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DEPARTMENT OF ENERGY

GUIDE TO WATER SUPPLY REGULATIONS 2024

EFFECTIVE DATE: 01/01/2024

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Contents

Changes History Sheet

DOC. CHANGE REQUEST NO. & DATE	PAGE NO.	SUMMARY OF CHANGE	NEW EFFECTIVE DATE

1. Introduction

1.1 Purpose

1.1.1 This Guide provides guidance in support of the Water Supply Regulations.

1.1.2 The purpose of this Guide is to provide details of the general principles and basic design considerations that will ensure the safe, hygienic, reliable and secure construction and operation of customer Service Connections.

1.1.3 This Guide is intended to assist the designers, installers, Customer(s) and the Responsible Person(s) in understanding the requirements for a sound and reliable water supply connection.

1.1.4 This Guide ensures compliance with applicable international and national standards and Good Industry Practice.

1.1.5 The objective of this Guide is to explain:

(a) the Water Connection arrangements; and

(b) the Water Fittings requirements which a Distribution Company and its Customers shall follow in order to prevent wastage, Contamination and overconsumption of Wholesome water.

1.1.6 This Guide has been developed in consultation with the Distribution Companies along with private and government organizations.

1.1.7 In developing this Guide, the Department of Energy has referred to the following standards, Regulations and guidelines:

(a) Standard Specification for Water Works (Abu Dhabi Water and Electricity Authority)

(b) Unification of Water Supply and Plumbing Regulations – Gulf Co-operation Council

(c) General Guidelines – Water Distribution – Abu Dhabi Distribution Company

(d) Water Supply (Water Fitting) Regulations – UK

(e) British Standard BS EN 806-1, BS EN 806-2, BS EN 806-3, BS EN 806-4, BS EN 806-5 and BS 8558

(f) The Code of Practice for the Inspection and Cleaning of Customer Water Storage Tanks – The Department of Energy, Abu Dhabi

(g) Tankering Regulations, DoE, Abu Dhabi

(h) The Guide for Chemicals and Products that come in contact with Drinking Water, DoE, Abu Dhabi

(i) Uniform Plumbing Code of Abu Dhabi Emirate – Environment Agency, Abu Dhabi

(j) User Guide for the International Building Codes in the Emirates of Abu Dhabi – Department of Municipal Affairs, Abu Dhabi

(k) Estidama Pearl Rating System as appropriate.

1.2 Scope

1.2.1 This Guide shall apply to:

(a) any Person applying for a new Water Connection, whether permanent or temporary

(b) the Person responsible for rearranging an existing connection, including a meter installation, or for disconnection from a Distribution Company's system

(c) the Person, company or organization, including Water Fittings manufacturers or suppliers/agents, engaged in any activities relating to the production, supply, erection, maintenance and operation of the Service Pipe and Internal Plumbing System that are in a Customer's Premises.

1.2.2 This Guide covers the part of the water supply installation between a Distribution Company's system and a Customer's installation, which generally consists of the Water Fittings including a Service Connection, Customer Meter,

storage tanks and any direct connection to the kitchen in a Low-rise, single metered Premises like a villa and shabiat, if applicable.

1.2.3 The scope of this Guide does not include the water Distribution System belonging to Distribution Companies. The Service Pipe and fittings that are required at the interface with Customers are within scope. This is illustrated diagrammatically in Figures 1.1-1.3. The roles of different Entities listed in these diagrams are shown in Table 1.1.

1.2.4 The DoE will ensure that regular reviews and updates are carried out after consultation with Distribution Companies and Persons affected and will publish reprints accordingly.

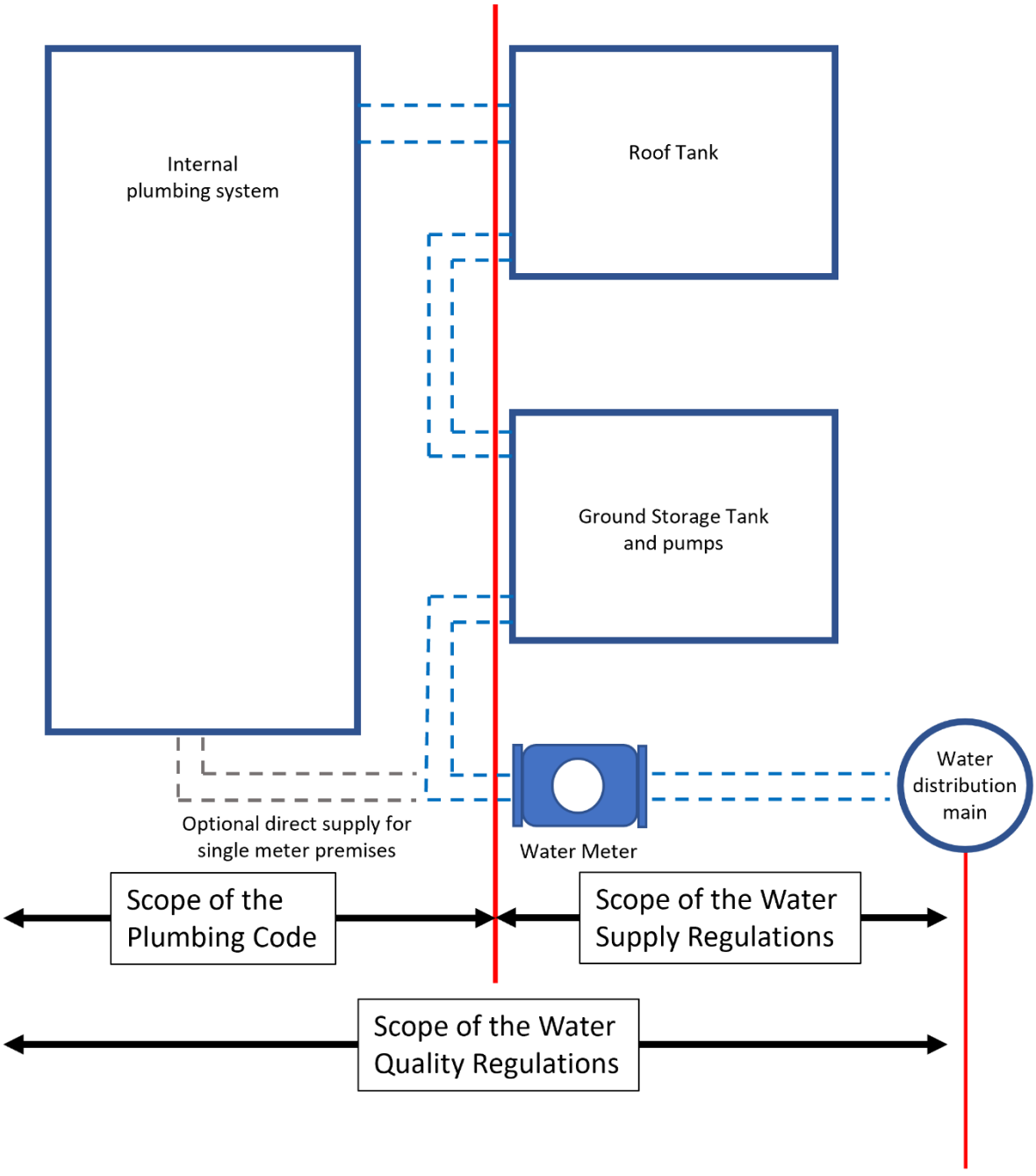

Figure 1.1: Diagram to illustrate the extent and scope of Water Supply Regulations - Case (A) When both the Roof Tank and Ground Storage Tank are present

Notes: This diagram is for illustration purposes only and does not show all fixtures and fittings to be included as part of a Water Connection.

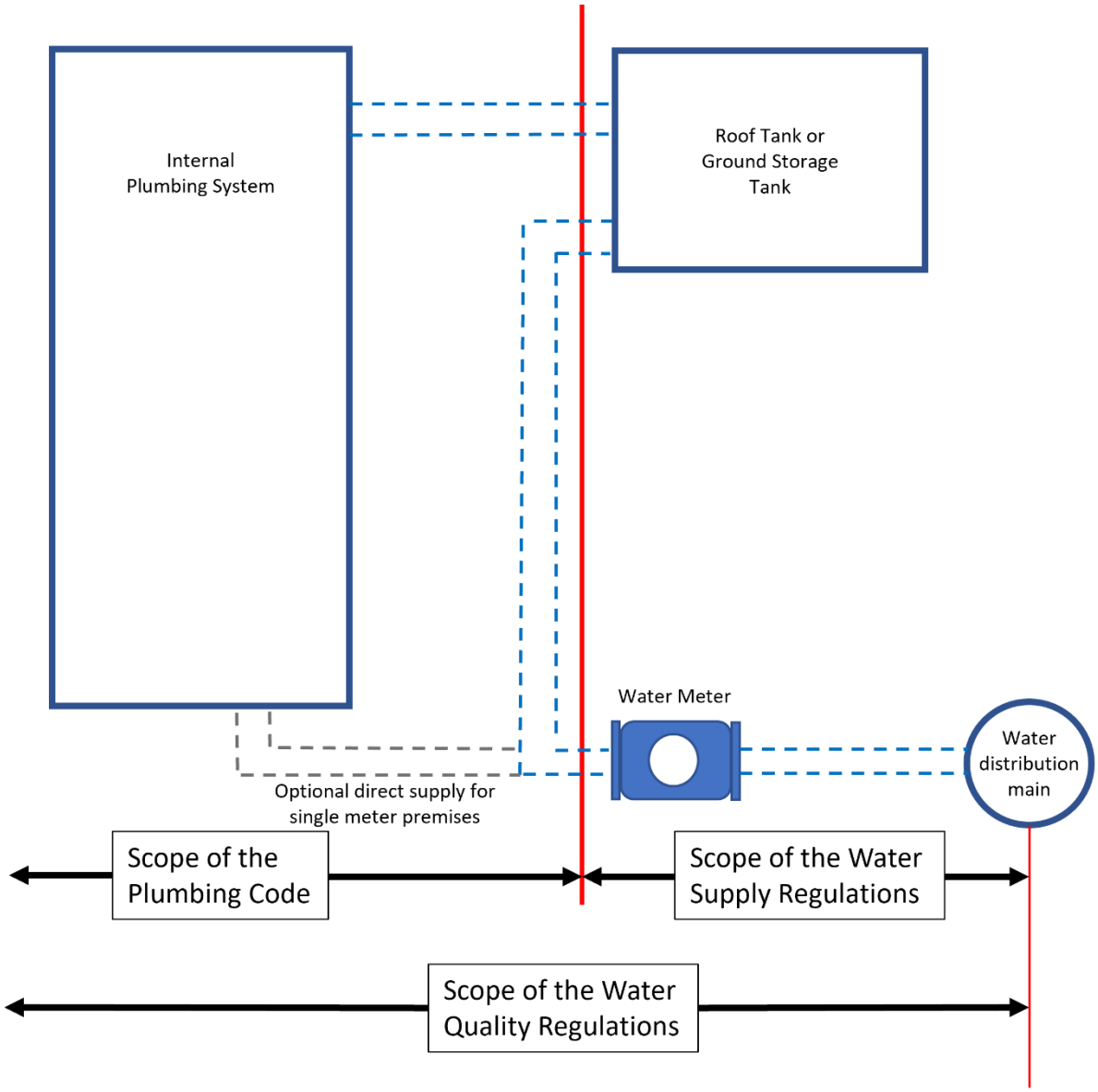

Figure 1.2: Diagram to illustrate the extent and scope of Water Supply Regulations - Case (B) When either the Roof Tank or Ground Storage Tank are present

Notes: This diagram is for illustration purposes only and does not show all fixtures and fittings to be included as part of a Water Connection.
Due to areas overlapping on ownership and regulations, the above illustration reflects new connections.
Existing connections would see the 'Ground Storage Tank and Pumps' along with the 'Roof Tank' moved under the scope of the Plumbing Code.

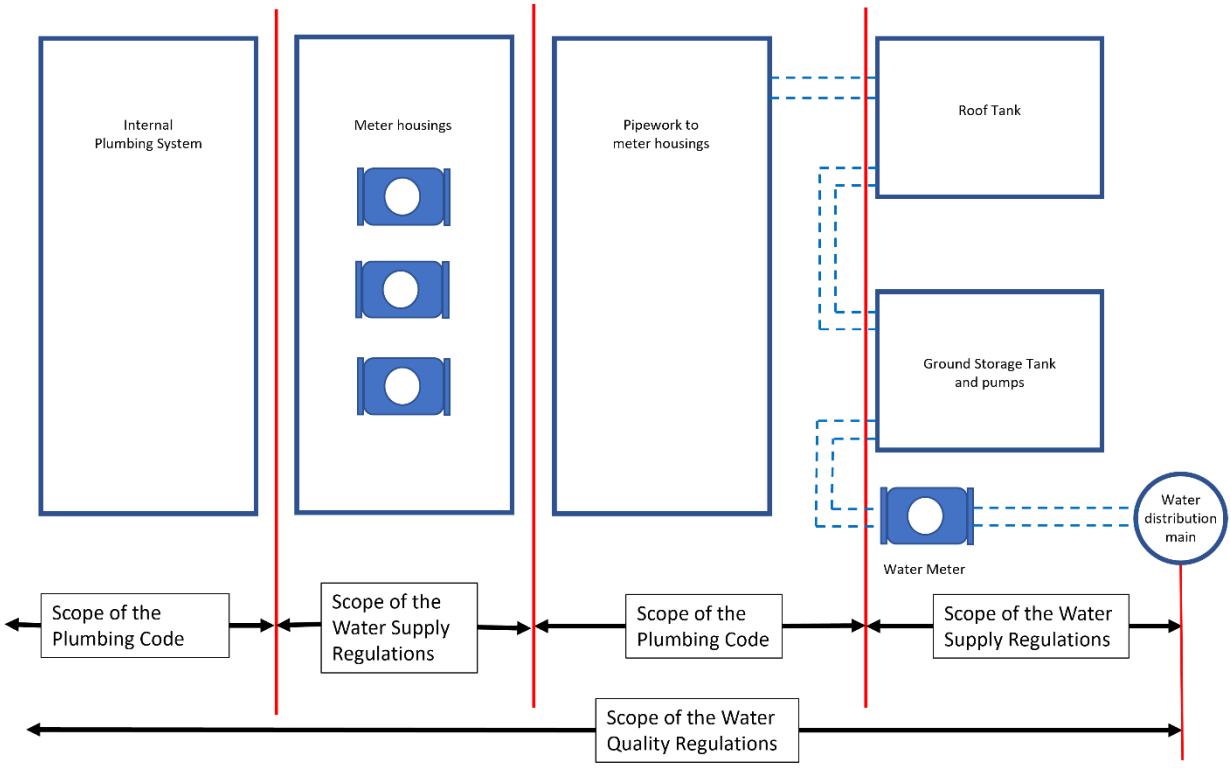

Figure 1.3: Diagram to illustrate the extent and scope of Water Supply Regulations Case (C) - Multiple Occupancy Premises

Notes: This diagram is for illustration purposes only and does not show all fixtures and fittings to be included as part of a Water Connection.
Due to areas overlapping on ownership and regulations, the above illustration reflects new connections.
Existing connections would see the 'Ground Storage Tank and Pumps' along with the 'Roof Tank' moved under the scope of the Plumbing Code.

Table 1.1: Roles and Responsibilities

Legislation	Document Owner	Responsible for Implementation
The Water Quality Regulations (Latest Version)	DoE	Distribution Companies, Entities and Customers who operate of receive Wholesome water
Water Supply Regulations (Latest Version)	DoE	Distribution Company/Responsible Person
Uniform Plumbing Code of Abu Dhabi Emirate (Latest Version)	EAD	Municipalities

1.3 References

1.3.1 A list of titles and references that have been taken into consideration in the preparation of this Guide can be found in Annex C.

1.4 Distribution

1.4.1 Soft copies of this document can be downloaded from the DoE website as https://www.doe.gov.ae.

2. Definitions

2.1 Interpretation

2.1.1 Words defined in this Part begin with capital letters when used in the Regulations.

2.1.2 Words and expressions other than those defined in these Regulations, other than those defined herein, shall have the meanings ascribed to them in Law (as applicable).

2.1.3 Words and expressions to which meanings are assigned by these Regulations shall (unless the contrary intention appears) have the same respective meanings in any document issued by the DoE under these Regulations.

2.1.4 Unless the context otherwise requires, any reference in these Regulations to a numbered Part, Clause or Schedule is a reference to the Part, Clause or Schedule of these Regulations bearing that number.

2.1.5 Words using the singular or plural number also include the plural or the singular number respectively.

2.1.6 Unless otherwise specified, days shall mean calendar days.

2.2 Definitions

Accredited – Means that a body, facility, or laboratory is recognized by an independent third-party accreditation body, such as the QCC, ILAC or UKAS, as conforming to international standards. The DoE does not carry out any accreditation.

Adequate Network Pressure – Means that the water pressure is not less than 1.25 bar (12.75 meters head) at the Customer Meter, or, in the case of High-rise Buildings, the first storage tanks, and has sufficient pressure to deliver water directly to the Roof Tanks of Low-rise Buildings. Pressure at all points along the length of the Service Pipe shall be at least 0.5 bar (5.1 meters head) at all times.

ADWEA – The former Abu Dhabi Water and Electricity Authority. This has been superseded by the DoE under Law No. (11) of 2018.

Air Gap – Means an unobstructed vertical space between the inlet pipe opening and the flood level of a tank.

Back Pressure – Is a resistance or force opposing the desired flow of water through network pipes.

Back Siphonage – Is a reversal of normal flow in a system caused by a negative pressure (vacuum or partial vacuum) in the supply piping.

Backflow – Means flow that is in a direction contrary to the intended normal direction of flow, within or from a Water Fitting.

British Standard – Means a standard or specification published under the authority of the General Council of the British Standards Institution and shall be the current revision of the standard.

Check Meter – A Water Meter installed at the Point of Delivery of a multi-meter/multi-story/multi-tenant building, used for the purpose of evaluating water balance and loss assessment.

Concealed Water Fitting – A Water Fitting which:

(a) is installed below ground

(b) passes through or under any wall, footing or foundation

(c) is enclosed in any chase or duct

(d) is in any other position which is inaccessible or renders access difficult.

Contamination – Includes any alteration in chemical or biological quality of water due to a change in temperature or the introduction of polluting substances.

Customer – Means the Person to whom the Distribution Company supplies Wholesome water under a supply agreement.

Customer Meter – Means the primary Water Meter installed for the purpose of billing a Customer.

Distribution Company – Means a company or body holding a Distribution License from the DoE, pursuant to the Law.

Distribution System – Means the system of connected assets up to the Water Connection consisting of water pipes and any fittings owned or operated by a licensee which are used for the distribution of Wholesome water to the Water Connection. This includes any plant or equipment, including metering equipment, owned or operated by the licensee in connection with the distribution of water.

DoE – The Department of Energy in the Emirate of Abu Dhabi, established under the Law.

Entity – an individual, establishment, company, association, society, partnership, corporation, municipality, institution, government organisation, agency or group.

Fire Service – Means the pipes, tanks, pumps and fittings installed for the purpose of firefighting.

Float Valve – Means any float-operated valve for controlling the inflow of water to a cistern or tank.

Good Industry Practice – Means the exercise of that degree of skill, prudence and foresight which would reasonably and ordinarily be expected from a skilled and experienced Person engaged in the same type of undertaking under the same or similar circumstances.

Ground Storage Tank – Means a break tank located on the ground within a Premises for the purpose of holding or storing Wholesome water at atmospheric pressure for subsequent use. It is often the receiving tank after the Point of Delivery to the Customer from the Distribution System.

High-rise Building – Means a building over 7 meters in height, measuring from ground level at the building to top of roof as per design.

Improvement Notice – Means a notice prepared by the Distribution Company and approved by the DoE for the purpose of instructing the Responsible Person to comply with the Regulations.

Internal Plumbing System – Means the system of connected Water Fittings in a Customer's Premises.

Law – Means both Law No. (11) of 2018 and Law No. (2) of 1998 (unless the context indicates otherwise).

License – Means a license authorizing the licensee to conduct a distribution and supply business as described in Article (94) of Law No (2) and as amended from time to time.

Low-rise Building – Means a building up to 7 meters in height, measured from the finished ground level of the building to the top of the roof as per design.

Minimum Pressure – Means the lowest operating pressure at the Point of Delivery.

Overflow Pipe – Means a pipe from a tank in which water flows only when the water level in the cistern exceeds a predetermined level.

Person – Means anybody, corporation, partnership, person or other Entity having independent legal personality.

Point of Delivery – Means the physical connection point at which the Wholesome water leaves the Service Pipe and enters the Customer Water Fittings, immediately after the Customer Meter.

Premises – Means a tract or plot of land and includes the buildings and any appurtenances on the land. A Premises may contain more than one property or dwelling and more than one Customer.

Pressure Relief Valve (PRV) – Means a pressure-activated valve which opens automatically at a specified pressure to discharge fluid.

Responsible Person – Means the Person who assumes actual responsibility for the installation or the ownership of the Water Fittings. That Person can be a

Customer or account holder with the Distribution Company, or be a contractor, a consultant or others as appointed or authorized to liaise with the Distribution Company to fulfil the requirements of the water supply connection.

Roof Tank – Means a fixed container, cistern, or break tank located on the roof of a building for the purpose of holding or storing Wholesome water at atmospheric pressure. If there is no Ground Storage Tank within the Premises, it is the receiving tank after the Point of Delivery to the Customer from the Distribution System.

Service Connection – A Water Connection including pipework and fittings up to the Point of Delivery.

Service Pipe – Means the pipe from a Water Connection to the Water Meter.

Servicing Valve – Means a valve for shutting off, for the purpose of maintenance or service, the flow of water in a pipe connected to a Water Fitting.

Shall – Means must comply.

Should – Means recommended.

Stop Valve/Gate Valve – Means a valve, other than a Servicing Valve, used for shutting off the flow of water in a pipe.

Tank Capacity – In relation to a cistern or tank, means the volume of storage, excluding the unusable top level, measured up to the level of water that can be reached according to the inflow control device setting.

Tankering Regulations – means the Tankering Regulations issued in 2020 by the DoE under the Law (unless the context indicates otherwise), and as amended from time to time.

Terminal Fitting – Means a water outlet device such as a tap, shower, toilet or appliance.

Vent Pipe – Means a pipe open to the atmosphere which exposes the system to atmospheric pressure at its boundary.

Warning Device – Means an instrument or device (audible, or visual) or both) that is installed in water storage tanks to indicate water is overflowing.

Water Connection – Means a point of access to the existing Distribution System to supply Wholesome water by means of a Service Pipe.

Water Fitting – Means pipes, pipe fittings, joints, valves, and Backflow prevention devices downstream of the Point of Delivery required to facilitate the connection arrangement to the Customer and covered under the remit of these Regulations. This includes the Customer's Ground Storage Tank and/or Roof Tank. Without limiting the foregoing, Water Fitting shall also include pumps, meters or any other relevant fittings.

Water Hammer Arrester – Means a device designed to provide protection against excessive surge pressure (hydraulic shock) in the building water supply system where water is abruptly stopped.

Water Meter – Means a device used for measurement of water flow or volume which is either read manually or recorded remotely**.**

Water Quality Regulations – Means the Water Quality Regulations issued by the DoE under the Law (unless the context indicates otherwise) and as amended from time to time**.**

Water Supply Regulations – Means the Water Supply Regulations issued by the DoE under the Law (unless the context indicates otherwise) and as amended from time to time.

Water Tanker – Means a road vehicle registered by the relevant authority following certification of the Tanker for the purpose of supplying Wholesome water as defined in the Tankering Regulations.

Wholesome water – Means water as defined in the Water Quality Regulations.

2.3 Abbreviations

AC – Asbestos Cement

ADAFSA – Abu Dhabi Agriculture and Food Safety Authority

BS – British Standard

BSP – British Standard Pipe

CPVC – Chlorinated Polyvinyl Chloride

DI – Ductile Iron

EU – European Union

EPDM – Ethylene Propylene Diene Monomer

GI – Galvanized Steel (also known as galvanized iron)

GRE – Glass-Reinforced Epoxy

GRP – Glass-Reinforced Plastic

HDPE – High-Density Polyethylene

ISO – International Standards Organization

MAOP – Maximum Allowable Operating Pressure

MDPE – Medium-Density Polyethylene

NSF – National Science Foundation (US)

PTFE – Polytetrafluoroethylene (Teflon)

PVC – Polyvinyl Chloride

QA/QC – Quality Assurance/Quality Control

SDR – Standard Dimension Ratio

uPVC – Unplasticized Polyvinyl Chloride

UV – Ultraviolet

WDC – Water Distribution Code

WQR – Water Quality Regulations

WRUK – Water Regulations UK

WRc – Water Research Centre (UK)

WSR – Water Supply Regulations

2.4 Units

°C – degrees Celsius

bar – metric unit of atmospheric pressure (10m head)

g – gram

gallon – imperial gallon (1 gallon = 4.55 liters)

GPM – Gallons Per Minute

hr – hour

kg – kilogram

kg/m^3 – kilogram per cubic meter (density)

km – kilometer

l/s – liter per second (velocity)

m – meter

m^3 – cubic meter (volume)

mg/l – milligram per liter (concentration)

ml – milliliter

mm – millimeter

MPa – Megapascal (tensile strength or pressure)

m/s – meter per second (velocity)

N – Newton (one kilogram per meter per second squared)

N/mm^2 – Newton per square millimeter (tensile strength or pressure)

W/m^2 K – Watt per square meter per unit temperature difference (thermal conductivity)

” – inch

’ – foot

For the benefit of the reader, some numeric values have been provided in multiple units. In the case of any discrepancy or rounding uncertainty, the metric value should be taken to be exact.

3. General

3.1 Existing Arrangements

3.1.1 Any connection arrangement installed prior to the publication date of the latest version of this Guide shall not be subject to this Guide unless:

(a) that arrangement contravenes material of construction, wastage or Contamination requirements as given in the Regulations

(b) any work on a Premises takes place which requires additions or modifications to the existing arrangement.

