95% r. H constant with salty environment
- Duration: 1000 hours
- Verification Cycle: Every 100 Hrs.
- Electricity Meter status: Powered ON (loaded above 50%) and covers are placed (not opened)
- Water Meter status: Powered ON and water flowing with flow rate between 0.05 m³/h to 5 m³/h and 70 deg C water temperature, and covers are opened.
- Minimum Quantity: 4 of each type.
- Vibration frequency: 10-15 Hz

Resume the test

- After the visibility check, the test is being resumed till the next assigned check point and till the completion of the 1000 hours.

2nd Test

- Similar to 1st test with temperature fluctuating (reaching 85 deg C and stay for 1 hr. minimum).

Witnessing of tests:

- HALT shall be carried out for all kinds of supplied meters; Kahramaa may attend these tests or may accept receiving the certificate of completing HALT tests from a selected 3rd party lab by Kahramaa.
- Kahramaa to be notified in advance before any planned HALT tests.

Pass/Fail criteria (verification):

- Using a tool that is accepted by Kahramaa the below shall pass for each 100 hrs. cycle:
- A visual (with photo capturing): All Display Segments are read easily, and all connectors/terminals are in a good shape.
- Functional/Operational: All features and components are good (such as alarms LED, Batteries operating, connectors quality etc..).
- Calibration: Accuracy tests showing all parameters are within the meter class level.
- Communication: all communication/s is/are established and available for more than 97% for 1 hr.
- Complete test duration Thermal profile retrieved from the chamber controller shall be reviewed and accepted by Kahramaa.
- Pass all above for 3 cycles (i.e. 300 Hrs.) is the minimum KM could accept for initial pre-qualification

Test Results

- After each cycle of check (i.e. every 100 hrs.), the results shall be recorded as the below table with photo capturing and printouts for the testing (every meter break pints shall be recorded for KM evaluation):

Visibility check results

Functional /Operational Check and visual analysis					
Meter SL#	100	200	300	400	-----
	Hours	Hours	Hours	Hours	Hours
	OK	OK	OK	OK	OK
.....					

Accuracy check results

Functional /Operational Check and visual analysis					
1	2	3	4	5	6
	Hours	Hours	Hours	Hours	Hours
Meter SL#	100	200	300	400	-----
	Hours	Hours	Hours	Hours	Hours
	OK	OK	OK	OK	OK
.....					

Communication check results

Communication Check					
1	2	3	4	5	6
	Hours	Hours	Hours	Hours	Hours
Meter SL#	100	200	300	400	-----
	Hours	Hours	Hours	Hours	Hours
	OK	OK	OK	OK	OK
.....					

- Test will be carrying out with 100 hr. verification and if found appearance of deform / destruction of Meter physically (even in 1 meter), Test shall be stop and meter shall be conducting for Accuracy Test.
- 100 Hourly Report shall be generated from independent 3rd party facility with relevant test information.
- Each 100 hr. shall have record with clear photos / video show relevant of chamber setting of running test data.
- Independent 3rd party facilities can propose recording cycle (i.e. 100 hour or other time frames) and shall keep monitored Meter operational condition in best way to track record but needs to obtain approval of test details form KM.
- KAHRAMAA may witness these tests or may accept receiving the certificate of completing HALT tests. KAHRAMAA shall be notified six weeks in advanced before any planned HALT tests.
- Tenderer shall attach full information for the proposed water meters (i.e. certificates, manuals, previous supply/ installation made with size and place of supply/ installations) and any other information deemed necessary.