3.1.2 Prior consent shall be granted by a Distribution Company as per their approved procedures before any additions or modifications to an existing connection arrangement are carried out.

3.2 Quality of Installations

3.2.1 Distribution Companies have an obligation to ensure that hygiene procedures related to the installation of Water Fittings are followed during installation work. A Distribution Company may therefore request that individuals involved in such installation work undergo a competency test, prepared in accordance with its practices and standards, in order to ensure the quality of this work.

3.3 Quality of Supply

3.3.1 As prescribed in the Water Supply Regulations, a Distribution Company shall:

(a) maintain a Minimum Pressure of 1.25 bar (12.75m) at the end of the main Service Pipe to a Customer during normal water supply operations, measured at the Customer Meter.

(b) ensure that under normal operating conditions sufficient water is supplied to meet demand.

(c) evaluate the size of any connection with consideration to friction losses for all types of Service Connections.

3.3.2 A Distribution Company shall also ensure the water it supplies is compliant with the Water Quality Regulations.

3.4 Application for a Connection

3.4.1 An application shall be accompanied by:

(a) a location site plan

(b) an application form prepared by the appropriate Distribution Company

(c) a scale drawing of the Customer's internal water system plan

(d) any other relevant documents a Distribution Company may request, as specified in Annex A of this Guide.

3.4.2 A cost estimate, material inventory and connection arrangements shall be prepared by a Distribution Company to facilitate the connection to Customers.

3.5 Operation and Maintenance

3.5.1 The Responsible Person shall ensure Water Fittings and storage tanks are inspected and maintained according to the procedures set out in this Guide and the Code of Practice for the Inspection and Cleaning of Customer Water Storage Tanks.

3.5.2 If, during inspection by a Distribution Company, it is found that a storage tank, including its Water Fittings, does not comply with the Regulations, it shall be considered non-compliant, and an Improvement Notice shall be issued by the Distribution Company to the Responsible Person.

3.5.3 Failure to comply with such an Improvement Notice, or with any follow-up inspection report or instructions from a Distribution Company, shall result in the Responsible Person being issued with a final notice, upon which the water supplied to the Premises shall be disconnected.

3.5.4 Following compliance by the Responsible Person, and upon further inspection and approval by the Distribution Company, the drinking-water supply shall be reconnected to the Premises.

4. Water storage tanks

4.1 Water demand and sizing criteria

4.1.1 The demand criteria in Tables 4.1 should be used as a guide when calculating the required size of storage tanks, new water Service Connections and Water Fittings, and Customer Meters. However, in line with Distribution Company demand management practices, which ensure that 'reasonable demand' is constantly monitored, these rates may be modified. Please refer to the relevant Distribution Company for updated rates.

4.1.2 The figures in Table 4.1 are estimates and include daily demand rate in both liters and imperial gallons for various types of residential and commercial Premises. Best estimates for hours of water use and peak factors should be used based on the information available, relying on the estimates provided in Tables 4.1 and 4.2 when no better information is available. The total water usage should be calculated by summing the relevant data in Tables 4.1 and 4.2. The values in Table 4.2 should considered to be applicable for domestic and non-domestic land uses and for both uses of Wholesome and recycled water. However, these Regulations pertain to the supply of Wholesome water and only uses of Wholesome water should be considered during sizing and demand estimation. Sizing of Water Connections to industrial and other high-consumption Customers shall be determined by the Distribution Company's supply and demand management policies. Information shall need to be submitted to the Distribution Company with all relevant references.

4.1.3 For high-consumption Customers, water storage Tank Capacity is determined by daily demand, site-specific conditions and Distribution Company policy regarding Customer-side demand management. Distribution Companies should agree an optimal daily demand rate with high-consumption Customers to avoid oversizing of storage tanks.

4.1.4 The provision of Ground Storage Tanks at Customer Premises (particularly in Low-rise Buildings) shall be considered following consultation with the

Distribution Company. Where Adequate Network Pressure and good security of supply is available, the installation of Ground Storage Tanks in addition to Roof Tanks should be avoided (connection arrangement as shown in Guide Annex D.5).

Table 4.1: Part 1: Buildings

Type of Premises & consumption categories	Description	Estimates of daily rate of consumption (imperial gallons)	Rounded estimates of daily rate of consumption (liters)	Hours of water use	Peak demand factor (ratio to average hour*)
Residential					
Per residential flat	per capita	50	225	24	2.25
	Studio [a]	100	450		
	1 bedroom [a]	120	550		
	2 bedrooms [a]	180	820		
	3 bedrooms [a]	220	1000		
	4 bedrooms [a]	280	1250		
	5 bedrooms [a]	350	1600		
	per maid's room [b]	50	225		
Per block of flats	swimming pool (usage per m^2)	4-5	18-22		
	gym (usage per flat in block)	0.05	0.25		
	cleaning	1	5		
Villa and shabiat [2]	per capita [a]	77	350		
	per bedroom [a]	110	500		
	per small service block [b]	250	1100		
	per large service block [b]	450	2000		
	per external majlis [b]	150	675		
	per maid's room [b]	50	225		
	per guard room [b]	100	450		
	swimming pool/m^2 [c]	4-5	18-22		
Workers' Housing	per capita	44	200		
Per block of workers' housing	Per block of flats	swimming pool (usage per m^2)	4-5		
		gym (usage per flat in block)	0.05		
		cleaning	1		
Hospitality residential					
Hotel [1]	per bed	100-150	450-675	24	2.25
Schools / universities	per student	05-10	25/45	10	2
Hostel	per bed	44	200	24	2.25
Residential and nursing homes for older people	per bed	100-150	450-675	24	2.25
Service & other non-residential					
Offices [5]	per capita [a]	10	45	8	1.5
	per sanitary piece [a]	35-50	160-225		
	per square meter [c]	1	4.5		
Car wash station (CWS)	per manual channel	800	3600	10	1.5
Car wash station (CWS)	per automatic channel	2400	10800	10	1.5
Common market	per square meter	1.1	5	10	1.5

* Consumption divided by opening hours

Type of Premises & consumption categories	Description	Estimates of daily rate of consumption (imperial gallons)	Rounded estimates of daily rate of consumption (liters)	Hours of water use	Peak demand factor (ratio to average hour*)
Hospital	per bed	150	675	24	1.2
Day clinic	per medical practitioner	100	450	8	1
Day clinic (with dental)	per medical practitioner	150	675	8	1
Restaurants	per meal	2	9	8	1.5
Services in a building	up to 5 floors	165	750	10	1.5
Services in a building	from 6 to 10 floors	330	1500	10	1.5
Services in a building[4]	above 10 floors	660	3000	10	1.5
Public toilets	per sanitary piece	35-50	160-225	24	2.25
Mosques <300m^2	per square meter	5.5	25	24	5
Mosques >300m^2	per square meter	3.5	16	24	5
Female praying rooms	per square meter	2	9	24	5
General services[3]	per plot square meter	0.2	0.9	10	1.5
Petrol stations		200	900	12	10
Public swimming pools		Capacity + 0.9 per plot square meter	Capacity + 0.2 per plot square meter	10	10
Assembly buildings where most water use is during intervals or other concentrated periods of time	per plot square meter	0.2	0.9	10	10
Assembly buildings where most water use is not during intervals or other concentrated periods of time	per plot square meter	0.2	0.9	10	1.5

Notes:
1.Hotel category up to 5 stars. Hotels/resorts above 5 stars will be subject to assessment.
2. For the shabiat and villa category, a reduction factor may be applied for every additional bedroom according to the Distribution Company's own criteria.
3. 'General services' means water used for internal gardening and general cleaning purposes for a standard-size shabiat and villa.
4. Rates of consumption for buildings higher than 20 floors shall be adjusted proportionally.
5. All consumption rates for sanitary pieces shall be calculated based on water-efficient plumbing fittings, as required by ESTIDAMA / as per Chapter 29 Plumbing Systems of the Abu Dhabi International Building Code (ADIBC).
a. Alternative if number of bedrooms unknown
b. Additional – add as applicable.
c. Alternative if sanitary pieces unknown
Note that core values should always be calculated, while additional elements should be calculated as applicable.
General: Water consumption rates for other uses, e.g., cooling services, shall be determined following consultation with the Distribution Company. For some of the categories, the Responsible Person has a choice of consumption rate which is subject to the Distribution Company approval.

4.1.5 For industry, unit rates for light industry (e.g., warehouses) should be based on number of staff and per capita consumption of 50l/d. Wherever possible

rates for medium and heavy industry should be based on types of product or services provided by the industry. However, for general planning purposes the following rates can be used for light industry and warehouses: 10m3/hectare/d.

Table 4.2 Part 2: Outdoor use

Description	Comment	Estimates of daily rate of consumption (imperial gallons)	Rounded estimates of daily rate of consumption (liters)	Hours of water use	Peak demand factor (ratio to average hour†)
Irrigation					
Palm trees	Per tree	22	100	2	12
Other trees	Per tree	15	68		
Shrubbery	Per m^2 ground coverage	2	9		
Other horticultural ground coverage	Per m^2 ground coverage	1	4.5		
Livestock					
Dairy cows	Per cow	35.2	160	2	12
Other cattle	Per animal	22.0	100		
Horses	Per horse	15.4	70		
Sheep	Per sheep	2.2	10		
Goats	Per goat	4.4	20		
Poultry	Per bird	0.05	0.2		

4.2 Firefighting reserves

4.2.1 The Abu Dhabi Civil Defence Authority is the only reference for determining the quantity and application of water allocated for firefighting purposes for Premises requiring internal firefighting systems. The Tank Capacity shall be sufficient to cater for the duration of fire flow as determined by the Abu Dhabi Civil Defence Authority and shall be no less than 60 minutes, subject to the Abu Dhabi Civil Defence Authority approval in all cases.

4.2.2 Fire reserves should be provided as a separate, metered tank where possible. When this is not appropriate, the lower part of a Ground Storage Tank may be reserved for the Fire Service by maintaining a minimum water level either by means of a pump control, or another approved device. The allocated fire reserve shall be held completely within the Ground Storage Tank's actual capacity. This fire reserve shall be considered to be part of the Wholesome water system and all fittings, such as pumps for fire flows, shall

† Consumption divided by opening hours

comply with the requirements of the Water Supply Regulations and this Guide to ensure that water remains Wholesome. Applications shall be subject to compliance with UAE FLSC and as General Directorate of the Abu Dhabi Civil Defence Authority regulates.

4.2.3 If the total required capacity exceeds three times the average daily water demand, then a dedicated firefighting water reserve tank shall be provided. If water is supplied from the domestic water supply system, this shall be via a dedicated suction pipe, or a dedicated pipe from the Roof Tank, and there shall be adequate Backflow prevention to avoid Contamination and water stagnation. Separate firefighting reserve tanks should have a circulation pump that automatically circulates at least 20% of the water volume for at least 8 hours/day to prevent stagnation. It is recommended that the dedicated firefighting water reserve tank should be cleaned at least annually. For pressurized firefighting tanks (not under atmospheric pressure) the test drain line shall be connected to a pressure break chamber connected to the nearest appropriate drain line to prevent flow exceeding 4550l/min (1000GPM). Applications shall be subject to compliance with UAE Fire and Life Safety Code of Practice and as General Directorate of Abu Dhabi Civil Defence Authority regulates.

4.2.4 The Abu Dhabi Civil Defence Authority should be consulted to determine the firefighting systems and actual quantity of firefighting water reserve required. The construction of Fire Services shall comply with the requirements of the UAE Fire and Life Safety Code of Practice, Fire Service Regulations and instructions issued by the Abu Dhabi Civil Defence Authority. Final approval from the Abu Dhabi Civil Defence Authority shall be obtained for firefighting systems after incorporating all the requirements of the Distribution Company.

4.3 Tank storage capacity

4.3.1 Total storage capacity of the Ground Storage Tank and Roof Tanks or cistern shall be as per the following limits:

(a) Minimum Capacity = 1 x daily consumption + firefighting reserve

(b) Maximum Capacity = 1.2 x daily consumption + firefighting reserve, where daily consumption is estimated based on the guidelines provided in Clauses 4.1.1.1- 4.1.2.

4.3.2 Where actual daily consumption is not known, estimated daily consumption should be used in accordance with Clauses 4.1.1.1-4.1.2.

4.3.3 The Distribution Company shall decide the specific storage capacity requirement (between maximum and minimum) that the Responsible Person can install in the Premises. The Distribution Company should evaluate the capacity with consideration of the type of supply (intermittent or continuous) and the security of supply in terms of pressure and flow conditions in the area where the Premises are located.

4.3.4 Although the storage requirement shown above is vital for the security of supply, it should be noted that water stagnation is not recommended. This is to ensure water quality in the tanks does not deteriorate due to possible depletion of residual chlorine which may result in microbiological Contamination. If water stays inside the tank for more than four days without being used, the tank shall be inspected, and the water tested before its use. This should be done in line with the Code of Practice for the Inspection and Cleaning of Customer Water Storage Tanks.

4.3.5 For Customers provided with Ground Storage Tanks only, the complete water capacity may be held in the Ground Storage Tank if the Premises are metered prior to the tank's installation, and the Distribution Company has approved the boosting arrangements.

4.4 Ground Storage Tanks and roof cistern general requirements

4.4.1 The general requirements are concerned with location, installation, construction material, protection, testing and disinfection of Ground Storage Tanks and Roof Tanks.

4.4.2 Diagrams illustrating common connection arrangements for storage tanks are included in Annex D. These are for illustration only. Detailed drawings

shall be submitted in accordance with Annex A of the Guide and/or as per requirements of the Distribution Company.

4.4.3 Where Ground Storage Tanks or Roof Tanks have a bypass installed, the bypass shall consist of the following:

(a) A Stop Valve at each end of the bypass pipe as close as is reasonably practicable to the parent pipe.

(b) An adequate Backflow prevention device to prevent Backflow from the Service Pipe, their associated fittings, or the Water Fittings to the Distribution System.

(c) A drain valve to allow the bypass to be drained down when not in use to prevent the water becoming stagnant.

(d) When not in use, the bypass pipework should be removed and the ends sealed, and the remaining valves should be capped.

Examples are shown in Annex D.

4.4.4 Where a Ground Storage Tank is permitted to be bypassed by the Distribution Company, the Ground Storage Tank should be drained down to prevent any stagnation of water. If this becomes a permanent arrangement, the Ground Storage Tank and associated pipework should be removed.

4.4.5 Where Ground Storage Tank is not present, for supply of Water by Tankers in emergency situations, Distribution Companies shall be consulted.

4.5 Tank placement and location

4.5.1 The tank shall be in a location that will preserve the water quality. The tank shall be located away from any source of pollution and where there is no industrial, hydro-carbon activity that may result in water Contamination. The distance between the tank wall and any part of the wastewater drainage system shall be no less than 1,500mm and properly protected from ingress of foreign objects.

4.5.2 Tanks shall be located in such a way that they are accessible for inspection, maintenance or replacement without the need to disturb the associated infrastructure.

4.5.3 No storage cistern or tank shall be buried directly in the ground. Underground tanks are only permitted in basements or in purpose built underground pump rooms, as illustrated schematically in D10 in Annex D, upon approval by the Distribution Company. Construction of underground reinforced concrete water storage tanks shall be avoided for villas and Low-rise Buildings used for commercial purposes unless approved by the Distribution Company. Storage tanks shall be placed to avoid potential flooding. Storage tanks shall be fitted with a suitable Backflow prevention device, and water overflow arrangements shall be considered. Such arrangements should ensure water overflowing from the tanks is directed to the drain and that no water returns to the tank following an overflow.

4.5.4 All tank access and inspection openings shall be at least 300mm above the highest recorded flood level. If no flood records exist, a suitable estimate should be made so that all access and inspection openings are at least 300mm above ground level. A suitably sized sump pump shall also be installed when and where applicable in order to mitigate the risk posed by surface flooding.

4.5.5 Storage tanks used for industrial, livestock, agricultural and other purposes, that may come into contact with Category 3, 4, or 5 fluid (see section 5.6.2) or foreign material that could pose a risk to human health, should be dedicated for that use only, and provided with suitable Backflow prevention devices, overflow arrangements, and an Air Gap of no less than 50mm.

4.6 Fittings and accessories of tanks and cisterns

4.6.1 The maximum height of the inlet to the Premises' Ground Storage Tanks shall not exceed 4,000mm from the finished ground level at the property boundary and shall allow the tank to be filled to the top water level under typical network pressure.

4.6.2 Float-controlled valves or equivalent flow control inlet devices should be securely and rigidly attached to the cistern or the tank, and installed so that the valve closes when the level of the water is no less than 25mm and preferably no more than 50mm below the overflow level of the tank or roof cistern.

4.6.3 All inlets to storage tanks and roof cisterns should be provided with a Servicing Valve to facilitate maintenance and a float-operated valve, or some other no less effective device, that is capable of controlling the flow of water into the cistern. The Servicing Valve should be fitted as close as is reasonably practicable to the float-controlled valve or other device.

4.6.4 All outlets other than Vent Pipes, Overflow Pipes and warning pipes relating to storage tanks or cisterns supplying water shall be fitted with a Servicing Valve as close to the cistern or tank as is reasonably practicable. Where practicable, all outlets from a cistern should be taken from the bottom of the cistern; a sump pit measuring at least (600 x 600 x 200mm) shall be provided for tanks and cisterns larger than 10,000 liters. The tank floor should be sloping down towards the sump pit at a gradient of at least 2.5%.

4.6.5 Tanks shall allow for the water level to be easily checked. For tanks more than 2,000mm deep, a water level indicator shall be provided unless the tank is a pre-formed polyethylene tank, and it is impractical to install an indicator. One common level indictor for a group of connected tanks is acceptable, subject to the Distribution Company's approval. Tanks shall be inspected for leakage during the Tank cleaning and disinfection routine as specified in the Code of Practice for the Inspection and Cleaning of Customer Water Storage Tanks.

4.6.6 All tanks shall have a rigid, close-fitting and securely fixed cover which is self-venting to allow the passage of air to and from the tank as the water level changes, but which excludes light and insects from the cistern. It shall be made of materials which do not shatter or fragment when broken and which will not contaminate the water quality. There should be a watertight seal between the lid and supporting frame. All non-metallic materials in contact

with the contents, including any surface where condensate forms, shall conform with the current version of BS 6920 (or an equivalent). Cisterns storing more than 1,000l of water shall be constructed and placed so that the cistern may be inspected and cleaned without it having to be wholly uncovered.

4.6.7 The storage tank shall be designed to ensure that any maintenance activities for all Water Fittings, particularly to foot valves and float-controlled valves, can be done without the need for draining or causing any damage to the tank structure.

4.6.8 At least one capped or down-facing air vent shall be installed per water tank. One additional vent shall be provided per 40m2 of tank area or at a spacing of 7m, evenly distributed over the tank area. The vent shall be at least 65mm in diameter, equipped with a stainless-steel mosquito screen. Tanks, including screens and vents, shall be cleaned at regular intervals in accordance with the Code of Practice for the Inspection and Cleaning of Customer Water Storage Tanks. The tank shall have a clear height (free-board) of no less than 300mm, but not exceeding 500mm, between the top water level and roof (inside surface).

4.6.9 Where the water level in the tank is more than 1,500mm, an internal ladder (in addition to an external ladder for non-buried tanks) shall be installed unless there is no access for human entry. The internal ladder shall be made of a non-metallic material (approved plastic or GRP) or of stainless-steel grade 316. An external ladder shall be made of a material capable of withstanding the prevailing weather conditions. It shall be properly fixed under or near to the tank access. It shall have a width of no less than 400mm, with the distance between steps no more than 250mm, and the height between the last step and ground no more than 300mm. The ladder (internal or external) should have a safety cage where there is a vertical drop of 2m or more, in accordance with BS 5395-3.

4.6.10 A nameplate no less than 300 x 200mm shall be securely attached to the tank exterior, by stainless steel grade 316 bolts and nuts or a similar

approved arrangement, in a clearly visible and accessible location, preferably on the tank inlet side. The nameplate shall be made of a material not affected by weather conditions. The following data shall be engraved on the plate:

(a) tank material

(b) tank design and maximum operating parameters (pressure and temperature)

(c) serial number

(d) name of manufacturer or brand (trade) name

(e) tank size or capacity (in cubic meters or imperial gallons)

(f) date of manufacture

(g) approval from global Accredited water institution (i.e., WRAS).

4.7 Material and construction

4.7.1 Tanks constructed for the storage of Wholesome water shall be made of a material that does not cause Contamination or change the aesthetic quality of water supplied by the Distribution Company. Tanks may be made of fiberglass (glass-reinforced plastic), reinforced concrete (cement), reinforced plastic (polyethylene, polypropylene, CPVC), stainless steel grade 316 or above, or any other material approved by the Distribution Company.

4.7.2 Tanks and cisterns holding Wholesome water shall be of a suitable grade and material to meet the provisions of BS 6920-1 or equivalent standards approved by the DoE. The tank construction material, lining, gaskets, adhesives, coating or any other part in contact with the stored water shall not impart taste, color, odor or toxicity, nor promote microbiological growth. A certificate from the relevant authorities in Abu Dhabi and/or recognized international institutions such as NSF or WRc may be requested, to ensure the tank's fitness for storing potable water in the prevailing climatic conditions in compliance with Chapter 6 of the Water Quality Regulations issued by the DoE.

4.7.3 The tank shall be constructed of a watertight material of adequate strength and shall be suitable for the storage of potable water at at least 52°C at atmospheric pressure. The temperature of the stored water shall ensure that the water is Wholesome. This will likely require that the water is kept at less than 30°C, in order to restrict microbiological growth.

4.7.4 In case tanks are used for storing water both for firefighting and domestic consumption purposes and, no hazardous material or materials likely to contaminate the water, (e.g., GI) should be used anywhere in the firefighting system connected to such tanks, (e.g., suction pipes and fittings, breaching inlets, and testing lines). Use of vertical submersible turbine pumps shall be avoided, even if coated with an approved coating.

4.7.5 Externally bolted paneled base tanks shall have 500mm minimum clear access between the bottom base panels and finished ground level. Other tanks shall be at least 200mm above the finished floor level of the surrounding area. Where possible, the ground should slope away from the tank in all directions so no surface water can flow towards it.

4.7.6 No tank or fitting intended for conveying or storing water shall be lined or coated internally with coal tar or bitumen, or any other substance that contains these substances. All internal or external coatings of water storage tanks shall be approved by the Distribution Company. Internal coatings shall be fit for use with Wholesome water in compliance with Chapter 6 of the Water Quality Regulations issued by the DoE.

4.7.7 Water storage tank design and engineering shall include consideration of all types of loads to which the tank will be subjected. It shall be ensured that all design calculations have allowed for safety factors that will enable tanks to withstand the internal and external forces to which they are subjected.

4.8 Overflow and warning pipe arrangements

4.8.1 The location of the cistern or tank overflow (warning or Overflow Pipe) shall be readily identifiable, and the discharge should be in a conspicuous and visible position. Every storage tank larger than 1,000 liters (220 gallons) shall

be fitted with an Overflow Pipe. Storage tanks larger than 100,000 liters (22,000 gallons) shall also be fitted with Warning Device, depending on the Distribution Company's instructions, which will indicate that water is about to overflow, and a device that will enable any overflow to be controlled. It is recommended that a control device is used to circulate the water in the tank to avoid stagnation.

4.8.2 A warning/Overflow Pipe made of rigid pipe should be at least twice the internal diameter of the inlet pipe and no less than 19mm (bore) internal diameter. The actual internal diameter of the pipe(s) installed should be capable of taking any possible flow in the pipe arising from any failure of the inlet valve, taking into account the effect of any screen. Such pipes shall be made of corrosion-resisting material, be integrated with the tank or otherwise fastened onto the tank with corrosion-resisting fasteners, and properly screened to prevent ingress of any animal or foreign material. When determining the size of an Overflow Pipe, account should be taken of any insect or vermin screens installed which may reduce the nominal flow capacity of the Overflow Pipe.

4.8.3 Where two or more cisterns have a common warning pipe, that pipe shall be installed so that the source of any overflow may be readily identified and shall be so arranged that any overflow from the tank or cistern cannot discharge into another.

4.8.4 Where it is not possible to fit an overflow pipe, a Warning Device operating independently from the inflow control device shall be required. Where necessary, the Distribution Company may require a water level indicator to be fitted, particularly for tanks of 100,000 liters and above.

4.8.5 When internal Water Meters are installed, the Overflow Pipe from the Roof Tank shall be connected to the Ground Storage Tank or underground tank, provided the construction of the Ground Storage Tank or the underground tank has been allowed, and there is no risk of water Contamination. Such a connection shall be approved by the Distribution Company. The Customer is

liable for any water losses within the plumbing system and may be charged for any such losses as stipulated in Clause 7.5.2.

4.9 Tank protection

4.9.1 All water storage tanks with a capacity of more than 50,000 liters shall be partitioned, in order to allow maintenance activities to take place without causing supply interruptions (unless a second tank is available). If the tank is internally partitioned, each compartment shall be treated as an independent water tank. As far as these guidelines are concerned, the partition shall extend the full height of the tank, and each compartment shall be capable of supporting water on either side with one side empty. All other inlet and outlet connection arrangements shall be considered, and separate inlet and outlet connections, overflow, flow control, drainage and isolation valves provided.

4.9.2 All water storage tanks manufactured from translucent material (plastic polymers) shall be protected from solar heat gains by insulation applied during manufacture and by shading from sunlight where possible. The insulation shall be resistant to UV radiation and made of rigid foam of suitable thickness calculated in accordance with BS EN 1057, or as approved by the Distribution Company.

4.9.3 The water storage tanks and associated fittings and structures shall be designed with consideration to the prevailing climatic conditions of the Emirate of Abu Dhabi. Specifically, tanks shall be suitable for the following climate conditions:

(a) ambient temperatures in the shade of at least 52ºC

(b) ambient temperatures of 1ºC or lower

(c) ambient relative humidity of 100%

(d) wind speeds at least 50 km/hr.

4.9.4 The exterior body of the tank shall be capable of withstanding environmental circumstances that could lead to corrosion, paint removal, cracks and other defects. Tanks shall be suitable for the storage of desalinated water.

4.9.5 Every water storage tank and cistern shall be adequately supported to prevent thermal movement or distortion or damage to it, or to any Water Fitting connected to it. Any water jet shall be directed away from the tank sides and joints.

4.9.6 Tank foundation and, where required, shed installation, shall be of rigid construction, permanent in nature and made of a durable weather-resistant material. The expected life of the shed and foundation shall be more than, or similar to, that of the tank itself. The tank foundation shall be rigid, smooth and level. The shed roof shall overhang each wall of the water tank by at least one meter. The roof space above the cover shall be no less than 400mm.

4.10 Storage tank testing and disinfection (new installations)

4.10.1 After completion of tank installation, the tank shall be hydrostatically tested in accordance with the following:

(a) Before testing is carried out, the tank shall be filled with water to the top level of the side panels, and the Overflow Pipe, drain and other pipes shall be blanked off. The static water test shall be for a period of no less than one hour for tanks that are not concrete. Concrete tanks shall be filled with water to normal maximum depth at a uniform rate of no greater than 2m in 24 hours. A period of up to 21 days shall be allowed for stabilization, after which the water level shall be recorded by approved means at 24-hour intervals, for a test period of 7 days. During the test period, the total permissible drop, after allowing for evaporation and rainfall, shall not exceed 1/500 of the average water depth of the full tank or 10mm, whichever is the lesser.

(b) Notwithstanding the satisfactory completion of the above test, on the specified faces of the structure there shall be no visible staining or damp patches.

(c) Continuous inspection shall be carried out for the whole testing period. All leaks found shall be repaired, and the static test repeated until no leakage is observed. Repairs shall conform to manufacturers' recommendations or instructions and be carried out by Persons competent in that work. For concrete tanks, any caulking or making good of cracks in the wall section shall, where practicable, be carried out from the liquid-facing side.

(d) While the tank is being emptied, precautions shall be taken to ensure that the design vacuum is not exceeded.

(e) The testing medium shall be potable water. In order to avoid waste, pumping from one tank into another during testing may be allowed.

(f) The hold time between completion of the filling and start of emptying shall be no less than 24 hours in order to allow the tank to settle. Discharging of the water shall be carried out in a controlled manner to avoid scouring or flooding.

4.10.2 After completion of the testing, each tank shall be disinfected in accordance with the procedure below (tank disinfection shall be carried out only after completion of Service Connection flushing and disinfection where applicable). In the case of existing Customer storage tanks, disinfection procedures stipulated in the Code of Practice for the Inspection and Cleaning of Customer Water Storage Tanks shall be followed.

4.10.3 The disinfection of newly installed tanks with a capacity of less than 5,000 liters shall be carried out according to the following procedures:

(a) Requirements for the notification of building occupants and safety procedures as detailed in the Code of Practice for the Inspection and Cleaning of Customer Water Storage Tanks shall be followed.

(b) Tank disinfection shall be carried out by a specialized contractor. The disinfection procedure is to flush the tank, introduce the disinfectant (approved type of hypochlorite to 20mg/l) and leave it for a one-hour contact period at a level just below the Overflow Pipe. If the concentration is satisfactory (5mg/l and above), the tank should be drained and thoroughly flushed until the chlorine concentration meets the requirements set out in the Water Quality Regulations. Following disinfection procedures, the Responsible Person shall arrange to have water samples taken for chemical and bacteriological tests at an Accredited water quality testing facility to ensure the water quality is Wholesome.

(c) If the water quality sample results do not meet the requirements set out in the Water Quality Regulations, the disinfection and sampling procedure shall be repeated. The newly installed tank shall not be put into service until the sample results comply with the Water Quality Regulations.

(d) The disinfection of newly installed tanks with a capacity greater than 5,000 liters shall follow the requirements for the notification of building occupants and safety procedures as detailed in the Code of Practice for the Inspection and Cleaning of Customer Water Storage Tanks shall be followed. In addition, the following procedure shall be followed:

(i) The tank shall be filled to a depth of 300mm with Wholesome water.

(ii) Sufficient sodium hypochlorite (approved type) shall be added to give a solution containing approximately 20mg/l, or to a concentration approved by the Distribution Company; this solution shall then be mixed thoroughly. Where other disinfectants are used, the concentration and the procedure shall be as per the manufacturer's recommendations and shall be approved by the Distribution Company.

(iii) A small portable pump shall be temporarily mounted outside the tank with suction and discharge hoses extending through the tank main openings.

(iv) The discharge hose shall be equipped with a suitable nozzle or pipe reducer to provide a sufficient flow of chlorinated water, when discharged from the portable pumps, to reach all parts of the tank interior.

(v) The interior of the tank shall then be sprayed according to the procedure set out in the Code of Practice for the Inspection and Cleaning of Customer Water Storage Tanks.

(vi) It is recommended that the pump be placed outside the tank to avoid the additional hazard associated with the presence of carbon monoxide exhaust fumes inside the tank.

(vii) After disinfection, the chlorine solution shall be drained to waste to a location approved by the relevant authorities, or as recommended by the Distribution Company. The tank shall then be flushed until the chlorine concentration meets the requirements set out in the Water Quality Regulations and sealed.

(viii) Following disinfection procedures, the Responsible Person shall arrange to have water samples taken for chemical and bacteriological tests at an Accredited water quality testing facility to ensure the water is Wholesome. If the water quality sample results do not meet the requirements set out in the Water Quality Regulations, the disinfection and sampling procedure shall be repeated. The newly installed tank shall not be put into service until the sample results comply with the Water Quality Regulations.

(ix) Special attention should be taken when high chlorine concentrations and other disinfectants are being used, as they may affect new coatings or linings in tanks and cisterns.

4.10.4 Following the completion of disinfection procedures for tanks of all sizes, the Distribution Company and Responsible Person shall document evidence which shall be kept on file and shall be made available to Department of Energy and the relevant Municipality upon request.

4.11 Operation of and maintenance procedure for storage tanks

4.11.1 All tanks shall be operated and maintained by the Responsible Person, to provide Wholesome water at all times. Tanks are subject to cleaning and inspection frequency and procedures as stipulated in the Code of Practice for the Inspection and Cleaning of Customer Water Storage Tanks.

4.11.2 Storage tanks above ground and of less than 5,000 liters capacity shall be visually inspected by the Responsible Person at intervals of no greater than one year, to ensure that the tank is not leaking and has not suffered physical damage (for example scratches, dents, holes, deformation of any kind) or material degradation (for example, corrosion to glass reinforcement or resin delamination, oxidation of metallic parts) to the tank structure, its fittings and supports, including overflow arrangements. Damage to tanks, fittings and any supports shall be repaired immediately on observation by the appropriate means for that tank type. After internal repairs are required, tanks shall be subject to flushing and disinfection according to the procedure in Clause 4.10.1, and to water quality and hydrostatic testing prior to being returned to service.

4.11.3 Storage tanks in or below ground and not exposed for visual inspection, and tanks greater than 5,000 liters in capacity, shall be subject to a hydrostatic test carried out by the Responsible Person at intervals no greater than five years. Leaks shall be identified, and the tank repaired or replaced as appropriate.

4.11.4 All repairs shall conform to best practice in terms of workmanship and materials and shall conform to manufacturers' recommendations. Materials used in repairs or maintenance shall not adversely affect the quality of the water contained therein.

4.11.5 Replacement tanks and fittings shall comply with the current version of the Water Supply Regulations and its Guide at the time of replacement.

4.11.6 Improvement Notices shall be prepared as appropriate and should be applicable for the circumstances prevailing. Human health and hygiene impacts shall be resolved as soon as possible, after no longer than 1 week. 'Boil Water' warning notices shall be issued to all consumers of water supplied from the failed tanks. Structurally damaged and leaking facilities may warrant a less urgent time scale, but no longer than 1 month. A 'Boil Water' notice means consumers shall boil tap water before drinking, washing, cooking or for food production purposes.

4.11.7 Follow-up inspections, to lift the Improvement Notice, shall be undertaken by the Responsible Person no longer than 1 week after improvement and water samples taken for bacteriological and chemical tests at an Accredited water testing facility, at the owner's expense, to ensure the water stored is Wholesome.

4.11.8 Responsible Person shall provide no fewer than 48 hours' notice (in writing), to all Customers within the Premises prior to any maintenance work, advising them of any possible interruptions to the water supply and any precautions that need to be taken while the maintenance work is being carried out.

4.12 Reinforced concrete water storage tanks and reservoirs

4.12.1 The following information details the minimum requirements for design consideration when constructing reinforced concrete tanks.

4.12.2 Basic design considerations

4.12.3 A topographical site survey and soil investigation are required at the proposed location of the reinforced concrete tank in accordance with the Abu Dhabi International Building Code.

4.12.4 The reservoir foundation shall be free of unsuitable material to the level required as per survey/soil investigation recommendations.

4.12.5 The quality of concrete (minimum to be of grade 40N/mm2), other materials and workmanship shall be adequate for safety, serviceability and durability.

4.12.6 The concrete tank shall be designed in such a manner that it sustains all loads and deformations of normal construction and use and has adequate durability and resistance to the effects of arid desert conditions and winds. As a minimum, it shall be adequate for the prevailing climatic conditions plus a 50% safety factor on loads to account for climate change. Refer to Clause 4.9.3.

4.12.7 The specification for concrete tanks shall be in accordance with the Standard Specification for Water Works No. W-C-SS-007 (former AWEA Standard), or as approved by the Distribution Company.

4.12.8 The dividing wall (where constructed) shall be designed such that either compartment may remain full of water whilst the other compartment is empty. The minimum free-board (top water level) shall be 300mm to the roof soffit.

4.12.9 The tank roof shall be designed to withstand the dead load from the concrete roof slab and other fixtures, live loads, and an allowance for personnel working on the roof. The roof shall be built to the design as approved by the designer or owner's representative (consultant). The tank roof shall have an access manhole with a minimum clear opening of 800 x 800mm covered by a light duty access cover resting on 200mm high concrete upstand.

4.12.10 Thermal effects due to temperature variations shall also be considered in the design. All structural reservoir components shall be constructed of reinforced concrete, and their form shall be determined by the allocated site dimensions and the need to allow for future storage and downstream distribution facilities.

4.12.11 Joints in tanks may be used in conjunction with a corresponding proportion of reinforcement, to control the concrete crack widths arising from shrinkage and thermal changes to within acceptable limits, and in accordance with BS EN 1992 3. Provision of expansion joints shall be made with caution and a minimum number of expansion joints is recommended.

Joints in the floor slab of the tank shall be repeated on the screed below to avoid non-uniform movement. Poly-membranes shall be included between the screed and floor slab. PVC water bars of approved size and make shall be provided at all joints.

4.12.12 Roof slabs shall be designed as flat slabs with all interior joints acting as construction joints so that the slab is structurally monolithic. Where roof and walls are monolithic, movement joints in the roof shall correspond with those in the walls to avoid the possibility of sympathetic cracking.

4.12.13 Tanks installed outdoors without a protective shed above them shall have a 1% minimum slope towards one or more sides, or any other effective system for draining the tank roof. No water shall be allowed to accumulate on the tank roof. For paneled tanks, the roof joints shall be made flush with the surrounding panel to prevent any type of accumulation.

4.12.14 The tank inlet and outlet connections shall be a complete arrangement of flanged water inlet and outlet fittings to BS EN 1092-1 and BS EN 1092-2, along with a puddle flange either cast or welded on connection and shall be properly aligned both in the horizontal and vertical planes to ensure a watertight joint.

4.13 Reinforced plastic water storage tanks

4.13.1 The following information details the minimum requirements for design consideration when installing plastic water tanks.

Basic design consideration

4.13.2 Every tank shall be accompanied by a copy of the manufacturer's catalogue showing operational and maintenance instructions, and precautions to be taken by the end users. Certificates to indicate suitability of material for storing Wholesome water shall be provided, as well as other test certificates as required by the Distribution Company. The Distribution Company may also request additional tests to be undertaken by the relevant international and national testing authorities.

4.13.3 Manufacturers' instructions and guidelines concerning the storage of tank parts and accessories, general site conditions for final tank location, installation methodology, and usage and commissioning of the tank shall be strictly observed.

4.13.4 Tanks shall be erected, tested, and commissioned as per supplier/manufacturer instructions. Following installation, the tank shall be tested, cleaned and flushed before being put into service. See Clause 4.10.1.

4.13.5 The internal and external surface of the shell or panel shall have a smooth finish and be free of defects so as to prevent the adhesion of foreign matter such as dust, dirt, moss, algae, bacteria, scale formation and rust.

4.13.6 All domestic water tanks used for storing Wholesome water shall be protected from excessive heat, direct sunlight and UV rays. The tank exterior shell/panel, fastener, supports, etc. shall be protected against direct weather conditions for the duration of their expected life. This means the tank shall be either UV stabilized with suitably insulated material, kept indoors or under a protective structural shed.

4.13.7 The design of tanks shall ensure that there is regular turnover of water such that the water remains Wholesome. In particular, inlet and outlet connections shall be designed to encourage mixing throughout and prevent areas of stagnation or 'short circuiting' within the tank (for example, positioning inlets and outlets on opposite sides, connecting cisterns in parallel and/or the use of delayed action Float Valves).

4.13.8 The tank material shall be opaque (95% and above) to help reduce evaporation of disinfectant and inhibit algal growth; the color of the tank panel and protective wrapping shall aid in reducing heat absorption.

4.13.9 Sealant materials used shall be approved for being in contact with potable water, flexible, and resistant to UV rays. Sealants should maintain these qualities for the expected life of the tank. The internal tank joints of panels shall be made flush with tank panels to prevent the accumulation of deposits and facilitate cleaning. Sealant shall not protrude outside joints, as this

hinders the cleaning process and aids dirt accumulation; when sealant is extruded, it shall be trimmed back flush with the tank panel.

Installation and erection

4.13.10 All reinforced plastic tanks shall be erected with a flat supporting base. Tanks shall have clear access of no less than 600mm all around and shall be suitably fixed in accordance with manufacturers' recommendations.

4.13.11 Each tank with a capacity of 10,000 liters and above shall have a complete arrangement of flanged water inlet and outlet fittings to BS EN 1092-1 and BS EN 1092-2. For tanks with a capacity of less than 10,000 liters, tank connection fittings, and Water Fittings suitable for connection to tank inlet and Service Pipes, shall comply with BS EN 10226-1.

4.13.12 Flexible connectors shall be used wherever necessary to prevent stress and vibration from being transferred to the water tank.

4.13.13 Tanks shall be installed on a stable foundation. Externally located tanks shall be bolted or clamped if necessary to protect them from settling and to enable them to withstand external forces that may cause movement.

Tank fittings and accessories

4.13.14 All metallic parts in contact with water such as panels, bracing, tie rods, angle plates, roof supports etc., shall either be covered by a non-metallic plastic shrinkable tube or an approved similar protective material, or shall be made of stainless-steel grade 316 (or above).

4.13.15 At least one access cover shall be provided for each water tank. Two access covers shall be required for tanks with a capacity greater than 10,000 liters. The cover(s) shall be an elevated, lockable hinged cover with gasket and locking mechanism. Access holes shall have a suitably sized clear opening of no less than 600mm in diameter if circular, or 600 x 600mm if square. In small cylindrical tanks, access covers shall be located within reachable distance of float-operated valves for ease of maintenance.

4.13.16 All connections between panels shall be externally flanged for ease of maintenance, cleaning and hygiene considerations. Bolts and nuts shall be of stainless-steel grade 316 or above.

4.13.17 Panel type tanks shall be supplied with at least one concave section bottom panel fitted with an arrangement to drain the tank; alternatively, the panels adjacent to the tank bottom shall be sloped, or so designed that water is effectively channeled to drain the panel, leaving no water accumulated within the tank. The minimum size of the drain shall be no less than the size of the inlet pipe. Cylindrical tanks shall be fitted with a drain connection to allow complete draining of the tank. All tanks shall be located in a well-drained location.

4.14 Glass-reinforced plastic (GRP) water storage tanks

Basic design consideration

4.14.1 Manufacturing and design shall conform to Standard Specification No.W M SS 013 (former ADWEA Standard) or equivalent for glass fiber-reinforced plastic cisterns for potable water storage:

(a) The maximum tank height shall not exceed 4,000 mm.

(b) The GRP panel safety factor shall be a minimum of 6.

(c) The design shall be suitable for wind velocities of at least 50 km/hr.

(d) The roof panels of the tank shall withstand a load of at least 100 N and the dead load of the structure.

(e) Earth loads shall be determined by the rational soil mechanics method.

4.14.2 The tanks shall be manufactured from hot-pressed molded GRP panels. The tank material shall meet the requirements of the WRc (Water Research Centre, UK), the WRAS (Water Regulations Advising Scheme, UK) or equivalent approved standards. Cold-pressed molded GRP panel tanks are acceptable subject to the Distribution Company's approval.

(a) The internal and external surface of the shell or panel shall be smoothly finished; no fiber shall project out and the surfaces shall be free of defects such as crazing, wrinkles, crevices and pinholes so as to prevent the adhesion of foreign matter such as dust, dirt, moss, algae, bacteria, scale formation and rust.

(b) The GRP sheet molding compound shall have UV protection features to ensure long panel life.

(c) The base panels shall be of a convex shape to assist in the complete draining of water.

(d) All tank openings shall be flanged, with the flanges rated and drilled to match the supply/discharge pipeline ratings; otherwise to BS EN 1092-1 and BS EN 1092-2. All nozzles shall be of uPVC.

(e) GRP tanks shall be constructed with internal partition walls to provide separate sections so that one section can be isolated for maintenance while the other section(s) is/are still operational. In this case, each section shall be provided with the specified accessories to allow for safe isolation.

(f) All tanks shall be fitted with roof supports manufactured from uPVC pipes. Tanks up to 5,000 x 5,000 x 3,000mm (H) shall be fitted with an internal bracing system comprised of angle brackets manufactured in stainless steel grade 316L or above.

(g) Tanks with dimensions above 5,000 x 5,000 x 3,000mm (H) shall be fitted with a hot-dipped galvanized external bracing structure. Each tank shall be permanently equipped with an internal ladder of uPVC or GRP and a hot dipped galvanized external ladder.

(h) Each tank shall be fitted with a hot-dipped galvanized mild steel beam/channel skid. The steel skid shall be fixed on the concrete beams by anchor bolts and levelled. The allowable deflection of the steel footing shall not exceed 3mm.

4.14.3 All bolts, nuts and washers shall be of stainless-steel grade 316 (or above) when in contact with water. Bolts, nuts and washers not in contact with water shall be of stainless-steel grade 316L and above for corrosive environments.

4.14.4 For outdoor bolted tanks, insulated GRP panels shall be utilized to withstand the temperature extremes. The insulated tank panels shall be protected with insulation applied during manufacture with at least 25mm of polyurethane foam or 40mm of expanded polystyrene. The insulation shall not be exposed to external weather conditions. It shall be covered with a permanently fixed external cover made of the same material as used in the GRP panels, and shall be resistant to UV radiation, weather-resistant and watertight.

Storage tanks Installation

4.14.5 The tank foundation shall be designed to withstand the total weight of the tank with water, including an adequate factor of safety as per the applicable design standards.

(a) The construction of the tank foundation shall be carried out in accordance with the tank manufacturer's requirements. Tank foundation shall be rigid and smooth and have an elevated surface.

(b) The foundation construction shall allow for adequate drainage of water away from the tank, so that moisture may not accumulate under the tank. Externally bolted paneled base tanks shall have a 500mm minimum clear access below their base panels.

4.14.6 Gaskets and bolting shall be furnished for all access holes, hand-holes and other openings that call for blind flanges or covers. At least two sets of gaskets of the same materials shall be furnished; one set for testing and one set unused and packed separately with proper protection and markings.

4.15 Galvanized steel tanks

4.15.1 Installation of household water storage tanks made from galvanized mild steel sheets is not recommended. This is due to manufacturing quality as well as the observation that poor conditions and rust have adversely affected

the quality of water stored in many existing tanks. Such tanks can only be installed in exceptional circumstances upon Distribution Company approval.

5. Water Fittings

5.1 Materials and substances used in Water Fittings

General

5.1.1 Materials or substances, either alone or in combination, which cause, or are likely to cause, deterioration to the quality of water should not be used in the construction, installation, renewal, repair or replacement of any Water Fitting which conveys or receives Wholesome water.

5.1.2 For non-metallic materials, this requirement is deemed to be met by compliance with the latest version of BS 6920-1, or the equivalent standard approved by the DoE.

5.1.3 There are typically two forms of evidence to demonstrate BS 6920 conformity for non-metallic Water Fittings and/or their component parts. These are:

(a) Non-metallic component certification (from a third-party certification body, such as WRAS)

(b) BS 6920 test reports (from a suitably Accredited test laboratory, such as those recognized by the QCC, ILAC or UKAS).

5.1.4 Such evidence should be provided to the Distribution Company prior to installation. For metallic materials, this requirement is deemed to be met by inclusion on the 4MS Common Composition List‡, or other suitable certification, indicating that the long-term leaching is unlikely to cause risk to human health.

5.1.5 Water Fittings and materials for Water Fittings complying with Clause 5.1.1 should be tested by a suitably Accredited test laboratory (such as those recognized by the QCC, ILAC or UKAS), and the results certificates shall be provided to the Distribution Company upon request. Water fittings shall have a pressure rating (PN) suitable for the application and of at least 10 bar.

‡ This list has set performance criteria for metal alloys that have low leaching levels (Common Composition List can be found here - https://www.umweltbundesamt.de/en/topics/water/drinking-water/distributing-drinking-water/approval-harmonization-4ms-initiative

5.1.6 The following factors should be considered when determining the suitability of materials and fittings which are, or will be, in contact with the water supplied:

(a) Internal and external temperatures to which they will be subjected

(b) Presence of Contamination in the ground based on soil investigation

(c) The effect of internal and external corrosion

(d) Compatibility of different materials

(e) The effect of ageing, fatigue, durability and other

(f) permeability.

Joining of different types of materials

5.1.7 Except for plastic pipes, new pipework should not be connected to existing lines or other pipework without appropriate protection being provided against galvanic corrosion.

Plastics and permeable materials

5.1.8 Water Fittings should be made of materials that do not allow permeation of any contaminants that are present, or likely to be present, where the fitting is to be installed.

5.1.9 Water Fittings made of plastics or other materials which are likely to be damaged by exposure to oil, petrol or any other contaminant should not be laid in contaminated ground, or should be protected.

5.1.10 Pipes or connections buried near contaminated locations should be made of pipe material that is impermeable or protected by appropriate material.

5.1.11 The minimum distance between the Service Connection and all other services shall be no less than 350mm from all directions except sewerage lines, where the distance should be no less than 1,500mm.

Dezincification-resistant materials

5.1.12 Water Fittings are to be resistant to corrosion and, where specified, to dezincification.

5.1.13 All Concealed Water Fittings, except Terminal Fittings, (including those buried underground), together with Backflow prevention devices, are required to be manufactured of gunmetal or other dezincification-resistant materials.

General protection and control measures

5.1.14 Every Water Fitting shall meet the following requirements:

(a) Water Fittings shall be immune to or protected from corrosion by galvanic action or by any other process which is likely to result in Contamination or waste of water.

(b) Water Fittings shall be constructed of material of such strength and thickness as to resist damage from any external load, vibration, stress or settlement, pressure surges, or temperature fluctuation to which it is likely to be subjected.

(c) Water Fittings shall be watertight, and be so constructed and installed as to:

(i) prevent ingress by contaminants.

(ii) minimize the risk of permeation by, or deterioration from, contact with any substance which may cause Contamination.

(iii) be adequately supported.

(d) No Water Fitting shall be installed, connected or used in a manner that is likely to have a detrimental effect on the quality or pressure of water in a water main or other pipe of the Distribution Company.

(e) No fitting which is designed to be operated or maintained, whether manually or electronically, or which consists of a joint, shall be a Concealed Water Fitting or embedded in any wall or solid floor.

(f) No pipe, cistern, tank or other apparatus used for conveying or receiving potable water shall convey or receive non-potable water.

(g) Water Fittings shall be adequately protected against damage from any cause, including the environment through which they pass.

5.2 Fixing of Water Fittings

5.2.1 Allowance should be made to accommodate any reasonably foreseeable movement, including thermal movement, in accordance with BS EN 806-1, BS EN 806-2, BS EN 806-3, BS EN 806-4, BS EN 806-5 and BS 8558.

5.2.2 No bend or curve in any pipe shall be made that significantly diminishes or alters the internal diameter or strength of the pipe in any part.

5.2.3 Every pipe shall be fixed so as to avoid sagging, the development of air locks or reverberation.

5.3 Fittings Stop Valves, Servicing Valves and drain taps

5.3.1 Draw-off taps, Stop Valves, Servicing Valves and draining taps should be designed so that, where applicable, their seals:

(a) can be readily renewed or replaced

(b) do not incorporate a loose washer plate

(c) can be designed and manufactured so that they may be easily closed to shut off the supply of water

(d) can be operated at the appropriate water temperature and pressure.

5.4 Pressure requirements

5.4.1 All Water Fittings should be capable of withstanding an internal water pressure of no less than 1.5 times the maximum operating pressure.

5.4.2 In determining the maximum operating pressure to which the system is subjected, the increase in static pressure in the following instances should be taken into consideration:

(a) Pressure in the Service Pipe during night periods when there may be little demand on the system

(b) Pressure caused by pumps in any water supply installation where pumps are installed

(c) Pressure resulting from static head or building height.

5.4.3 No water filter, water softener or any other device shall be installed directly in Service Connections that may cause pressure loss to the Customer Premises. All other Water Fittings, Water Meters, Backflow prevention devices and valves shall be sized correctly in order to minimize pressure losses.

5.4.4 Where Water Fittings are subjected to excessive pressure due to high water supply pressure or pump pressure, or pressure drop, the Responsible Person shall ensure a pressure regulator adjusted to the requirements of the Distribution Company is installed.

5.5 Surge pressures

5.5.1 Where a Customer is connected directly to a Service Pipe (connection arrangement as shown in Guide Annex D.5), the internal test pressure applied to the installation shall take into consideration any transient or surge pressures that may be generated within the system.

5.5.2 Transient pressure increases or surges (water hammer) may be generated by the rapid closure of a valve, for example, float-operated valves, spherical valves or disc valves. When installed, attenuation devices or Water Hammer Arresters may reduce the effects of surges. Pipe and/or fittings manufacturers should be consulted for recommended surge pressure limits whilst designing for such transient situations.

5.6 Backflow prevention

5.6.1 The method of installation of all pipes, fittings or apparatus shall be such that:

(a) The creation of a negative pressure of air in the pipes shall be avoided

(b) Pipes, fittings and apparatus shall be free from Backflow by either Back Pressure or Back-Siphonage at all times, and that waste or Contamination of the water supply shall be prevented

(c) Backflow is prevented by using the appropriate type of Backflow prevention arrangement or device (see Annex B).

5.6.2 The UK Water Supply (Water Fittings) Regulations 1999 specify 5 fluid categories of water and the relevant back flow/back siphonage protection required for each point of use risk. For example, a single check valve (or non-return valve) can only be used where there is a very minimal change to the water (i.e., temperature) from its supplied condition, whereas a significant risk such as the mixing of chemicals would require a category 5 protection such as an airgap. These fluid categories have been amended to suit the situation in Abu Dhabi. The requirements for protection for each category of water are listed below.

Fluid category 1

Wholesome water supplied by a Distribution Company and complying with the requirements of the Water Quality Regulations issued by the DoE.

Examples:

- Water supplied directly from a Distribution Company to the Point of Delivery.

Fluid category 2

Water in fluid category 1 whose aesthetic quality is impaired owing to:

- a change in its temperature
- the presence of substances or organisms causing a change in its taste, odor or appearance, including water in a hot water system.

Examples:

- Mixing of hot and cold water supplies.
- Domestic softening plant (common salt regeneration).

- Drink vending machines in which no ingredients or carbon dioxide are injected into the supply or distributing inlet pipe.
- Fire sprinkler systems (without antifreeze).
- Ice making machines.
- Water-cooled air-conditioning units (without additives).

Fluid category 3

Fluid which represents a slight health hazard because of the concentration of substances of low toxicity, including any fluid which contains:

- ethylene glycol, copper sulphate solution or similar chemical additives, or
- sodium hypochlorite (chloros and common disinfectants).

Examples:

- Water in primary circuits and heating systems with or without additives in a villa/house.
- Domestic wash basins, baths and showers.
- Domestic clothes and dishwashing machines.
- Home dialysis machines.
- Drink vending machines in which ingredients or carbon dioxide are injected.
- Commercial softening plant (common salt regeneration only).
- Domestic handheld hoses with flow-controlled spray or shut off control.
- Handheld fertilizer sprays for use in domestic gardens.
- Domestic or commercial irrigation systems without insecticide or fertilizer additives and with fixed sprinkler heads not less than 150mm above ground level.

Fluid category 4

Fluid which represents a significant health hazard because of the concentration of toxic substances, including any fluid which contains:

- chemical, carcinogenic substances or pesticides (including insecticides and herbicides)
- environmental organisms of potential health significance.

Examples:

General:

- Primary circuits and heating systems in other than a villa/house.
- Fire sprinkler systems using antifreeze solutions.

Villa/house gardens:

- Mini irrigation systems without fertilizer or insecticide application, such as pop-up sprinklers or permeable hoses.

Food processing:

- Food preparation.
- Dairies.
- Bottle washing apparatus.

Catering:

- Commercial dishwashing machines.
- Bottle washing apparatus.
- Refrigerating equipment.

Industrial and commercial installations:

- Dyeing equipment.
- Industrial disinfection equipment.

- Printing and photographic equipment.
- Car washing and degreasing plants.
- Brewery and distillation plants.
- Water treatment plants or softeners using other than salt.
- Pressurized firefighting systems.

Fluid category 5

Fluid representing a serious health hazard because of the concentration of pathogenic organisms, radioactive or very toxic substances, including any fluid that contains:

(a) faecal material or other human waste

(b) butchery or other animal waste

(c) pathogens from any other source.

Examples:

General:

- Industrial cisterns.
- Non-domestic hose union taps.
- Sinks, urinals, WC pans and bidets.
- Permeable pipes in other than domestic gardens laid below or at ground level with or without chemical additives.
- Grey water recycling systems.

Medical:

- Any medical or dental equipment with submerged inlets.
- Laboratories.
- Bed pan washers.

- Mortuary and embalming equipment.
- Hospital dialysis machines.
- Clothes washing plant in healthcare Premises.
- Nondomestic sinks, baths, wash basins and other appliances.

Food processing:

- Butchery and meat trades.
- Slaughterhouse equipment.
- Vegetable washing.

Catering:

- Dishwashing machines in healthcare Premises.
- Vegetable washing.

Industrial and commercial installations:

- Industrial and commercial plants etc.
- Mobile plant tankers and gully emptiers.
- Laboratories.
- Sewerage treatment and sewerage cleaning.
- Drain cleaning plants.
- Water storage for agricultural purposes.
- Water storage for firefighting purposes.

Commercial agriculture:

- Commercial irrigation outlets below or at ground level and/or permeable pipes with or without chemical additives.

- Insecticide or fertilizer applications.
- Commercial hydroponic systems.

5.7 Location of Water Fittings

5.7.1 With the exception of Water Fittings that are located in an internal wall that is not solid, a duct that may be readily exposed, or under a suspended floor that can be readily removed and replaced or to which there is access, no Water Fitting should be:

(a) located in the cavity of a cavity wall.

(b) embedded in any wall or solid floor.

(c) installed below a suspended or solid floor at ground level.

Accessibility of Water Fittings

5.7.2 Except where specifically approved by the Distribution Company, all pipes and fittings shall be arranged so as to be readily accessible and, where enclosed, the casing or duct shall be so constructed as to afford ready means of access to the pipes and fittings for the purposes of examination, repair, replacement and operation.

5.7.3 The point of discharge of any pipe shall be in a position readily accessible for inspection. Duct ends shall be sealed to prevent ingress of foreign material.

Concealed Water Fittings

5.7.4 A concealed pipe may be installed in a pipe sleeve or duct located under or within a solid floor, provided that the pipe can be readily removed and replaced.

Depth of pipes laid in the ground

5.7.5 Every Service Pipe laid in the ground shall be 750mm deep, and at no time less than 500mm or more than 1,000mm below the surface of the ground, measured from the top of the pipe to the ground surface, except where the depth is reduced at the entry to, and exit from, a meter chamber. When passing through the foundations of a building, the Service Pipe shall be fitted

in a sleeve or duct installed during the construction of the building. Pipes passing through any road or rail crossings shall be protected with concrete encasements.

5.7.6 No pipe shall be laid or fixed so as to pass into or through any sewer or drain, any manhole connected thereto, or into or through any manure hole, cesspool, septic tank, soak-away or refuse pit.

5.7.7 No pipe shall be laid or installed in any foul soil or other substance that could cause either Contamination of the water in the pipe or deterioration of the pipe material.

5.7.8 Pipes made of materials susceptible to permeation by any substance that could cause Contamination of the water supply shall not be installed or allowed to remain in a position where such permeation could reasonably be expected to occur, for example at or near petrol filling stations.

5.7.9 Every Water Fitting, every component of a Water Fitting, and any pipe below ground which may be in contact with water shall be resistant or immune to dezincification.

5.7.10 Where compliance with the minimum cover of 500mm is impracticable, and with the written approval of the Distribution Company, the Water Fittings should be installed as deep as is practicable below the finished ground level and be adequately protected against damage (both within and out-with a Premises).

Jointing of fittings

5.7.11 Jointing should be by threaded connections to BSP, with taper thread to BS EN 10226, or be by flanged connections drilled to BS EN 1092-1 and BS EN 1092 2.

5.7.12 Water Fittings installed underground, or embedded in any wall or solid floor, should not be jointed or connected to any other Water Fitting by adhesives.

Irrigation supply

5.7.13 Every pipe supplying a tap used for garden watering or other outdoor use shall be provided with a non-return valve, unless fed independently from a storage cistern.

Operational fittings

5.7.14 Operational fittings such as Stop Valves, Servicing Valves and drain taps should be readily accessible for operation and maintenance.

5.7.15 Operational fittings may be located in a duct or access chamber provided with a hinged door or removable cover that is visible at all times. The door or cover should not be covered with any decorative material that requires removal to access the door or cover, e.g., carpet, wall or floor tiling, or wallpaper.

5.8 Stop Valves to Premises

5.8.1 Every water Service Pipe that supplies a Premises shall be fitted with a Stop Valve to control the supply to that Premises only.

5.8.2 Where a water Service Pipe supplies water to two or more Premises, it should be fitted with a Stop Valve to which each occupier of the Premises has access.

5.8.3 Stop Valves shall be located inside Premises, above floor level, and shall prevent the supply of water to any part of the Premises.

5.9 Cross connection to unwholesome water and Backflow prevention

5.9.1 Any Water Fitting conveying:

(a) Rainwater, recycled water, treated grey water or well water, and any fluid other than Wholesome water supplied by a Distribution Company

(b) Any fluid that is not potable water

shall be clearly identified so as to be easily distinguished from Service Pipes and Water Fittings conveying Wholesome water supplied by the Distribution Company.

5.9.2 No internal pipe or pump delivery pipe that draws water from a storage tank shall convey, or be connected so that it can convey, anything other than potable water supplied by the Distribution Company, unless a Backflow device approved by the Distribution Company is installed.

5.9.3 To prevent Contamination of any part of the water installation, and to prevent the Backflow of water from the installation to the supply mains, Backflow prevention shall be provided on all tanks and Service Pipes.

5.9.4 The method of Backflow prevention and the type shall be in accordance with BS EN 806-1, BS EN 806-2, BS EN 806-3, BS EN 806-4, BS EN 806-5 and BS 8558:

(a) Where it is necessary to prevent Backflow between separately occupied Premises.

(b) Where the Distribution Company or DoE or Person authorized in accordance with these Regulations has given notice that such prevention is needed for the whole or part of any Premises. See Clause 7.9.1 to 7.9.1.

5.10 Provision of Servicing Valves

5.10.1 Inlets to all float-operated valves and all cisterns should be provided with a Servicing Valve to facilitate maintenance.

5.10.2 Servicing Valves should be fitted as close as is reasonably practicable to float-operated valves or the other inlet devices of an appliance.

5.10.3 Servicing Valves may be of the screw-down or spherical type.

5.11 Float operated valves

5.11.1 Float-operated valves and other fittings for controlling flow to cisterns or tanks should:

(a) Be capable of controlling the flow of water into any cistern or tank and, when closed, be watertight and remain watertight.

(b) Incorporate, as applicable, a renewable seat and a washer which are resistant to both corrosion and erosion by water or have some other no less effective valve closure assembly.

(c) As applicable, have a float that is constructed of a non-corrosive material capable of withstanding, without leaking, any water temperature in which it operates or is likely to operate, and have a lifting effort such that, when no more than half immersed, the valve is capable of drop-tight closure against the maximum operating pressure at that elevation in the building.

(d) When acting via an operating lever, and when the valve is closed, withstand, without bending or distorting, a force twice that to which it is ordinarily subject, and, in the case of a 15mm size valve, be constructed so that the water shut-off level may be altered or adjusted without bending the float lever.

(e) Preferably be installed such that the level in the Roof Tank is controlled by an electric float switch, in order to alleviate any water hammering effect on the transfer pump and Water Fittings downstream of the pump.

(f) Be installed in such a manner that the valve shuts off the inflow of water at a suitable level below the overflowing level of the tank.

5.11.2 Valves should be designed and operated such that the minimum tank fill rate exceeds half of the average hourly consumption, in order to avoid drip filling and under-registration of the upstream Water Meter, unless otherwise agreed with the Distribution Company.

5.11.3 So far as is reasonably practicable, float-operated valve operation should not be prevented or impaired by scale. With regard to any scale likely to be deposited on the valve or float, the valve should be capable of being adjusted to prevent any flow through the valve above the required water level.

5.12 Disconnection, redundant fittings and dead ends

5.12.1 Dead legs in the water system should be avoided. Any draw-off fitting that is permanently removed from the installation should have the branch pipe

serving the fitting disconnected at its source. The owner/Responsible Person should apply to the Distribution Company for the supply to be disconnected. This Guide applies in particular to consumers who wish to demolish a building to which a Service Pipe has been laid. Such consumers shall, prior to the commencement of demolition work, apply to the Distribution Company to have the supply disconnected to prevent damage, waste or Contamination of the water supply.

5.13 Setting out

5.13.1 All service pipework shall be accurately located in a plan and at an elevation to suit the requirement of the water supply layouts and general arrangement drawings, and as required by the approved design.

5.13.2 Sight rails shall be set in position, using a surveyor's level and benchmarks established alongside the work. The practice of "transferring" levels by means of a straight edge and spirit level shall not be permitted.

Installation of pipes and ducts

5.13.3 The water Service Pipes shall preferably be installed in straight lines, with proprietary fittings used at any change in direction or level. All socketed pipes shall be laid with the sockets facing upstream. All pipes shall be fully supported at the required intervals using mounting that is in strict accordance with the recommendations of the pipe manufacturer.

5.13.4 Immediately prior to laying, all pipes and fittings shall be examined carefully to ensure that they are sound. No damaged or defective items shall be used. Any part length used shall be cut squarely and cleanly at the end. All pipes shall be clean before installation and jointing.

5.13.5 Water Service Pipes may include bends, tapers, junctions, or sections consisting of other special pipes of particular patterns, as required.

5.13.6 When pipes pass through walls, floors or ceilings, they shall be sleeved and sealed. All concealed pipes within walls, ceilings or floors shall be run within a protective conduit.

5.13.7 Before commencement, the Responsible Person shall coordinate and finalize the routes, ground/invert levels, positions of manholes etc. with the Distribution Company, in order to aid the smooth progress of the pipework installation.

5.13.8 All changes in the design shall be subject to the approval of the Distribution Company.

Detectable tape

5.13.9 Where Water Supply Systems are run underground, pipes shall be adequately protected and marked using detectable tape. Tape shall be installed 250mm above the buried pipe and shall be in accordance with the following specification:

(a) tape width – 250mm

(b) tape material – plastic

(c) tensile strength – 10 N/mm^2

(d) detection strip width – 50mm

(e) detection strip material – plastic aluminum coated

(f) color – blue

(g) printing – CAUTION – WATER PIPE BELOW (in Arabic and English).

Pipe bedding and surrounding material

5.13.10 Pipe bedding and surrounding material shall be well rounded, not angular. In cases where the excavated material is suitable, the bottom of the trench shall be trimmed and loosened to form the bed; otherwise, the trench shall be excavated to a depth below the invert level to allow for the thickness of bedding material. No sharp material shall be in contact with the Service Pipe.

5.13.11 In cases where dug material is not suitable, imported granular material shall be used to provide 100mm bedding and surrounding material, see Table 5.1.

Table 5.1: Pipe bedding and surrounding material for different pipe diameters

Nominal **pipe diameter (mm)**	Pipe bedding and surrounding material
≤65	Fine or coarse sands up to 5mm maximum diameter (choice depending on pipe material).
66-149	10-14mm maximum diameter single-sized material or 5-14mm graded aggregate.
≥150	10, 14, or 20mm single-sized material or 5-14mm or 5-20mm graded aggregate.

5.13.12 Imported material for bedding and surround for a given pipe size shall be in accordance with the requirements of BS EN 12620.

5.13.13 All surround and backfill materials up to 500mm above the pipe shall be loose laid and hand compacted only.

5.13.14 If the excavated material contains stones larger than 40mm, the bedding material shall be extended 150mm around the circumference of the pipe. Alternatively, the backfill can be graded to eliminate stones exceeding 40mm, and this selected backfill used for the first 300mm around the circumference of the pipe. The remainder of the trench may be backfilled with suitable excavated material.

Valve chambers and pits

5.13.15 All chambers and pits upstream of the Customer Meter shall be constructed of reinforced concrete, pre-cast concrete sections, or of solid concrete blocks, to the internal dimensions laid out in BS 5834-4, or of a material approved by the Distribution Company. Chambers and pits shall be designed to account for the vehicular or other loading to which they will be subjected. Valve chambers, pull chambers, and Water Meter chambers shall not be located in traffic areas, including parking areas. Special approval shall be obtained from the Distribution Company if such a requirement cannot be met.

5.13.16 Foundations to such chambers and pits shall be of concrete complying with the relevant clauses of the Concrete Specification and shall finish flush with the chambers and pit sides unless specifically otherwise required.

5.13.17 The ends of all pipes shall be built neatly into the blockwork and gaps filled and finished flush using mortar. External surfaces shall be waterproof to prevent external ground or surface water from entering the valve chamber. Valve chambers and pits shall be provided with a soak-away pit filled with gravel. The soak-away shall have a minimum size of 100 x 100mm (plan dimensions).

5.13.18 Where subsequent pipework is to be installed, an adequate length of free end is to be left for later coupling.

5.13.19 Where the depth of invert of manholes upstream of the Customer Meter exceeds 1m below the finished ground level, aluminum steps to BS EN 13101 shall be built. These shall have vertical intervals of 300mm, with alternate steps in line vertically, and measure 225mm center to center horizontally.

5.13.20 Entry to deep manhole chambers (>1,500mm) shall be by means of one or more caged vertical aluminum ladders.

5.13.21 Manhole covers and frames shall be of blue epoxy coated ductile iron complying with BS EN 124, or an equivalent standard, and shall be designed for the loading category to which they will be subjected. Normally, if not exposed to traffic loads, they shall be of minimum Class B125. Any manhole cover located in traffic areas, including parking areas, are subject to Distribution Company approval.

5.14 Testing, disinfection and flushing

Testing

5.14.1 The entire installation up to the Roof Tank should be tested hydraulically on completion, by subjecting, for a maximum of 3 hours, all supply and distribution pipes, fittings and connections to an internal test pressure of 1.5 times the maximum allowable operating pressure (MAOP) that is specified for the installation or relevant part.

5.14.2 For systems that do not include any plastic pipes i.e., those that solely contain pipes made of rigid materials such as copper, stainless steel etc.), the testing requirement shall be in accordance with BS EN 806-1, BS EN 806-2, BS EN 806 3, BS EN 806-4, BS EN 806-5 and BS 8558.

Testing procedure

5.14.3 The water service pipelines, joints and fittings shall be tested prior to surrounding, backfilling, building into walls and floors, or other concealment.

5.14.4 All tests shall be performed in convenient sections for each system, in the presence of, and to the satisfaction of, the Distribution Company, where requested.

5.14.5 Prior to the commencement of testing, the system shall be thoroughly cleaned by flushing with Wholesome water to ensure no foreign matter remains within the pipe.

5.14.6 The pipes shall then be filled and tested in accordance with the latest version of IGN 4-01-03 ‘Guide to the pressure testing of pressure pipes and fittings for use by public water suppliers’ and BS EN 805 ‘Water supply – requirements for systems and components outside buildings’.

5.14.7 All gauges used shall be in good operating condition, shall be accompanied by the relevant valid calibration and test certificates, and shall be of a condition that is satisfactory to the Distribution Company.

5.14.8 During the test, all exposed pipes, joints, fittings, valves, etc. shall be carefully examined, and any joint or item showing signs of leakage shall be rejected.

5.14.9 All sections or items rejected shall be removed and replaced, and the test shall be repeated to the satisfaction of the Distribution Company.

Disinfection

5.14.10 For the purposes of disinfection, the following procedures shall be followed:

(a) Sodium hypochlorite (food grade):

(i) The system shall be filled with chlorinated water at an initial concentration of 20mg/l for a contact period of 1 hour. If the free residual chlorine measured at the end of the contact period is less than 10mg/l, the disinfection process shall be repeated until 10mg/l is reached, or as instructed by the Distribution Company.

(ii) After successful chlorination, the system shall be immediately drained and thoroughly flushed with clean water. Flushing shall continue until the free residual chlorine is at the level present in the potable water supplied.

(b) Other disinfectants:

(i) The system shall be filled with the approved disinfectant solution at the initial concentration and for the contact time specified by the manufacturer. If the residual amount of the approved disinfectant at the end of the contact time is less than the manufacturer's recommendation, the disinfection procedure shall be repeated.

5.14.11 The Distribution Company shall be satisfied that the water supplied is Wholesome as defined in the Water Supply Regulations. Disinfection may be required in accordance with Clause 5.14.10 above.

5.14.12 Should the hydrostatic test fail, and repair work involve emptying the pipeline, the disinfection and subsequent testing procedures shall be repeated.

5.14.13 Once flushed, the water in the new pipelines shall be allowed to stand for a further 24 hours. Samples shall then be taken from locations directed by the Distribution Company and immediately submitted for chemical and bacteriological testing at an Accredited laboratory. Samples will be deemed to have passed if they meet the requirements of Clause 5.14.15.

5.14.14 Chemical and bacteriological tests shall be undertaken by the Distribution Company laboratory, or at an Accredited laboratory.

Acceptance criteria for disinfection

5.14.15 The pipeline shall not be considered acceptable until the bacterial count, the recorded total chlorine and the pH are within acceptable limits as defined within the Water Quality Regulations. If the tests show that a satisfactory Wholesome water standard has not been achieved, the test shall be repeated.

Flushing

5.14.16 After all hydrostatic testing and disinfection has been completed and the pipeline is ready in all other respects, the new pipeline shall be flushed out with potable water from the existing mains to which the new pipeline or network is or will be connected. Flushing entry and exit points shall be designed to allow a minimum of 1.0m/s water velocity in the main pipeline, in order to remove any sand or other debris. The quantity of flushing water shall be calculated as the equivalent to 3 times the volume of the pipeline to be flushed, unless directed otherwise by the Distribution Company.

5.14.17 Flushing water shall be discharged, via temporary discharge lines, into the surrounding open desert area or into the existing storm water system or, if feasible, into road tankers. Discharge of flushing water into the existing storm water system shall be subject to the approval of the relevant Authorities.

6. Water pumps and treatment apparatus

6.1 General requirements

6.1.1 It is strictly prohibited to install any type of suction pump, whether externally or internally located, unless downstream of a storage tank and installed in accordance with Clauses 6.3.2 and 6.3.3.

6.1.2 All electrical wiring arrangements and electrical connections to the pump-sets and associated equipment shall comply with the DoE's Electricity Wiring Regulations.

6.1.3 All pump-sets shall be covered and installed in a clean and dry location and be protected from dirt and fumes. Pump-sets shall be located to allow safe access for maintenance activities, including the removal or replacement of parts.

6.1.4 All pump-set accessories and associated electrical and mechanical equipment shall be installed, tested and commissioned in accordance with manufacturer instructions for use.

6.1.5 The installation of pressure-reducing valves or pressure regulators shall be included in the Service Pipe or Water Fittings, in cases where pressure is likely to exceed 2.5 bar, or as specified by the Distribution Company.

6.1.6 Diagrams illustrating common connection arrangements to pumps are included in Annex D. These are for illustration only; detailed drawings shall be submitted in accordance with Annex A.

6.2 Transfer/booster pumps

6.2.1 Where required, transfer pump(s) shall be installed for the purpose of pumping water from the Ground Storage Tank to the Roof Tank. The flow rate of the pump shall be selected in such a way that the Roof Tank is filled within one to two hours after receiving a low-level signal, taking into consideration friction losses. Water velocity shall not exceed 2.0m/s in the riser pipe unless approved by the Distribution Company.

6.2.2 A high-level signal should be at least 50mm below the Overflow Pipe of the Roof Tank. Level control or float switches in contact with water shall be made of material that is safe and does not affect the water quality in any circumstances.

6.2.3 It is recommended that all Premises with pumps have at least two pumps (one duty and one standby) for security of supply purposes.

6.2.4 The alternative method of supply is by a direct boosting system from the Ground Storage Tank directly to the Premises by the use of a transfer pump and pressure vessel system (connection arrangement as shown in Annex D7). However, this system is permissible only for commercial and public buildings and shall be approved by the Distribution Company. All calculations regarding riser pipe and branches shall ensure that demand is supplied based on the appropriate consumption rate.

6.3 Pressure maintaining pumps

6.3.1 For multi-story buildings and High-rise Buildings supplied by Roof Tanks, the top floors shall be fed by one or more pressure-maintaining pumps, along with a pressure vessel, by drawing water from the Roof Tanks. The purpose of this is to maintain a constant pressure and overcome the problems of low pressure and loss of supply that may occur if the distance between the Roof Tank and top floor levels is approximately 10m or less (see Figure D.6).

6.3.2 For villas and Low-rise Buildings supplied by Ground Storage Tanks and/or Roof Tanks, pressure-maintaining pumps may also be installed to supply the top floors, if required. Any outdoor water requirements shall be satisfied separately by gravity and not by the pressure-maintaining pump serving the top floors.

6.3.3 The pressure-maintaining pump shall be sized to meet the plumbing system requirements, and the residual pressure shall in no case be less than 1.25 bar or more than 3.0 bar, or be as specified by the Distribution Company. A mechanism shall be used to regulate the discharge pressures, e.g., a pressure reducing valve, as required.

6.3.4 A bypass arrangement around the pressure-maintaining pump from the inlet of the Roof Tanks shall be provided in case of pump failures. The bypass arrangement should incorporate adequate Backflow protection. Water shall only flow through the bypass when pump failure occurs.

6.4 Suction pumps

6.4.1 Design drawings including a suction pump connected directly to the Distribution Company mains or Service Pipes, before the first storage tank, shall not be approved. Furthermore, permanent Water Connection shall be withheld until such pumps are removed.

6.5 Circulation pumps

6.5.1 Circulation pumps shall be provided for tanks of an irregular shape or with narrow passages or closed parts. Evidence shall be submitted to the Distribution Company that the flow rates of such pumps result in the whole Tank Capacity being circulated within six hours.

6.6 Water treatment apparatus

6.6.1 No domestic water treatment apparatus, softener, ion exchange unit, desalination unit, activated carbon or any other filtration system shall be connected directly to the Service Connection.

6.6.2 Apparatus or processes that may alter water quality characteristics prior to the Customer Meter should not be installed. Where further treatment is required for certain applications, the Responsible Person shall consult the Distribution Company or the authority concerned.

6.6.3 Filtration systems, or any other water treatment equipment installed, shall be maintained and operated according to the manufacturer's instructions for use. Bypass arrangements shall be considered in case of system failures.

6.6.4 Almost all water supplied by the Distribution Companies in the Emirate of Abu Dhabi is desalinated water, and therefore water treatment equipment specified shall be considered following a technical evaluation by the

Responsible Person. The Responsible Person may wish to seek information and data on the water quality supplied to the area of residence from the Distribution Company (e.g., Total Dissolved Solids, pH, Chlorine and Hardness) to verify whether additional treatment is required.

7. Water Meter provision and installation arrangements

7.1 General arrangements

7.1.1 All potable water outlets supplying water to Customer Premises and connected directly or indirectly to the water main, or sub-main, of the Distribution Company's water network, shall be metered in a manner approved by the Distribution Company and conforming to the Customer Metering Regulations, using an approved Water Meter.

7.1.2 Any building, part of building or Premises divided into isolated flats (separate occupation) shall be separately metered.

7.1.3 Open commercial spaces with one or more self-contained units located separately shall also be metered separately.

7.1.4 Service or utility water requirements: air conditioning, housekeeping, garbage room, public toilets, filtration system, firefighting and general services shall all be metered by one or more Water Meters as approved by the Distribution Company.

7.1.5 Swimming pools (both above and below ground level) larger than 50m3 with a fixed water supply connection shall be metered separately. Similarly, separate Water Meters shall be installed on fixed water supply connections for any non-domestic use, e.g., for irrigation and cooling systems.

7.1.6 The size and type of Water Meter shall be appropriate for the individual Customer's overall consumption pattern and maximum flow rates.

7.1.7 An appropriately sized Customer Meter shall be chosen such that the expected daily consumption, according to Table 4.1 or as otherwise agreed with the Distribution Company, divided by the Premises' water using hours and multiplied by the appropriate peak factor and a safety factor of 2, is less than the Q4 flowrate of the meter, and ideally less than the Q3 flow rate. In addition, half of the expected daily consumption per hour shall be greater

than the Q2 flowrate of the Water Meter, unless otherwise agreed with the Distribution Company.

7.1.8 Where the Customer Meter is susceptible to regular intermittent supply, the Distribution Company shall specify an appropriate Water Meter that does not account for air volumes, or an approved air-venting device shall be installed prior to the Water Meter.

7.1.9 Access to metering installations shall be made available to authorized officers of the Distribution Company for the purposes of meter reading, installation of a remote reading device, maintenance etc.

7.1.10 Diagrams illustrating common locations of Customer Meters are included for illustration purposes only. Detailed drawings showing the location of the proposed meter(s) shall be submitted in accordance with Annex A.

7.1.11 A metering installation shall meet the following requirements:

(a) The Customer Metering Regulations

(b) The relevant section of BS EN 806-1, BS EN 806-2, BS EN 806-3, BS EN 806-4, BS EN 806-5 and BS 8558

(c) The relevant parts of the Guide.

7.2 Meter standards and regulations

7.2.1 All Customer Meters used for measuring any supplies of water for revenue purposes shall be in compliance with the Customer Metering Regulations issued by the DoE. They should be approved by the Distribution Company and conform to the relevant standards included in the Regulations.

7.2.2 Customer Meters using electronic principles are acceptable so long as they are approved and compliant with the Distribution Company's requirements.

7.2.3 The meter numbering system shall be approved by the Distribution Company. The meter number, if unprotected, shall be engraved on the meter body on the same side as the reading display window. If the meter number is written

on the counter face of the meter, it should be protected by a toughened clear plastic or glass cover.

7.3 Illegal tampering

7.3.1 The meter shall be protected by the Responsible Person from illegal tampering, and access to components which may affect its metrological characteristics shall be prevented. The meter shall be installed in a secure location and have a valid manufacturer's, or other approved agent's, seal in place as specified by the Distribution Company. Where seals have become damaged or removed, the Customer shall inform the Distribution Company.

7.3.2 No Customer shall be permitted to remove or replace a Water Meter. Only the Distribution Company, or a Person authorized by the Distribution Company, may replace or remove a Water Meter. A Customer shall be legally liable if found responsible for such an act.

7.4 Water Meter housing

7.4.1 Customer Meters are calibrated measurement devices, and require some degree of protection against physical shock, maltreatment and tampering. In order to provide this protection, Customer Meters shall be housed in an approved manner in either cabinets or chambers, or rooms as approved by the Distribution Company.

7.5 Check Meters

7.5.1 The Service Pipe supplying multi-story and multi-tenanted metered buildings or Premises shall also be fitted with a Check Meter for water balance purposes. This is to ensure water losses or leakages inside the Premises' boundary are detected and repaired.

7.5.2 The Distribution Company may charge the Customer/Responsible Person for any water losses within the plumbing system, i.e., for the difference between the Check Meter reading and the sum of Customer Meter readings.

7.6 Externally installed meters

7.6.1 Externally installed Customer Meters of sizes up to and including 50mm diameter should be housed in cabinets intended for use on Service Connections, with the meter register facing outwards. The cabinet should be manufactured of press-molded fiberglass (GRP), or a material approved by the Distribution Company. The Customer Meter cabinet shall be of robust construction and shall be made of GRP with a UV stabilizer.

7.6.2 Externally located meters greater than 50mm in diameter shall be installed in the ground and housed in watertight chambers, and shall be sized so that ample space as specified by the Distribution Company is available for maintenance activities and the transmitter shall be housed in a GRP cabinet above ground. The meter register shall be viewable from the access point, and the chamber shall be fitted with a cover marked ‘Water Meter’ of a sufficient strength to carry anticipated loads, or as per the Distribution Company’s recommendation.

7.6.3 Water Meter cabinets shall have either louvered panels or shall have visible reinforced glass doors that open sideways, depending on the location and as per the Distribution Company’s recommendation. A PVC sleeve shall be provided with a pull rope from a Water Meter cabinet to the nearest electrical room and with a communication cable recommended by the Distribution Company, in order to facilitate any future remote reading and metering data management system.

7.6.4 Water Meter cabinets shall either be installed on a support outside the boundary wall or mounted in a recess in the boundary wall and made flush with the boundary wall external face. The cabinet shall be placed at such a height that the center of the reading window is approximately 1,500mm above the finished ground level or sidewalk level, or as approved by the Distribution Company according to site conditions. The cabinet shall be installed at a safe distance from electricity cabinets as determined by the Distribution Company.

7.6.5 A multi-meter cabinet can be used, provided that the spacing between meters is as specified and that all other requirements of the Distribution Company are met. All cabinets shall be provided with locks and drain outlets connected to an approved drain system by the Distribution Company.

7.6.6 Where required by the Distribution Company, examples of Water Meter cabinets submitted for approval shall be complete with all the necessary internal fittings, such as the Water Meter and lockable valve, and secured as if ready for connection.

7.7 Internally installed Water Meters

7.7.1 Internally installed Customer Meters, commonly used in multi-tenanted buildings, can either be installed in wall-mounted cabinets with doors made of aluminum and reinforced glass, or in a separate meter room. Internal meters shall be located in safe and easily accessible locations and conform to the Customer Metering Regulations.

7.7.2 Rooms housing Customer Meters shall have the following requirements:

(a) The room size shall be of a width no less than 1,000mm and be of suitable length.

(b) An electric light shall be provided where and if required.

(c) A drainpipe no less than 32mm in diameter shall be provided for each meter housing chamber or cabinet connected to the building's floor draining system.

(d) The meter(s) shall be fixed in a vertical position with suitable support.

(e) An engraved sign reading 'WATER METER ROOM', no less than 200 x 100mm in size, shall be fixed to the outside of the door of the room.

(f) Lights, switches and sockets inside the Customer Meter room shall have the degree of protection of IP65 or above.

(g) A PVC sleeve shall be provided, with a pull rope from the Water Meter room to the nearest electrical room and with a communication cable

recommended by the Distribution Company, to facilitate any future remote reading or metering data management system.

(h) The door of a Water Meter room or cabinet shall be provided with a master key system approved by the Distribution Company.

7.8 Water Meter identification tags

7.8.1 Tags shall be of rigid plastic material and be at least 60 x 60mm in size.

7.8.2 The title of the Premises served by the meter shall be engraved on the tags.

7.8.3 Tags shall be screwed to the wall or to the back of the cabinet.

7.9 Water Meter installation

7.9.1 Each Water Meter of up to and including 50mm diameter shall be provided with a lockable valve, upstream of the meter, and a Gate Valve downstream of the meter, both of the same size as the meter, along with suitable connectors to facilitate future meter changes.

7.9.2 For meters larger than 50mm diameter, a Gate Valve on each side of the meter shall be provided, along with an appropriate Backflow prevention device.

7.9.3 Where multiple meters are installed inside a single cabinet or a room, one main Gate Valve shall be provided inside the same room or cabinet, in order to isolate that group of Water Meters.

7.9.4 Where there are multiple metered connections within one Premises, each supply should be fitted with an appropriate Backflow prevention device, in order to prevent the Backflow of water between separately occupied Premises.

7.9.5 The Backflow prevention device shall be installed downstream of the meter in all cases. Where a drain valve is required, it shall be installed immediately downstream of the meter and Backflow prevention device.

7.9.6 Pipework shall be firmly fixed to prevent movement of the flexible joints within the meter assembly. Adhesive or plastic clamping is not permitted.

7.9.7 Meters can be fixed horizontally or vertically provided they are designed to operate in such an orientation and depending on the meter's nominal diameter. Meters of 80mm and larger are generally installed horizontally, or according to the Distribution Company's requirements and manufacturer's recommendations.

7.10 Grouping of Water Meters

7.10.1 Water Meters can be installed in groups of no more than 20 meters.

7.10.2 Center-to-center spacing of meters shall be no less than 170mm for meters less than 50mm in diameter.

7.10.3 Multi-meter cabinets can be used with the approval of the Distribution Company, provided the size is increased to accommodate all the meters. Center-to-center spacing of meters should be no less than 170mm, and the clearance from the edge of the meter to the cabinet side should be no less than 100mm.

7.11 Pressure-reducing valves

7.11.1 Pressure-reducing valves (PRV) shall be used on the upstream side of the meter if the pressure at that point is likely to exceed 2 bar, or shall be as specified by the Distribution Company (see Figure D.6).

7.11.2 Where required, one pressure-reducing valve shall be installed for each group of meters located on each floor of a building. This generally applies to the floors where the pressure in the riser pipe that feeds individual Customers exceeds 20m water head (2 bar). If the pressure is between 20 to 30m water head (2-3 bar) then a bypass line fitted with a Gate Valve shall be provided for each PRV. If the pressure is greater than 30m water head (3 bar), then a bypass line fitted with a PRV and Gate Valve on either side shall be provided. Gate Valves on bypass lines shall normally be closed.

7.11.3 Each pressure-reducing valve shall have a quick-isolation valve on either side and shall have provision for both a pressure gauge connection and a drain cock.

7.11.4 Pressure-reducing valves may be installed inside the meter cabinet or room.

7.11.5 The diameter of the pipe from overhead tanks to consumers shall be gradually reduced if the height of the tanks above curbstone level is more than 50m, provided this is agreed with the Distribution Company.

7.12 Location of Water Meters

7.12.1 Locations shall be individually determined by a survey of the existing or proposed position of the Ground Storage Tank in each plot. Such positions shall be plotted on a scale plan of the sector, with the proposed locations of the meter cabinets indicated. The plans shall be submitted to the Distribution Company for approval.

7.12.2 The location of the meter cabinet for each plot shall generally be positioned outside the plot boundary, except for buildings with no boundary wall, where the cabinet should be installed at a standardized height in accordance with Clause 7.6.4. In this case, the cabinet may be installed inside the property boundaries according to the Distribution Company recommendation. The Responsible Person shall undertake to keep the internal meter location fully accessible to the Distribution Company and shall not damage or prevent correct operation of assets owned by the Distribution Company.

7.12.3 Meter locations shall be approved by the Distribution Company, and meters should not be installed in any of the following locations:

(a) Inside the Customer's dwellings.

(b) Inside rooms reserved for other services such as electricity or telephones, garbage rooms, filter rooms, pump rooms, etc.

(c) On the top roof of a building where access is by means other than the main concrete staircases, unless approved by the Distribution Company.

7.13 Meter installation

7.13.1 The flanged connection shall be drilled according to ISO 7005-2 raised face. The flange pressure rating shall be as given in the fittings specification or data sheet.

7.13.2 A straight length of pipeline of the same diameter as the meter shall be provided both upstream and downstream of the flow meter, in order to prevent flow turbulence affecting the accuracy of the flow measurement.

7.13.3 The straight length at the inlet of the Customer Meter and the length at the outlet shall be equal to or in exceedance of that specified by the meter manufacturer. In the absence of such information, a distance of 10 times the meter's nominal diameter upstream and 5 times the meter's nominal diameter downstream.

7.13.4 The installation of the flow meter shall be such that it is possible to remove the meter at any time and replace it with the appropriate length of spool piece.

7.14 Setting out

7.14.1 Prior to final installation and operation of any Water Meter, it shall be confirmed by the installer that the pipeline, meter body and fittings are free of debris and potential pollutants.

8. Service Connection

A water Service Connection is a Water Connection performed by the Distribution Company or under the supervision of the Distribution Company. No other party is allowed to perform this Water Connection unless authorized by the Distribution Company. The connection is laid from the water distribution network main pipe by installing a Service Connection pipe, including all auxiliary fittings, from the tapping point up to the consumer Point of Delivery. All pipes laid by the Distribution Company for conveyance of Wholesome water shall be clearly marked as for this purpose, such as by a blue stripe.

The most common Service Connection sizes to households are 20mm and 25mm in diameter, except for 15mm in diameter for apartments, made from MDPE (Medium Density Polyethylene Pipe). Distribution Companies shall ensure that, under normal operating conditions, water is supplied at reasonable demand with a Minimum Pressure of 1.25 bar (12.75m) measured at the Customer's meter. The Distribution Company shall evaluate the size of the connection with consideration of friction and head losses for long Service Connections.

Diagrams illustrating the various connection arrangements are included in Annex D. Detailed drawings shall be submitted in accordance with Annex A.

8.1 Standard Service Connection

Service Connections are provided to Customers when the distribution main is available in the vicinity of the plot. Temporary supply through other means may however be offered in accordance with the Distribution Company's existing policy and arrangements.

Fittings for polyethylene Service Connection pipes such as tees, connectors, adaptors, elbows, couplings etc. shall be compression type or push-fit type as per the specifications within Annex B.

The size of the Service Connection shall be determined by only the Distribution Company. For guidance, the standard Service Connections for villas and houses are

normally of sizes 15, 20, 25, 40 or 50mm nominal bore diameter, and predominantly 20mm.

MDPE Service Connections pipes and fittings are used for the available pressure found in the network; however, HDPE may be used in certain high-pressure systems (9 bar and above), and in connections larger than 65mm in diameter. Only DI fittings (puddle flanges, spigot pieces, flange adapters and spool pieces) shall be used inside the chambers for connections larger than 65mm, and they shall be in accordance with ADWEA standard technical specifications.

Service Connection tapping

Service Connections are generally tapped to a distribution main using ferrules of size 15, 20, 25, 40 and 50mm by installing the polyethylene Service Connection pipe (including all auxiliary fittings) from the tapping point up to the Point of Delivery.

Service Connections (including any pipework to sub-metered Premises) shall be sized such that typical flowrates through the pipes at the expected network pressure allow for a constant level to be maintained in the next downstream tank under twice peak demand conditions (that is, providing a safety factor of 2).

Peak demand conditions shall be defined by the product of the expected daily consumption per hour of water use and peak factor in accordance with Table 4.1, or as otherwise agreed with the Distribution Company.

In the absence of storage tanks, connections will be sized in agreement with the Distribution Company such that they can withstand reasonable peak demand multiplied by a safety factor of 2.

Saddle straps with a flat boss shall be installed on the main water pipeline. The tapping to the pipeline shall be done though the saddle straps using a tapping machine approved by the Distribution Company. Screw-down ferrules shall be fitted to the saddle straps. The ferrule valve shall be closed until the Service Connection work is completed and tested.

Water Service Connection pipes

Water Service Pipe material is classified to two nominal sizes; up to 50mm nominal diameter and 65mm and above. The requirements relating to pipes and pipe specifications are included in Annex B. The Distribution Company's approval is needed prior to making any pipe material selection from the list below.

(a) Water Service Pipes of 50mm diameter and smaller shall be of one of the following.

(i) Medium Density Polyethylene Pipes (MDPE) PE 80 (The most common type of Service Connection pipe used by the Distribution Companies).

(ii) High Density Polyethylene (HDPE) PE 100 may be used in high-pressure systems.

(iii) Polypropylene random copolymer (PP-R) pipes.

(iv) Cross-linked polyethylene (PE-X) pipes and fittings.

(v) Pipes of a higher specification, e.g., stainless steel, subject to approval by the Distribution Company or the DoE.

(b) Water Service Connection pipes of 65mm diameter and larger shall be of one of the following:

(i) High Density Polyethylene (HDPE) pipes and fittings to ISO 4427 Parts 1, 2, 3 and 5 type PE 100 and to ADWEA Standard Specification for Water Works No. W-P-SS-005 (former ADWEA standard). Medium Density Polyethylene Pipes (MDPE) PE 80 may be used in low-pressure systems.

(ii) Ductile Iron (DI) pipes and fittings to ISO 2531 or equivalent.

(iii) Pipes of higher specification, e.g., stainless steel, subject to approval by the Distribution Company or the DoE.

All water Service Pipes shall be installed in accordance with Clauses 5.7.3 – 5.7.10, 5.13.3 - 5.13.8, 5.13.9, and 5.13.10 - 5.13.14 in this guide.

Polyethylene pipe shall be laid with as few joints as is reasonably practicable or unnecessary bends from the ferrule up to the consumer Point of Delivery. Between the Water Connection and the Point of Delivery, all pipework shall be joined by push-fit or compression fittings. Connectors, bends and adaptors shall be provided as necessary. The polyethylene pipe shall be installed in a uPVC protection pipe (duct) class 10 for protection and ease of maintenance. The uPVC pipe shall be 110mm in diameter for 15, 20 and 25mm polyethylene pipes, and 160mm in diameter for 40 and 50mm polyethylene pipes, or as required by the Distribution Company.

uPVC protection pipe shall be used in all green and unpaved areas. In sidewalk and paved areas, the uPVC protection pipe shall be encased in reinforced concrete. Warning tape shall be provided over the polyethylene pipe/uPVC protection pipe in green and unpaved areas or as stated in the latest standard drawings issued by DISCOs.

Service Connection fittings

Gate Valves shall be provided for all types of Service Connection to allow for the isolation of the Customer connection. The valve shall be installed at a point as near as possible to the tapping point. For 15, 20 and 25mm Service Connections, the Gate Valve shall be installed in a concrete chamber or in a GRP cabinet. For connections equal to or greater than 40mm (1½”), the Gate Valve shall be installed in the concrete meter chamber, or as specified by the Distribution Company.

For 15, 20 and 25mm Service Connections, GRP Water Meter cabinets fixed as described in Clause 7.6.4 shall be provided. The cabinet shall contain the Water Meter, with valves and fittings as described in Clause 7.9.1. The portion of the polyethylene Service Connection pipe between the finished surface level and the GRP Water Meter cabinet shall be protected with 110mm polyethylene protection tube, fixed to the wall inside a recess, if practical, using two brass clamps.

For connections of 40mm (1½”) and above, the following requirements shall apply:

(a) For 40 and 50mm Service Connections, either a GRP Water Meter cabinet (for threaded type Water Meters) or a concreate chamber shall

be provided to contain the Water Meter, valves and fittings, as described in Clause 7.9.1.

(b) For Service Connections larger than 50mm, a concrete chamber shall be provided to contain the Water Meter, valves and fittings, as described in Clause 7.9.1.

(c) Externally installed meters shall be housed as described in Clause 7.6.1 and 7.6.2. If a concrete chamber is used to house the Water Meter, a display unit shall be provided, which shall be fixed to, and recessed within, the boundary wall of the consumer plot/Premises.

(d) The internal plan dimensions of chambers, for different sizes of Service Connections, shall be as follows, or as agreed by the Distribution Company:

(i) 600 x 600 x 400mm for 15, 20 and 25mm Service Connections

(ii) 1200 x 800 x 400mm for 40 and 50mm Service Connection

(iii) For Service Connections larger than 50mm, the chamber size shall be as per ADWEA standard specification and drawings.

Concrete pulling boxes shall be provided at locations where the polyethylene Service Connection pipe changes direction at a 90º angle, or where instructed by the Distribution Company.

All concrete chambers for Service Connection shall have a ductile iron cover as specified by the Distribution Company.

The top level of the chambers shall be raised or lowered according to the level of the nearest sidewalk or road curbstone.

Service Connection terminal points

The polyethylene Service Connection pipe shall be terminated within a chamber or meter cabinet, or as instructed by the Distribution Company.

Fittings required for Service Connection are dependent on the type of connection. The connections in general are terminated at the Point of Delivery with a Gate Valve and a Water Meter.

Service Connection to HDPE

Joints on MDPE Service Connections over 65mm to HDPE pipelines shall be made either by electro-fusion or butt-fusion in accordance with the recommendations of the Distribution Company or manufacturer.

Bulk consumers Service Connection

Bulk consumers such as palaces or commercial and industrial Premises shall be provided with a suitably sized Service Connection approved by the Distribution Company.

Tee-connection

For bulk water consumers, a Service Connection could be arranged by using a Tee-connection from the distribution main (connection arrangement as shown in Annex D3). Such connections are generally 65mm and above in size. All such connections should be valved.

Each bulk consumer measuring point shall comply with the Distribution Company specification and be equipped with the following, as a minimum:

(a) provision for installing flow measuring instruments.

(b) a sample valve that can be used as an air vent.

Piping arrangements

The piping arrangements for installation shall be followed as defined within the relevant sections of the Water Works Standard Specification for the construction, testing and commissioning of piping works and systems for ductile iron, MDPE and HDPE (former ADWEA standard).

8.2 Type of Service Connections

There are two types of Service Connections:

(a) temporary – made to the Premises for a limited period and as approved by the Distribution Company

(b) permanent – made to the Premises for an unlimited period and as approved by the Distribution Company.

Connections can be divided according to their intended use by the distribution companies.

9. Approvals, inspection, safety and quality control

9.1 Approval of Water Fittings

9.1.1 For the purpose of ensuring that Water Fittings comply with this Guide, Customers, Responsible Persons, fittings suppliers and manufacturers' agents shall apply for approval in writing to the Distribution Company and, if required to do so, shall submit evidence to the Distribution Company that pipes, fittings, and apparatus, etc. comply with this Guide.

9.2 Inspection and testing

9.2.1 The Distribution Company reserves the right to request inspection reports from other bodies, in order to satisfy themselves that inspections of all Water Fittings installed on the Premises at any time during construction work were undertaken to ensure the requirements under this Regulation and its Guide are complied with.

9.2.2 The Distribution Company should assess Premises for their risk of Contamination to the Distribution System and conduct inspections at a frequency associated with that risk.

9.2.3 Premises judged to have the highest level of Contamination risk (e.g., hospitals, industrial plants) should be inspected at frequencies of no less than 5 years while those with the lowest risk of Contamination should only be inspected in cases where there is a water quality issue or a waste of water (e.g. a shabiat).

9.3 Quality control

9.3.1 If deemed necessary by the Distribution Company, the Responsible Person shall submit a copy of the quality assurance/quality control program or QA/QC Certificate, in order to ensure that a quality control system compliant with ISO 9001 or equivalent is in place.

9.3.2 The Distribution Company has the right to ensure that hygiene procedures related to the installation of Water Fittings are followed during work carried out by the Responsible Person. The Distribution Company may request that individuals involved in the work undergo a qualification test, prepared in accordance with the Distribution Company's practices and standards, to ensure a satisfactory standard of work is delivered.

9.4 Safety requirements

9.4.1 All necessary precautions shall be taken to ensure the safety of personnel and property. Work practices shall comply with applicable national or local codes, regulations, safety orders, and practices of the Distribution Company, that cover working conditions, trenching, hoisting, scaffolding, clothing, fire and explosion hazards, safety equipment, solvents, chemicals, lighting, venting and grounding of tanks.

9.4.2 Where applicable, rags and other waste material soiled with paints, thinners or solvents shall be kept in tightly-closed metal containers while not in use, and disposed of in an environmentally appropriate fashion once the work is completed.

9.4.3 Extreme precautions shall be taken when working with paint materials, cleaning fluids etc., especially in close proximity to oxygen piping or oxygen equipment. Heavy concentrations of volatile or toxic fumes shall be avoided. When working in confined areas, blowers or exhaust fans shall be used.

Annexes

The following annexures are presented in this section.

- **Annex A:** Water connection process and drawing approval requirements
- **Annex B:** Pipes and fittings specifications
- **Annex C:** References
- **Annex D:** Connection Diagrams

Annex A: Water Connection process and drawing approval requirements

Main steps for Water Connection process

The Distribution Companies use a 4-step process for Water Connections. These steps may vary slightly between the companies, however, in general the following applies:

Step 1: **Water Drawing Approval** - this step includes provision of detailed demand calculations and design drawings for the water supply system including the Water Connection location and the timescale for this anticipated new demand to occur by the Responsible Person and subsequent approval by the Distribution Companies.

Step 2: **Water Connection** – this step establishes the new connection assets required to supply the Premises, along with approvals from other governmental entities for the proposed route and the physical work required to make the connection.

Step 3: **Inspection of water supply system** – this step confirms that the supply system is constructed to the approved design drawings, after which an internal meter is issued, if required. For large (>25) agglomerations of buildings of the same type and similar design (e.g., apartments), the Distribution Company may inspect only a representative sample of Premises, such that a minimum of 5% or 10 (whichever is largest) of a given type of Premises are inspected.

Step 4: **Service agreement and final connection** - this step includes the signing of the service agreement and the commissioning of the connection.

Documents and procedure required for drawing approval

A.1 Submit a detailed overall drawing showing the building (Riser/Diagram) as well as horizontal plans for the building's floors including architectural details.

A.2 Details shall include the following:

(a) location and size of the main connection chamber

(b) size and type of the pipes feeding the Ground Storage Tanks, the encasing sleeves and the valves

(c) locations, dimensions and actual net capacity for Ground Storage Tanks and Roof Tanks, along with water piping details

(d) location of tanks' access covers, types of access covers and respective sizes

(e) location and size of tanks' sump pit and drain pit, if any

(f) sizes of tanks' ventilation pipes, roof cistern Overflow Pipes, and pipes

(g) details of head and duty of water-lifting pumps to the roof cistern and booster pumps to specific building floor/water utility locations

(h) details of head and duty of tanks' drainage pumps and drain location.

(i) location of firefighting pumps

(j) location of Water Meters and housing rooms, or meter cabinet

(k) details of vertical cross sections, showing dimensions of levels, material types and capacities, for:

(i) water tanks

(ii) the main connection chamber

(iii) meter cabinets

(iv) water pumps (single line diagrams)

(v) water tanks complete with internal pipework (single line diagrams).

(l) location of new connections to the existing Distribution System (tie-in points).

A.3 Use the metric system of units in drawings except for tank capacities, which shall be stated both in imperial gallons and liters.

A.4 Unless otherwise specified, the recorded water tank capacities in drawings shall be the effective capacity (the volume of water that is available for use).

A.5 Attach a Water Meter schedule with details of floor no., unit name, no. of units/floor, meter size, cumulative horizontal meters, meter type and total no. of meters.

A.6 Unless specified by the Distribution Company, approval of preliminary drawings is valid for a maximum of two years; otherwise a re-approval request shall be submitted.

A.7 The Distribution Company reserves the right to ask for any further information it deems reasonably necessary before granting a new connection.

Annex B: Pipes and fittings specifications

Pipes

Polyethylene pipes and fittings

B.1 Polyethylene Service Connection pipes and fittings shall be black PE80 medium-density polyethylene (MDPE) and shall comply with the requirements of ISO 4427 Parts 1, 2, 3 and 5 or EN 12201 Parts 1, 2, 3 and 5. The pipes shall have an SDR (standard dimension ratio) of 11.

B.2 The polyethylene pipes and fittings shall be suitable for use above ground and underground for conveying potable water at a working pressure of up to 12 bar. Connection by fusion is the recommended method of joining polyethylene pipes wherever possible.

B.3 The polyethylene pipe shall meet the minimum requirements of the following specification:

(a) Minimum density measured according to ISO 1183-2 shall be between 945 and 955kg/m^3.

(b) Melt flow rate measured according to ISO 1133-1 with a 5kg load shall be between 0.75 and 0.95g/10min.

(c) Tensile strength at yield, measured according to ISO 6259, shall be at least 18MPa.

(d) Elongation at break, measured according to ISO 6259 Parts 1 and 2, shall be at least 350%.

(e) Thermal stability, as measured by the oxidation induction time, in accordance with ISO 11357-6 and at a temperature of 200°C, shall be a minimum of 20 minutes.

B.4 The pipes shall be manufactured from polyethylene containing only antioxidants, carbon black and other additives necessary for the manufacturing of the pipes and shall conform to the requirements of Distribution Company Standards/Specifications and international specifications.

B.5 If reworked material is added or used, it shall be clean, derived from the same resin, reground under the supervision of the same manufacturer, and shall be compatible with the material to which it is added.

B.6 The material of any polyethylene pipe that is in contact with, or likely to come into contact with, Wholesome water shall not constitute a toxic hazard or support microbial growth, nor shall it give rise to unpleasant taste, odor, cloudiness or discoloration of the water.

B.7 The concentration of substances, chemical agents and biological agents that are leached from materials in contact with potable water, along with measurements of the relevant organoleptic/physical parameters, shall not exceed the maximum values recommended by the World Health Organization in its "*Guidelines for Drinking Water Quality*" or the EEC Council Directive on the "*Quality of Water Intended for Human Consumption*". The more stringent requirement should be observed in each case.

B.8 Polyethylene pipes shall be clearly marked, at intervals of 1m, indicating the manufacturer's name, nominal diameter, standard number, pipe class, pressure rating and date of pipe manufacture. The word "WATER" shall also be marked every 1m. The marking shall be by means of paint or engraved marks. All markings shall be blue in color. The pipes shall be supplied in coils of 150m and shall be kept shaded at all times. The coils shall be wrapped and shall not be exposed to direct sunlight.

Ductile iron pipes and fittings

B.9 Ductile iron pipes, fittings and jointing of the pipes and fittings should conform to Standard Specification for Water Works No. W-P-SS-001 (former ADWEA standard) or to ISO 2531 or equivalent British Standard.

Polypropylene random copolymer (PP-R) pipes and fittings

B.10 PP-R pipes, fittings and jointing of the pipes and fittings should conform to BS EN 1852-1, BS EN ISO 15874, or an equivalent international standard.

Cross-linked polyethylene (PE-X) pipes and fittings

B.11 PE-X pipes, fittings and jointing of the pipes and fittings should conform to BS 7291-1, BS 7291-3, ISO 15875 and AWWA C904. Other relevant standards for PE-X and PE-X systems include:

(a) ASTM F876 - Materials, Dimensions and Performance for Tube

(b) ASTM F877 - Performance Standard for Tube/Fitting Systems

(c) ASTM F2023 - Chlorine Resistance test method

(d) ASTM F2657 - UV Resistance test method

Service Connection fittings (mechanical)

B.12 Fittings for polyethylene Service Connection pipes, such as tees, connectors, adaptors, elbows, couplings, etc., shall be compression type or push-fit type, as per the particular specifications.

Compression fittings

B.13 Compression fittings shall meet the requirements of BS EN 1254-1, and BS EN 1254-2.

B.14 Compression fittings shall be made from gunmetal to BS EN 1982. The fittings shall be suitable for direct connection to polyethylene pipes. The compression ring shall be of EPDM and suitable for potable water.

B.15 The thread shall be BSP to BS EN 10226. The inserts shall be of copper and male/female fittings and shall be chamfered to aid assembly and to avoid the crossing of threads.

B.16 The fittings shall be capable of sustaining a working pressure of up to 16 bar without leakage.

B.17 The rubber compression rings shall be reusable at least 10 times.

B.18 The fittings shall be resistant to pull-out. No solvent welding shall be used in assembly.

Push-fit fittings

B.19 Push-fit fittings shall be suitable for use in underground and above-ground installations and shall be compatible with polyethylene pipes. The fitting shall consist of a body with internal taper, grip ring for end load resistance, 'O' ring for water tightness, seal and liner. The fittings shall be suitable for working pressures of up to 16 bar without leakage.

B.20 The fittings shall be of acetyl or polypropylene material, supplied complete with pre-assembled and captive grip ring and 'O' ring. The grip ring shall be made of acetyl and the 'O' ring of EPDM. The seal of the joint shall be made using water pressure as a thrust medium, and no other tools or nuts shall be used to obtain a watertight joint.

B.21 The ends of the polyethylene pipe shall be marked at two locations corresponding to the two points of resistance provided by the grip ring and the 'O' ring.

B.22 Extractor tools for the dismantling of push-fit fittings shall be supplied with the fittings. Five sets of metal extractor tools shall be supplied with each consignment. The tools shall be suitable for the diameter and type of push-fit fittings supplied.

B.23 The push-fit fittings shall carry the name of the manufacturer, size and standard number.

Saddle straps

B.24 Saddle straps for Service Connections shall be of flat-boss type suitable for tapping up to 2" diameter ferrule or equivalent. The strap shall be suitable for making Service Connections under pressure or dry, using an approved tapping machine into DI, AC, Steel or PVC pipes. The saddle shall be of two parts fitted with an EPDM sealing gasket in a groove on the underside of the flat boss.

B.25 The flat boss shall be cast with a hole or marking to facilitate the drilling and tapping process. The straps shall be supplied undrilled. If required by the Distribution Company, the saddle strap may be used as a blanking strap to seal

existing holes in the water pipelines after the removal of existing Service Connections.

B.26 The saddle strap shall be of gunmetal to BS EN 1982, with stainless steel nuts, bolts and washer to ISO 3506, and shall be suitable for a working pressure of up to 16 bar. The name of the manufacturer, patent number, pipe diameter for which the strap is suitable, and pipe material shall be engraved on the saddle strap.

Ferrules

B.27 Ferrules shall be the screw-down valve type allowing for the shut-off of the flow by means of a ½" square head spindle extending from the top cap for opening and closing. The valve shall close clockwise.

B.28 The ferrule outlet shall be a push-fit type or compression type to fit polyethylene Service Connection pipes.

B.29 The ferrule stem, banjo, spindle, inner plug and top cap shall be of gunmetal to BS EN 1982. The washers shall be of EPDM and shall provide the sealing between the outer body and the ferrule stem. The ingress of dirt shall be prohibited by a polyethylene top plug.

B.30 The ferrule shall be designed as a main stem with a 360º swivel outlet at 90º, with water flow controlled via the threaded inner plug. The inlet shall be a male taper thread to BS EN 10226.

B.31 The ferrule shall be suitable for potable water at a temperature of up to 45ºC and capable of sustaining a working pressure of up to 16 bar without leakage.

B.32 The ferrule shall permit the installation of Service Connections using under-pressure tapping through flat-boss saddle straps.

B.33 The name of the manufacturer, standard number and patent number shall be engraved on the body.

Stop Valves (medium pattern)

B.34 The Stop Valve shall be of the medium pattern type with female ends, manufactured and tested in accordance with the requirements of BS 5433. The

spindle shall be fitted with a brass crutch head. The valve shall be manufactured according to the following specifications:

B.35 The body, valve head and spindle head shall be manufactured from gunmetal to BS EN 1982.

B.36 The head works, consisting of the spindle, gland nut and washer plate, shall be manufactured from brass to BS EN 12165, and the washer plate nut from gunmetal. The following requirements also apply:

(a) The washer shall be manufactured from EPDM rubber to BS 3457.

(b) The sealing between the valve body and head shall be achieved by the provision of an EPDM rubber head seal.

(c) The packing between the spindle and the valve head shall consist of one piece of PTFE impregnated graphite aramid fiber valve packer.

(d) The Stop Valve shall withstand a working pressure of 16 bar without leakage.

(e) The valve shall close clockwise.

(f) The name of the manufacturer, patent number and flow direction shall be engraved on the body.

Gate Valve

B.37 The Gate Valve shall be of the non-rising stem type with female ends, manufactured and tested in accordance with the requirements of BS 5154 and BS EN 12288. The spindle shall be fitted with a handwheel. The valve shall be manufactured according to the following specifications.

(a) The body and valve gate/wedge shall be manufactured from gunmetal to BS EN 1982.

(b) The Gate Valve handwheel shall be made from aluminum.

(c) The Gate Valve shall withstand a working pressure of 16 bar without leakage.

(d) The valve shall close clockwise.

B.38 The name of the manufacturer, patent number and flow direction shall be engraved on the body.

Lockable ball valve

B.39 The service Water Meter, where installed in a wall-mounted GRP meter cabinet, shall be isolated by a lockable ball valve. The valve body shall be made of brass and suitable for a working pressure of up to 16 bar without leakage. Valve materials shall be as follows:

(a) valve body – brass to BS EN 12165, BS EN 12163, BS EN 12164 or BS EN 12167

(b) ball – nickel-plated brass

(c) sealing – PTFE

(d) 'O' ring – Viton

(e) retaining ring – brass.

B.40 The valve shall be suitable for water temperatures up to 45ºC. The valve ends shall be female threaded ends BSP to BS EN 10226. All valves shall be supplied with a lock and a master key. One key shall be provided for every 20 valves supplied.

B.41 The name of the manufacturer, patent number and flow direction arrow shall be engraved on the body.

Non-return valve

B.42 Non-return valves shall be of gunmetal to BS EN 1982. The valves shall be suitable for a working pressure of up to 16 bar without leakage.

B.43 The valve ends shall be female threaded ends BSP to BS EN 10226. The valves shall be suitable for horizontal and vertical upward flow installation.

B.44 The name of the manufacturer, patent number and flow direction arrow shall be engraved on the body.

B.45 Type AA Air Gaps (Air Gap with unrestricted discharge) shall comply with the requirements of BS EN 13076.

B.46 Type AB Air Gaps (Air Gap with weir overflow) shall comply with the latest version of BS EN 13077.

B.47 Type AC Air Gap (Air Gap with submerged inlet and circular overflow) shall comply with the latest version of BS EN 13078.

B.48 Type AD Air Gaps (Air Gap with injector [often known as jump jet]) shall comply with the latest version of BS EN 13079.

B.49 Type AF Air Gaps (Air Gap with circular overflow) shall comply with the latest version of BS EN 14622.

B.50 Type AG Air Gaps (Air Gap with minimum circular size overflow) shall comply with the latest version of BS EN 14623.

B.51 Single check valves shall comply with the latest version of BS EN 13959 and be either type EA or EB.

B.52 Double check valves shall comply with the latest version of BS EN 13959 and be either type EC or ED.

B.53 Type BA Devices, also known as Reduced Pressure Zone Valves (RPZ), shall comply with the latest version of BS EN 12729.

B.54 Type DB devices (pipe interrupter with vent and moving element) shall comply with the latest version of BS EN 14452.

B.55 Type DC devices (pipe interrupter with permanent atmospheric vent) shall comply with the latest version of BS EN 14453.

B.56 Type CA devices (non-verifiable disconnector with different pressure zones) shall comply with the latest version of BS EN 14367.

B.57 The types of devices and their suitable fluid categories for providing Backflow prevention are shown in Table B.1.

Table B.1 Backflow prevention arrangements and devices

Type	Description of Backflow prevention arrangements and devices	Suitable protection against fluid category	
		Back Pressure	Back Siphonage
AA	*Air Gap with unrestricted discharge*	*5*	*5*
AB	*Air Gap with weir overflow*	*5*	*5*
AC	*Air Gap with submerged inlet and circular overflow*	*3*	*3*
AD	*Air Gap with injector [often known as jump jet]*	*5*	*5*
AF	*Air Gap with circular overflow*	*4*	*4*
AG	*Air Gap with minimum circular size overflow*	*3*	*3*
EA	*Verifiable single check valve*	*2*	*2*
EB	*Non verifiable single check valve*	*2*	*2*
EC	*Verifiable double check valve*	*3*	*3*
ED	*Non verifiable double check valve*	*3*	*3*
BA	*Verifiable Backflow preventer with reduced pressure zone*	*4*	*4*
DB	*Pipe interrupter with atmospheric vent and moving element*	*-*	*4*
DC	*Pipe interrupter with permanent atmospheric vent*	*-*	*5*
CA	*Non verifiable disconnector with difference between pressure zones no greater than 10%*	*3*	*3*

Drill tap

B.58 Drill taps should be suitable for use with ductile iron water pipes, combined drill and tap with BSP thread to BS EN 10226, especially hardened, given a hardness range of 63-degree Rockwell for Talbot pressure tapping machine and for insertion of swivel balancing ferrule.

B.59 Drill bit size should be ¾" standard pattern. Cup drill and taps should be size 1 ½" BSPP-11 TPI-for Machine No 2.

Draw-off taps

B.60 Every metal-bodied or plastic-bodied tap or draining tap shall comply with the relevant requirements of BS EN 200 or BS 2879, or an approved equivalent standard.

GRP wall-mounted Water Meter cabinets

B.61 The Water Meter cabinet shall be of robust construction and made of GRP with a UV stabilizer gelcoat. The box shall have a lockable main door and a Water Meter reading/inspection door, also lockable, in order to enable meter reading

without opening the main door. A minimum of one set of master keys shall be provided for every 20 meter cabinets supplied.

B.62 The Water Meter cabinet shall be fixed to the wall using stainless steel expansion bolts of a minimum 10mm diameter, and be of the following specifications:

(a) body – high-class GRP, wall thickness 3mm

(b) size – 600 x 250 x 200mm (length x width x depth), or as instructed by the Distribution Company

(c) color – as approved by the Distribution Company prior to ordering

(d) hinges – stainless steel

(e) locking – main door: two locks with square key, Water Meter reading door: one lock with square key

(f) window – toughened clear glass (replaceable) bedded in rubber grommet

(g) text – “Water Meter” (in both Arabic and English, or as approved by the Distribution Company)

(h) accessories – each Water Meter cabinet shall be manufactured complete with the following:

(i) rubber grommet, installed in a groove surrounding the main door, in order to make the box waterproof and dustproof

(ii) two brass clamps including 8mm diameter SS bolts, nuts and washers

(iii) 4 No. 10mm diameter stainless steel expansion bolts and washers for wall fixing

(iv) vent and drain holes.

Jointing materials and compounds

B.63 Soft solder, for capillary jointing of copper or copper alloy Water Fittings, should consist of Tin/Copper (Alloy No. 23 or 24), or Tin/Silver (Alloy No.28 or 29), and comply with BS EN ISO 9453.

B.64 Silver solder or silver brazing filler metals, and copper-phosphors brazing filler metals for capillary jointing of copper or copper alloy pipes, should conform to BS EN ISO 17672, Table 2: Group AG (AG14 or AG20) or Table 3: Group CP (CP1 to CP6), respectively.

B.65 Silver solder or silver brazing material for capillary jointing of stainless-steel pipes should be cadmium-free.

B.66 Jointing compounds used for sealing screwed Water Fittings should comply with BS 6956.

B.67 Unsintered polytetrafluoroethylene (Teflon) tape (PTFE) for thread-sealing applications should comply with BS EN 751-3, and the material should also satisfy the requirements of BS 6920-1.

Annex C: References

Table C.1: Codes and Regulations used and referenced

Codes and regulations	
Code	The Water Distribution Code
Code	The Metering and Data Exchange Code
Code	Code of Practice for the Inspection and Cleaning of Customer Water Storage Tanks
Regulations	The Water Quality Regulations
Regulations	The Customer Metering Regulations
Regulations	The Water Supply Regulations
Regulations	UK Water Supply (Water Fittings) Regulations 1999

Table C.2: ISO standards used and referenced

International Organization for standardization (ISO)	
ISO 1133-1:2022	Plastics - Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics - Part 1: Standard method
ISO 1183-2:2019	Plastics - Methods for determining the density of non-cellular plastics -- Part 2: Density gradient column method
ISO 2531:2009	Ductile iron pipes, fittings, accessories and their joints for water applications
ISO 3506-1:2020	Fasteners – Mechanical properties of corrosion-resistant stainless steel fasteners - Part 1: Bolts, screws and studs with specified grades and property classes
ISO 3506-2:2020	Fasteners – Mechanical properties of corrosion-resistant stainless steel fasteners - Part 2: Nuts with specified grades and property classes
ISO 3506-3:2009	Mechanical properties of corrosion-resistant stainless steel fasteners - Part 3: Set screws and similar fasteners not under tensile stress
ISO 3506-4:2009	Mechanical properties of corrosion-resistant stainless steel fasteners - Part 4: Tapping screws
ISO 4427-1:2019	Plastics piping systems for water supply and for drainage and sewerage under pressure — Polyethylene (PE) — Part 1: General
ISO 4427-2:2019 + A1:2023	Plastics piping systems for water supply, and for drainage and sewerage under pressure — Polyethylene (PE) — Part 2: Pipes
ISO 4427-3:2019	Plastics piping systems for water supply, and for drainage and sewerage under pressure — Polyethylene (PE) — Part 3: Fittings
ISO 4427-5:2019	Plastics piping systems for water supply, and for drainage and sewerage under pressure — Polyethylene (PE) — Part 5: Fitness for purpose of the system
ISO 6259-1:2015	Thermoplastics pipes – Determination of tensile properties – Part 1: General test method
ISO 6259-2:2020	Thermoplastics pipes – Determination of tensile properties -- Part 2: Pipes made of unplasticized poly(vinyl chloride) (PVC-U), oriented unplasticized poly(vinyl chloride) (PVC-O), chlorinated poly(vinyl chloride) (PVC-C) and high-impact poly(vinyl chloride) (PVC-HI)
ISO 7005-2:1988	Metallic flanges -- Part 2: Cast iron flanges
ISO 9001:2015	Quality management systems – Requirements

ISO 11357-6:2018	Plastics – Differential scanning calorimetry (DSC) – Part 6: Determination of oxidation induction time (isothermal OIT) and oxidation induction temperature (dynamic OIT)
ISO 15875-1:2003 + A1:2007	Plastics piping systems for hot and cold water installations – Crosslinked polyethylene (PE-X) – Part 1: General
ISO 15875-2:2003 + A1:2007 + A2:2020	Plastics piping systems for hot and cold water installations – Crosslinked polyethylene (PE-X) – Part 2: Pipes
ISO 15875-3:2003 + A1:2020 + A2:2021	Plastics piping systems for hot and cold water installations – Crosslinked polyethylene (PE-X) – Part 3: Fittings
ISO 15875-5:2003 + C1:2007 + A1:2020	Plastics piping systems for hot and cold water installations – Crosslinked polyethylene (PE-X) – Part 5: Fitness for purpose of the system

Table C.3: ADWEA standards used and referenced

Abu Dhabi Water and Electricity Authority (ADWEA) standard specifications	
W-C-SS-007	Specification for Concrete Reservoirs
W-M-SS-013	Specification for GRP Bolted Tanks
W-P-SS-001	Specification for Ductile Iron Pipes, Fittings and Accessories
W-P-SS-005	Specification for High Density Polyethylene (HDPE) Pipes, Fitting and Accessories
W-I-SS-009 rev 2	Specification for Consumer Flow Meter

Table C.4: British Standards used and referenced

British Standards	
BS 1377-1:1990 (Withdrawn)	Methods of test for soils for civil engineering purposes - General requirements and sample preparation
BS 1377-2:1990 (Withdrawn)	Methods of test for soils for civil engineering purposes - Classification tests
BS 1377-3:1990 (Withdrawn)	Methods of test for soils for civil engineering purposes - Chemical and electro-chemical tests
BS 1377-4:1990 (Withdrawn)	Methods of test for soils for civil engineering purposes - Compaction-related tests
BS 1377-5:1990 (Withdrawn)	Methods of test for soils for civil engineering purposes - Compressibility, permeability and durability tests
BS 1377-6:1990 (Withdrawn)	Methods of test for soils for civil engineering purposes - Consolidation and permeability tests in hydraulic cells and with pore pressure measurement
BS 1377-7:1990 (Withdrawn)	Methods of test for soils for civil engineering purposes - Shear strength tests (total stress)
BS 1377-8:1990 (Withdrawn)	Methods of test for soils for civil engineering purposes - Shear strength tests (effective stress)
BS 1377-9:1990	Methods for test for soils for civil engineering purposes - In-situ tests
BS 2879:1980	Specification for draining taps (screw-down pattern)
BS 3457:1973 (Withdrawn)	Specification for materials for water tap and stopvalve seat washers
BS 5154:1991	Specification for copper alloy globe, globe stop and check, check and gate valves
BS 5395-3:1985 (Withdrawn)	Stairs, ladders and walkways. Code of practice for the design of industrial type stairs, permanent ladders and walkways
BS 5433:1976	Underground Stop Valves for water services
BS 5834-4:2011	Surface boxes, guards and underground chambers for the purposes of utilities. Specification for utility chambers
BS 5930:2015 + A1:2020	Code of practice for ground investigations
BS 6920-1:2014	Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water. Specification

BS 6956-5:1992	Jointing materials and compounds. Specification for jointing compounds for use with water, low pressure saturated steam, 1st family gases (excluding coal gas) and 2nd family gases
BS 7291-1:2010	Thermoplastics pipe and fitting systems for hot and cold water for domestic purposes and heating installations in buildings General requirements
BS 7291-3:2010	Thermoplastics pipe and fitting systems for hot and cold water for domestic purposes and heating installations in buildings. Specification for crosslinked polyethylene (PE-X) pipes and associated fittings
BS 8558:2015	Guide to the design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. Complementary guidance to BS EN 806
BS EN 124-1:2015	Gully tops and manhole tops for vehicular and pedestrian areas - Definitions, classification, general principles of design, performance requirements and test methods
BS EN 124-2:2015	Gully tops and manhole tops for vehicular and pedestrian areas - Gully tops and manhole tops made of cast iron
BS EN 200:2008	Sanitary tapware. Single taps and combination taps for water supply systems of type 1 and type 2. General technical specification
BS EN 751-3:2022	Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water. Unsintered PTFE tapes and PTFE strings
BS EN 805:2000	Water supply. Requirements for systems and components outside buildings
BS EN 806-1:2000	Specifications for installations inside buildings conveying water for human consumption. General
BS EN 806-2:2005	Specifications for installations inside buildings conveying water for human consumption. Design
BS EN 806-3:2006	Specifications for installations inside buildings conveying water for human consumption. Pipe sizing. Simplified method
BS EN 806-4:2010	Specifications for installations inside buildings conveying water for human consumption. Installation
BS EN 806-5:2012	Specifications for installations inside buildings conveying water for human consumption. Operation and maintenance
BS EN 1057:2006 + A1:2010	Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications
BS EN 1092-1+A1:2018	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Steel flanges
BS EN 1092-2:1997	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Cast iron flanges
BS EN 1254-1:2021	Copper and copper alloys. Plumbing fittings - Capillary fittings for soldering or brazing to copper tubes
BS EN 1254-2:2021	Copper and copper alloys. Plumbing fittings - Compression fittings for use with copper tubes
BS EN 1852-1:2018 + A1:2022	Plastics piping systems for non-pressure underground drainage and sewerage. Polypropylene (PP) – Specifications for pipes, fittings and the system
BS EN 1982:2017	Copper and copper alloys. Ingots and castings
BS EN 1992-3:2006	Eurocode 2. Design of concrete structures. Liquid retaining and containing structures
BS EN 1997-1:2004 + A1:2013	Eurocode 7. Geotechnical design - General rules
BS EN 1997-2:2007	Eurocode 7. Geotechnical design - Ground investigation and testing
BS EN 10226-1:2004	Pipe threads where pressure tight joints are made on the threads. Taper external threads and parallel internal threads. Dimensions, tolerances and designation
BS EN 10226-2:2005	Pipe threads where pressure tight joints are made on the threads. Taper external threads and taper internal threads. Dimensions, tolerances and designation
BS EN 12163:2016	Copper and copper alloys. Rod for general purposes

BS EN 12164:2016	Copper and copper alloys. Rod for free machining purposes
BS EN 12165:2016	Copper and copper alloys. Wrought and unwrought forging stock
BS EN 12167:2016	Copper and copper alloys. Profiles and bars for general purposes
BS EN 12201-1:2011	Plastics piping systems for water supply, and for drainage and sewerage under pressure. Polyethylene (PE). General
BS EN 12201-2:2011 + A1:2013	Plastics piping systems for water supply, and for drainage and sewerage under pressure. Polyethylene (PE). Pipes
BS EN 12201-3:2011 + A1:2012	Plastics piping systems for water supply, and for drainage and sewerage under pressure. Polyethylene (PE). Fittings
BS EN 12201-5:2011	Plastics piping systems for water supply, and for drainage and sewerage under pressure. Polyethylene (PE). Fitness for purpose of the system
BS EN 12288:2010	Industrial valves. Copper alloy gate valves
BS EN 12620:2002 + A1:2008	Aggregates for concrete
BS EN 12729:2023	Devices to prevent pollution by backflow of potable water. Controllable backflow preventer with reduced pressure zone. Family B. Type A
BS EN 13076:2003	Devices to prevent pollution by backflow of potable water. Unrestricted Air Gap. Family A. Type A
BS EN 13077:2023	Devices to prevent pollution by backflow of potable water. Air Gap with non-circular overflow (unrestricted). Family A. Type B
BS EN 13078:2003	Devices to prevent pollution by backflow of potable water. Air Gap with submerged feed incorporating air inlet plus overflow. Family A, type C
BS EN 13079:2003	Devices to prevent pollution by backflow of potable water. Air Gap with injector. Family A. Type D
BS EN 13101:2002	Steps for underground man entry chambers. Requirements, marking, testing and evaluation of conformity
BS EN 13959:2004	Anti-pollution check valves. DN 6 to DN 250 inclusive Family E, type A, B, C, and D
BS EN 14367:2005	Non controllable backflow preventer with different pressure zones. Family C, type A
BS EN 14452:2005	Devices to prevent pollution by backflow of potable water. Pipe interrupter with atmospheric vent and moving element DN 10 to DN 20. Family D, type B
BS EN 14453:2005	Devices to prevent pollution by backflow of potable water. Pipe interrupter with permanent atmospheric vent DN 10 to DN 20. Family D, type C
BS EN 14622:2005	Devices to prevent pollution by backflow of potable water. Air Gap with circular overflow (restricted). Family A, type F
BS EN 14623:2005	Devices to prevent pollution by backflow of potable water. Air Gaps with minimum circular overflow (verified by test or measurement). Family A, type G
BS EN ISO 9453:2020	Soft solder alloys. Chemical compositions and forms
BS EN ISO 14688-1:2018	Geotechnical investigation and testing. Identification and classification of soil - Identification and description
BS EN ISO 14688-2:2018	Geotechnical investigation and testing. Identification and classification of soil - Principles for a classification
BS EN ISO 14689-1:2003 (Withdrawn)	Geotechnical investigation and testing. Identification and classification of rock. - Identification and description
BS EN ISO 15874-1:2013 + A1:2022	Plastics piping systems for hot and cold water installations. Polypropylene (PP) – General
BS EN ISO 15874-2:2013 + A2:2022	Plastics piping systems for hot and cold water installations. Polypropylene (PP) – Pipes
BS EN ISO 15874-3:2013 + A2:2021	Plastics piping systems for hot and cold water installations. Polypropylene (PP) – Fittings
BS EN ISO 15874-5:2013 + A1:2018	Plastics piping systems for hot and cold water installations. Polypropylene (PP) – Fitness for purpose of the system
BS EN ISO 17672:2016	Brazing. Filler metals

BS EN ISO 17892-1:2014 + A1:2022	Geotechnical investigation and testing. Laboratory testing of soil - Determination of water content
BS EN ISO 17892-2:2014	Geotechnical investigation and testing. Laboratory testing of soil - Determination of bulk density
BS EN ISO 17892-3:2015	Geotechnical investigation and testing. Laboratory testing of soil - Determination of particle density
BS EN ISO 17892-4:2016	Geotechnical investigation and testing. Laboratory testing of soil - Determination of particle size distribution
BS EN ISO 17892-5:2017	Geotechnical investigation and testing. Laboratory testing of soil - Incremental loading oedometer test
BS EN ISO 17892-6:2017	Geotechnical investigation and testing. Laboratory testing of soil - Fall cone test
BS EN ISO 17892-7:2018	Geotechnical investigation and testing. Laboratory testing of soil - Unconfined compression test
BS EN ISO 17892-8:2018	Geotechnical investigation and testing. Laboratory testing of soil - Unconsolidated undrained triaxial test
BS EN ISO 17892-9:2018	Geotechnical investigation and testing. Laboratory testing of soil - Consolidated triaxial compression tests on water saturated soils
BS EN ISO 17892-10:2018	Geotechnical investigation and testing. Laboratory testing of soil - Direct shear tests
BS EN ISO 17892-11:2019	Geotechnical investigation and testing. Laboratory testing of soil - Permeability tests
BS EN ISO 17892-12:2018 + A2:2022	Geotechnical investigation and testing. Laboratory testing of soil - Determination of liquid and plastic limits
BS EN ISO 22475-1:2021	Geotechnical investigation and testing. Sampling methods and groundwater measurements - Technical principles for the sampling of soil, rock and groundwater
BS EN ISO 22475-2:2011	Geotechnical investigation and testing - Sampling methods and groundwater measurements - Part 2: Qualification criteria for enterprises and personnel.
BS EN ISO 22475-3:2011	Geotechnical investigation and testing sampling methods and groundwater measurements Part 3 - Conformity assessment of enterprises and personnel by third party
BS EN ISO 22476-1:2013	Geotechnical investigation and testing. Field testing - Electrical cone and piezocone penetration test
BS EN ISO 22476-2:2005 + A1:2011	Geotechnical investigation and testing. Field testing - Dynamic probing
BS EN ISO 22476-3:2005 + A1:2011	Geotechnical investigation and testing. Field testing - Standard penetration test
BS EN ISO 22476-4:2021	Geotechnical investigation and testing. Field testing - Prebored pressuremeter test by Ménard procedure
BS EN ISO 22476-5:2023	Geotechnical investigation and testing. Field testing - Prebored pressuremeter test
BS EN ISO 22476-6:2018	Geotechnical investigation and testing. Field testing - Self-boring pressuremeter test
BS EN ISO 22476-7:2012	Geotechnical investigation and testing. Field testing - Borehole jack test
BS EN ISO 22476-8:2018	Geotechnical investigation and testing. Field testing - Full displacement pressuremeter test
BS EN ISO 22476-9:2020	Geotechnical investigation and testing. Field testing - Field vane test (FVT and FVT-F)
BS EN ISO 22476-10:2017	Geotechnical Investigation and testing. Field testing - Weight sounding test
BS EN ISO 22476-11:2017	Geotechnical investigation and testing. Field testing - Flat dilatometer test
BS EN ISO 22476-12:2009	Geotechnical investigation and testing. Field testing - Mechanical cone penetration test (CPTM)
BS EN ISO 22282-1:2012	Geotechnical investigation and testing. Geohydraulic testing - General rules
BS EN ISO 22282-2:2012	Geotechnical investigation and testing. Geohydraulic testing - Water permeability tests in a borehole using open systems

BS EN ISO 22282-3:2012	Geotechnical investigation and testing. Geohydraulic testing - Water pressure tests in rock
BS EN ISO 22282-4:2021	Geotechnical investigation and testing. Geohydraulic testing - Pumping tests
BS EN ISO 22282-5:2012	Geotechnical investigation and testing. Geohydraulic testing - Infiltrometer tests
BS EN ISO 22282-6:2012	Geotechnical investigation and testing. Geohydraulic testing - Water permeability tests in a borehole using closed systems

Table C.5: ASTM Standards used and referenced

ASTM International Standards	
ASTM D5777-18	Standard Guide for Using the Seismic Refraction Method for Subsurface Investigation
ASTM F876-23	Standard Specification for Crosslinked Polyethylene (PEX) Tubing
ASTM F877-23	Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems
ASTM F2023-21	Standard Test Method for Evaluating the Oxidative Resistance of Crosslinked Polyethylene (PEX) Pipe, Tubing and Systems to Hot Chlorinated Water
ASTM F2657-21	Standard Test Method for Outdoor Weathering Exposure of Crosslinked Polyethylene (PEX) Tubing

Table C.6: AWWA Standards used and referenced

American Water Works Association (AWWA) Standards	
AWWA C904-22	Crosslinked Polyethylene (PEX) Pressure Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm) for Water Service

Annex D

Annex D1 Typical arrangement for small-size connections up to 25mm in diameter

Typical arrangement for small-size connections up to 25mm in diameter such as villa, shabiat or other similar Low-rise Premises, from the main distribution pipe to Customer Premises with Ground Storage Tank and bypass arrangements (inadequate pressure).

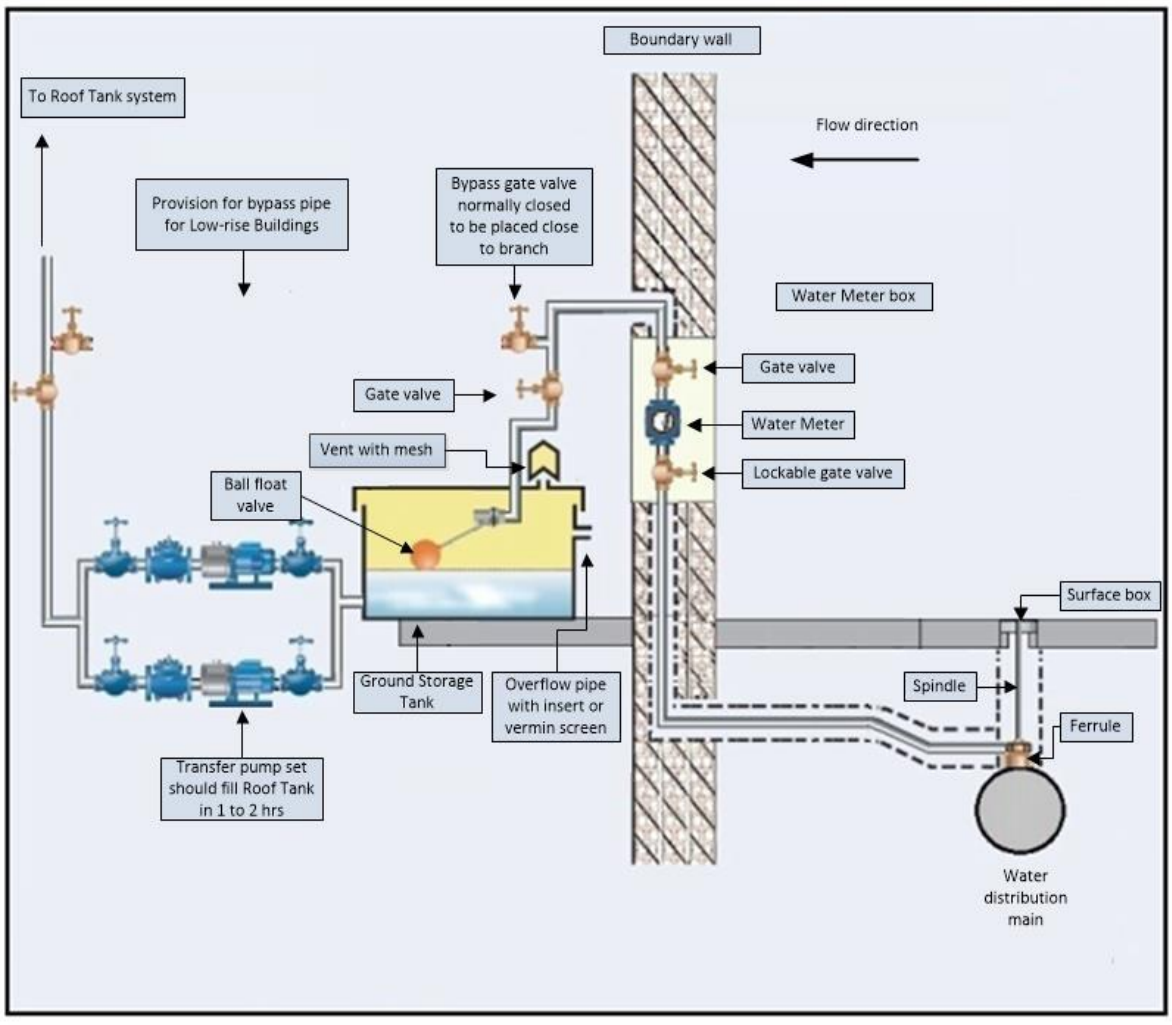

Figure D.1: Typical arrangement for small-size connections up to 25mm in diameter

The above drawing is for illustration purposes only. All drawings shall be submitted in accordance with Annex A of this Guide complete with all details. It should be noted that this part of the system shall comply with Distribution Company specific arrangements.

Annex D2 Typical Service Connection arrangement for water connection of 40 mm and 50 mm from the main distribution pipe to a Customer Low-rise Premise with Ground Storage Tank and bypass arrangement (Inadequate Pressure)

Typical connection arrangement for water Service Connection of 40mm and 50mm from the main distribution pipe to a Customer Low-rise Premises with Ground Storage Tank and bypass.

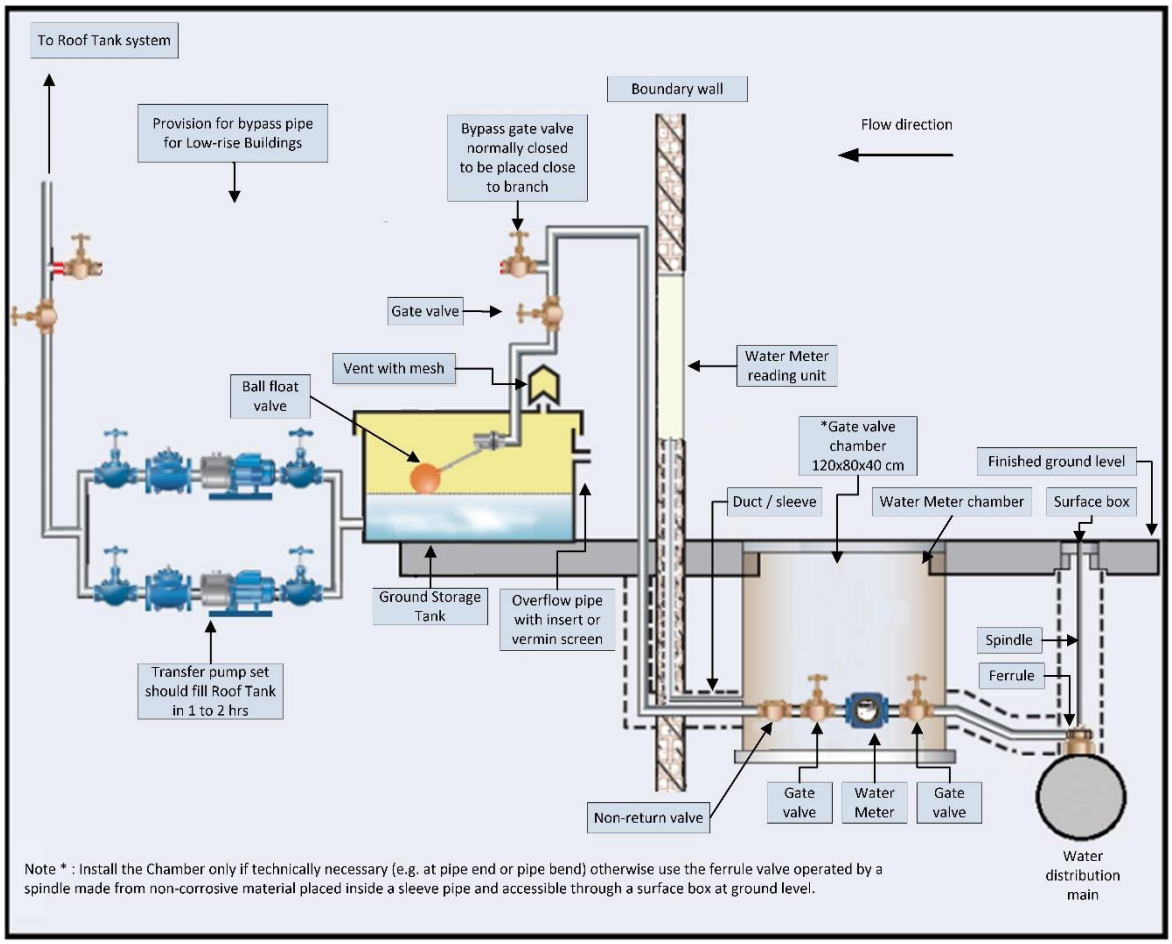

Figure D.2: A Typical Service Connection arrangement a main distribution pipe to a Customer Low-rise Premise with Ground Storage Tank and bypass

The above drawing is for illustration purposes only. All drawings shall be submitted in accordance with Annex A of this Guide complete with all details. It should be noted that this part of the system shall comply with Distribution Company specific arrangements.

Annex D3 A typical connection arrangement for a water Service Connection larger than 50mm (Bulk Connection)

Typical connection arrangement for water Service Connection larger than 50mm (2") (Bulk Connection).

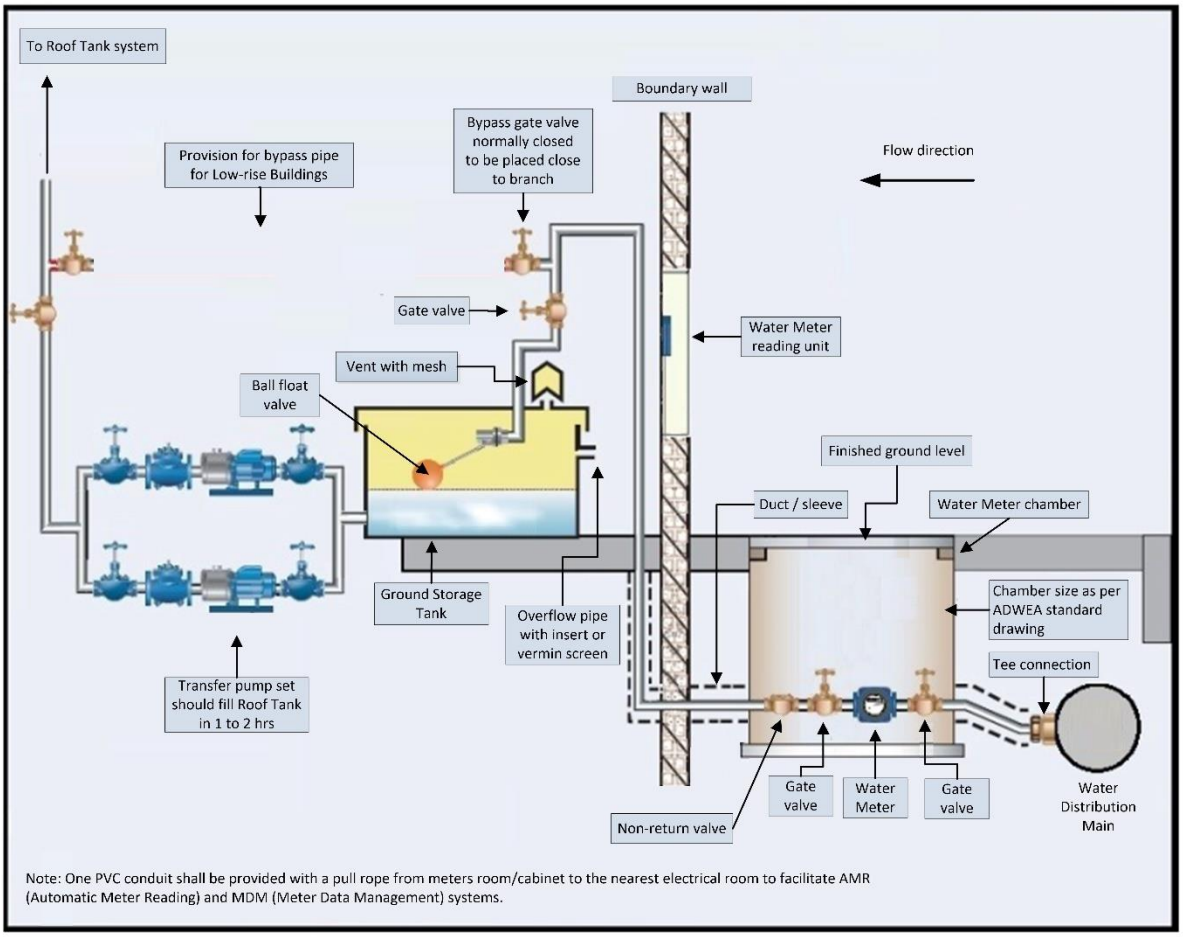

Figure D.3: A typical connection arrangement for a water Service Connection larger than 50mm

The above drawing is for illustration purposes only. All drawings shall be submitted in accordance with Annex A of this Guide complete with all details. It should be noted that this part of the system shall comply with Distribution Company specific arrangements.

Annex D4 Typical connection arrangements between Ground and Roof Tanks in Low-rise and High-rise Buildings

Typical connection arrangements between Ground and Roof Tanks in Low-rise and High-rise Buildings.

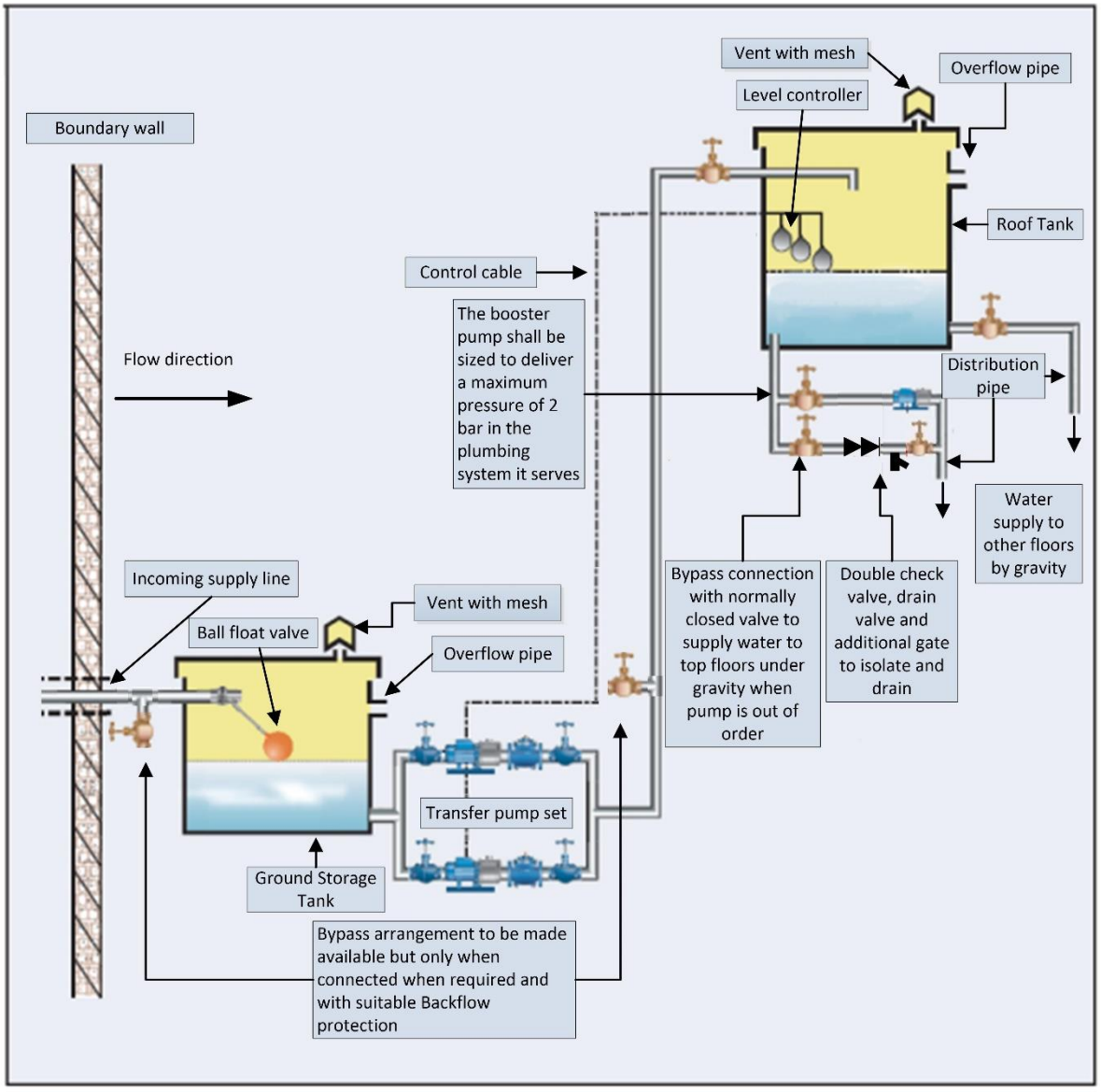

Figure D.4: Typical connection arrangements between Ground and Roof Tanks in Low-rise and High-rise Buildings

The above drawing is for illustration purposes only. All drawings shall be submitted in accordance with Annex A of this Guide complete with all details. It should be noted that this part of the system shall comply with Distribution Company specific arrangements.

Annex D5 A typical connection arrangement for various connection sizes to a Low-rise Building (single occupancy)

Typical connection arrangement for various connection sizes from the main distribution pipe to a Low-rise Building of single occupancy (metered externally) provided there is Adequate Network Pressure.

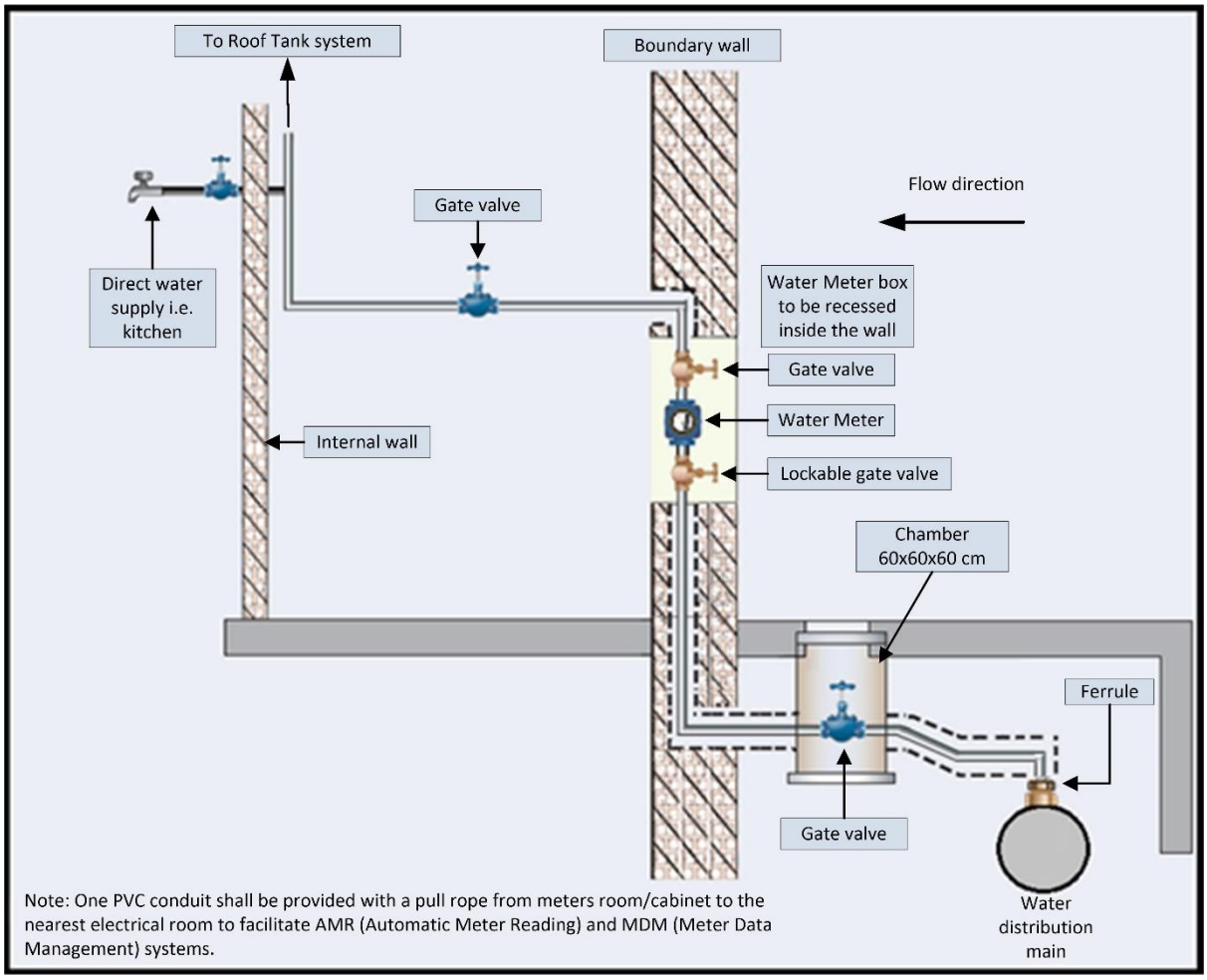

Figure D.5: A typical connection arrangement for various connection sizes to a Low-rise Building (single occupancy)

The above drawing is for illustration purposes only. All drawings shall be submitted in accordance with Annex A of this Guide complete with all details. It should be noted that this part of the system shall comply with Distribution Company specific arrangements.

Annex D6 A typical internal connection arrangement for a High-rise Building

Typical internal connection arrangement for a High-rise Building (metered internally).

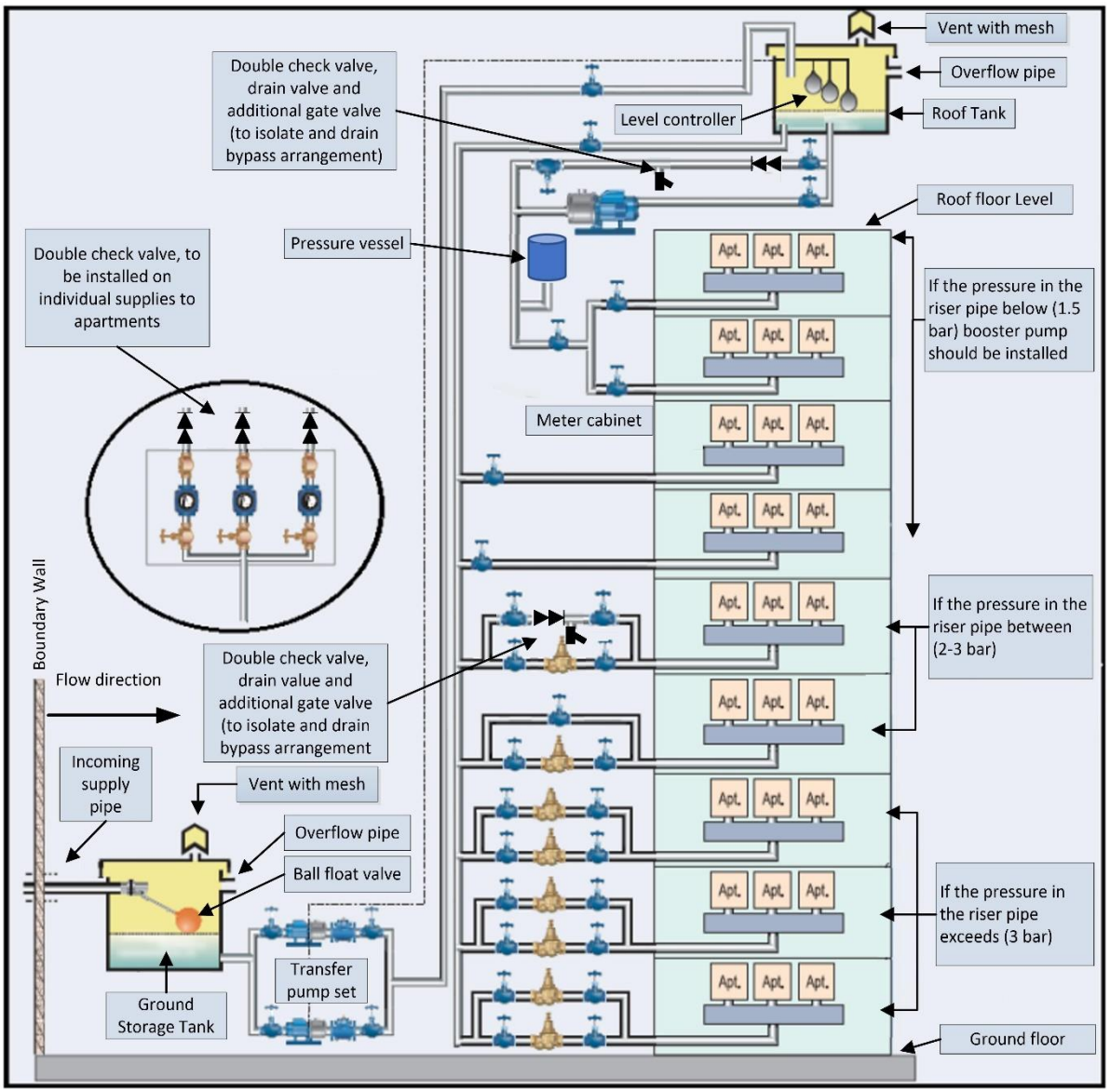

Figure D.6: A typical internal connection arrangement for a High-rise Building

The above drawing is for illustration purposes only. All drawings shall be submitted in accordance with Annex A of this Guide complete with all details. It should be noted that this part of the system shall comply with Distribution Company specific arrangements.

Annex D7 A typical connection arrangement for applications such as hotels and hospitals

Typical connection arrangement for certain applications such as hotels and hospitals (metered externally).

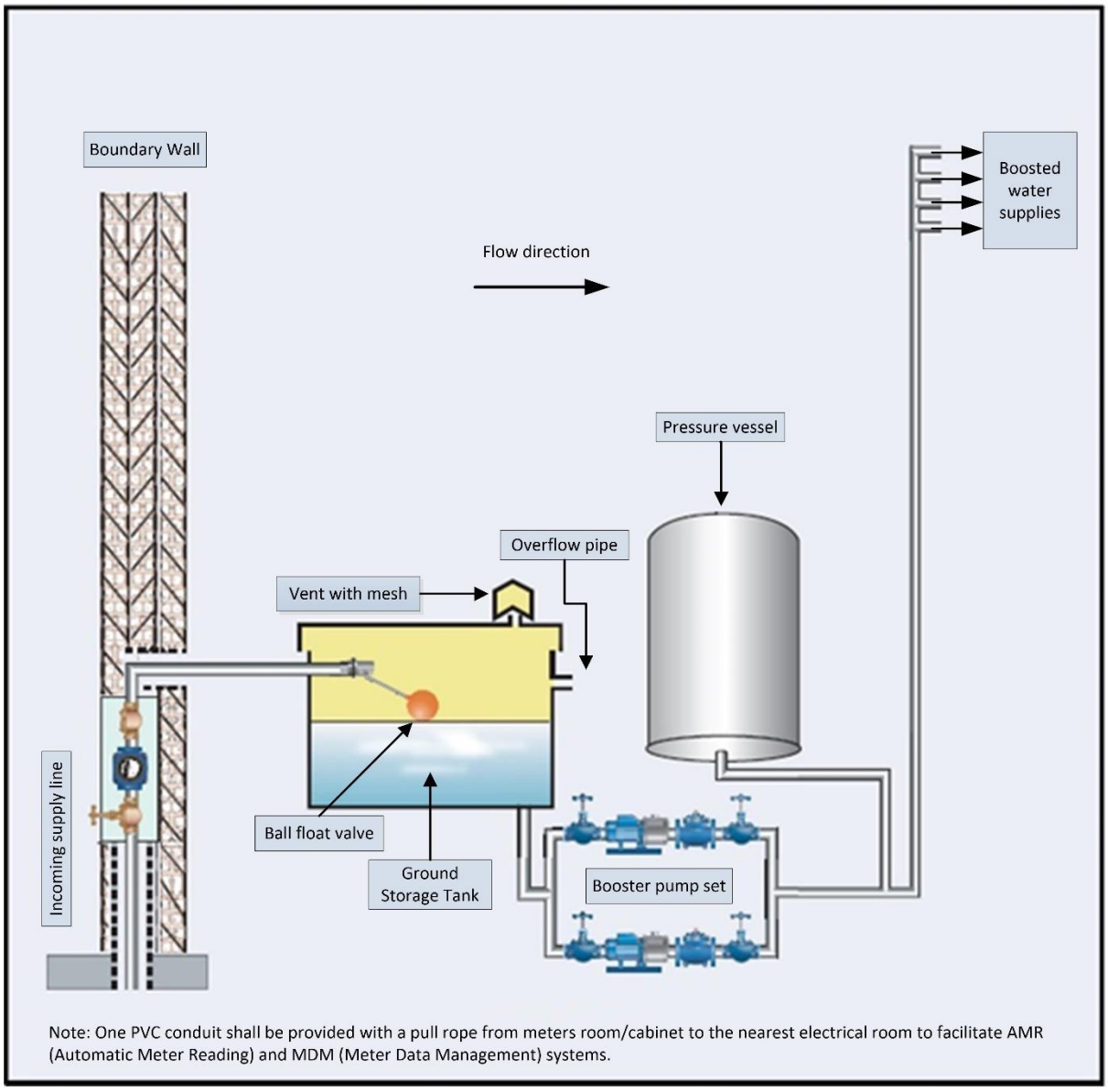

Figure D.7: A typical connection arrangement for applications such as hotels and hospitals

The above drawing is for illustration purposes only. All drawings shall be submitted in accordance with Annex A of this Guide complete with all details. It should be noted that this part of the system shall comply with Distribution Company specific arrangements. Metering for building services and shops shall be in accordance with the approved floor plan.

The valves layout in meter cabinet shall be fitted with pressure-reducing valve where applicable and the valve cabinet location may change subject to the Distribution Company's approval.

Annex D8 Example of a prohibited connection arrangement

Prohibited connection arrangement: the installation of an on-line pump that draws water directly or indirectly from the main distribution pipeline.

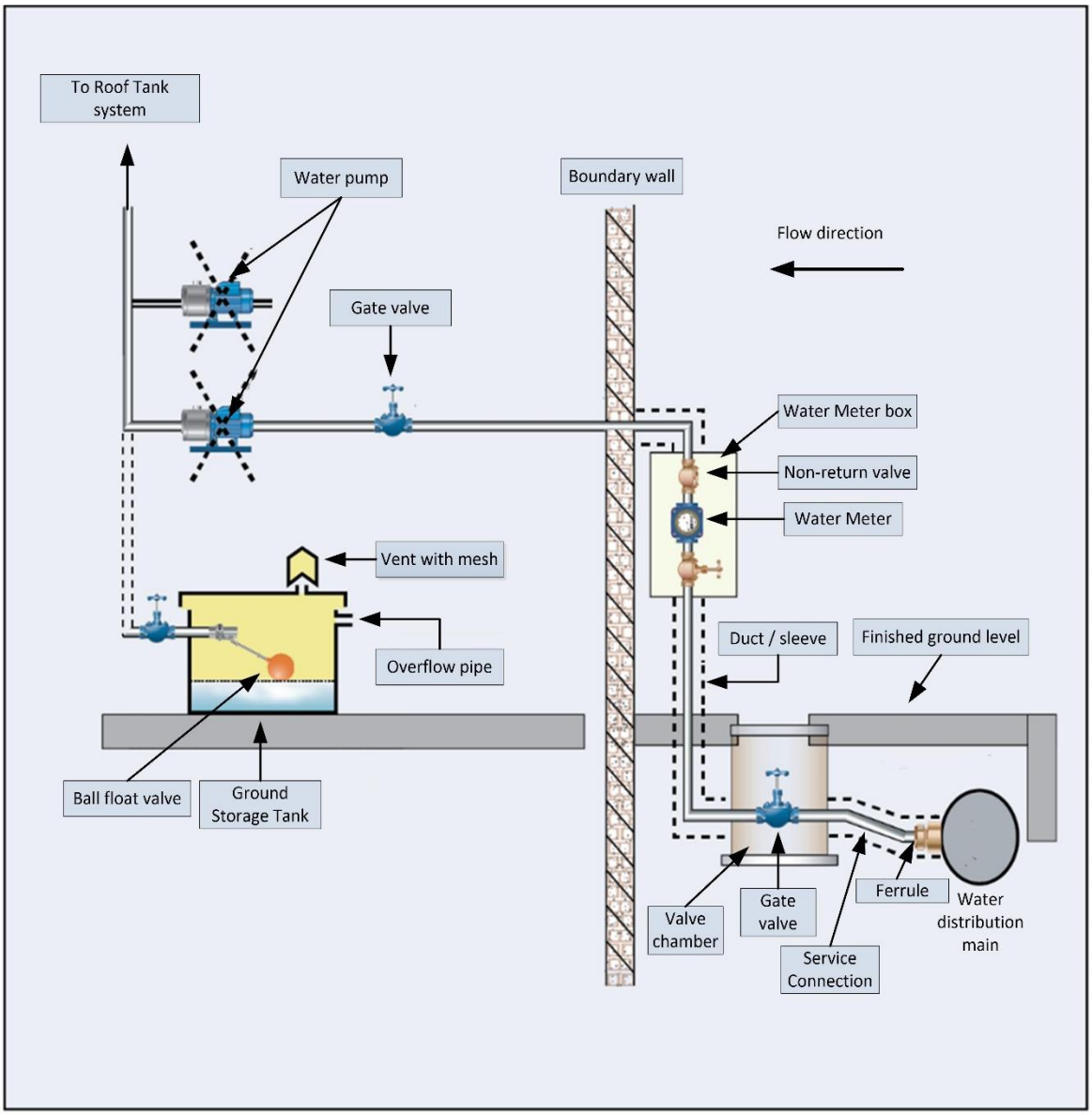

Figure D.8: Example of a prohibited connection arrangement

The above drawing is for illustration purposes only. It demonstrates that pumps installed for the purpose of drawing water from the main distribution pipe are not allowed and are considered contrary to the Regulations.

Annex D9 A typical Roof/Ground Storage Tank connection arrangement

Typical Roof/Ground Storage Tank connection arrangement.

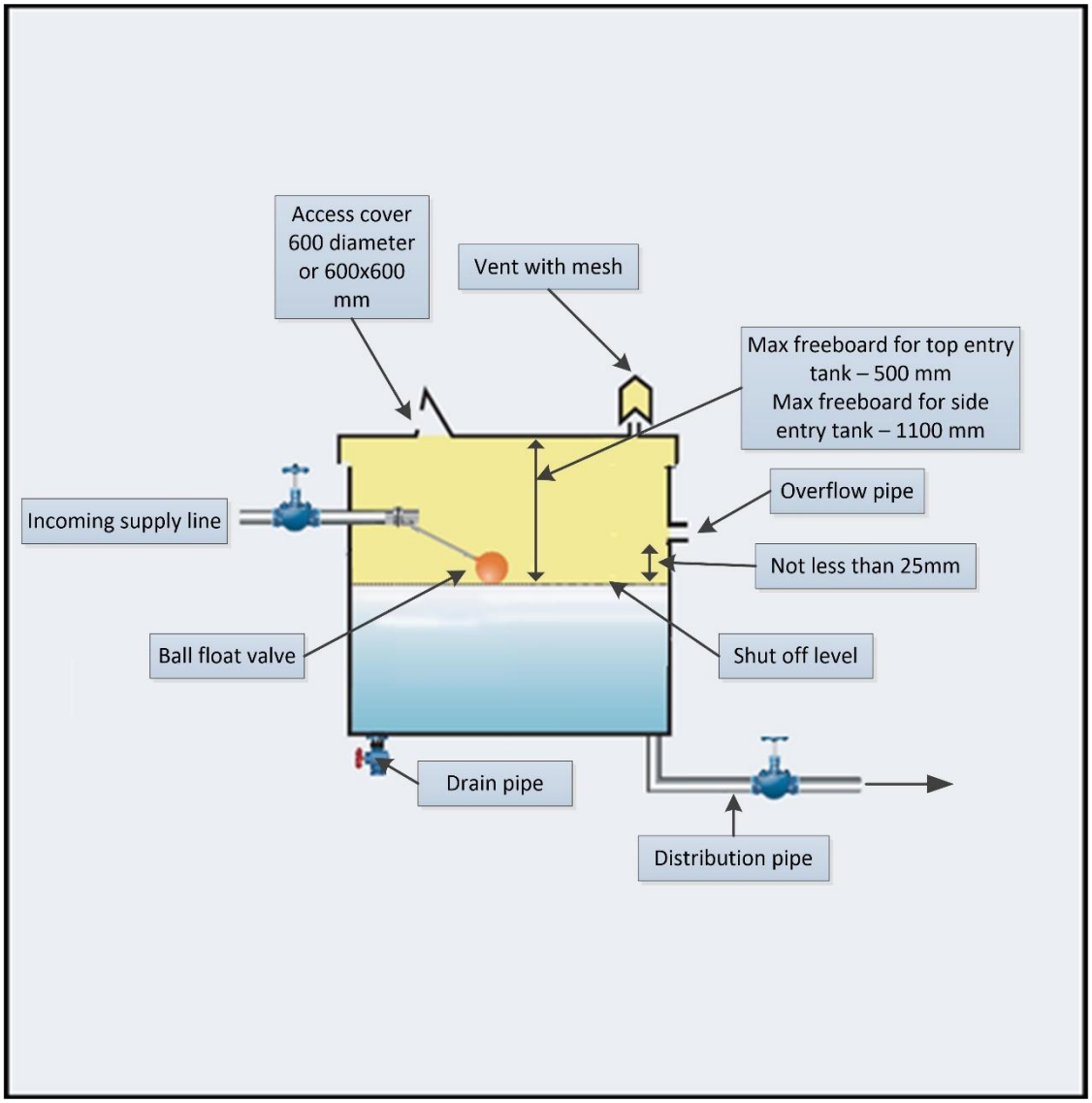

Figure D.9: A typical Roof/Ground Storage Tank connection arrangement

The above drawing is for illustration purposes only. General requirements for tank connection, fittings and accessories are dependent on the tank location, volume, height and material of construction as prescribed in this Guide. However, the standard requirements for a tank are that it should be provided with a flow-control device (float-operated valve), an Overflow Pipe, access/an access cover, service valves, a vent and drain connection (as necessary).

The Air Gap between the shut-off level and Overflow Pipe can vary according to the overflow control device and the end use of the water.

Annex D10 A typical underground tank installation arrangement

Typical underground tank installation arrangement.

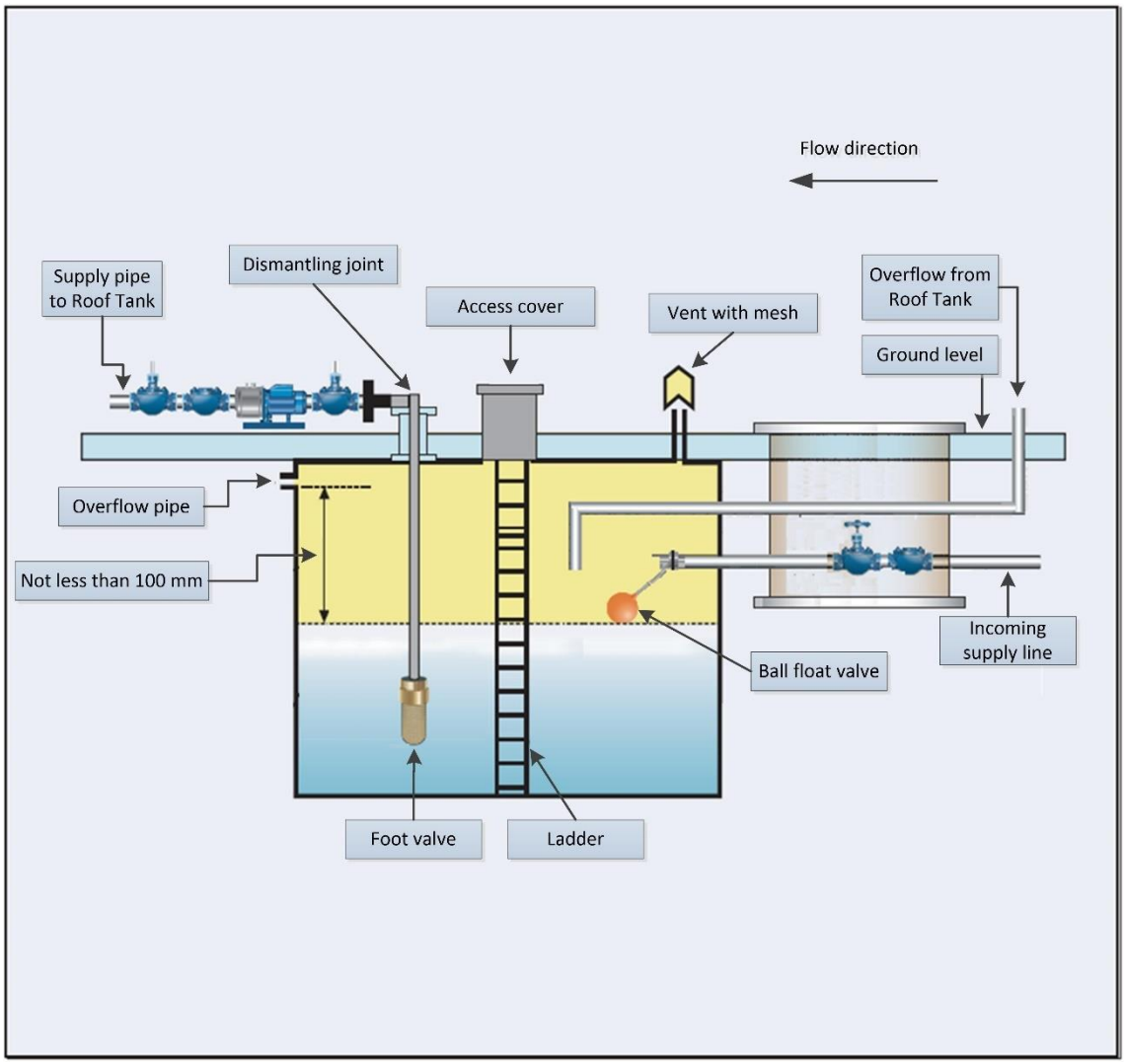

Figure D.10 A typical underground tank installation arrangement

The above diagram is for illustration purposes only. Underground tanks are only permitted in basements or in purpose built underground pump rooms upon approval of the Distribution Company.

Overflow arrangements shall be made to ensure no water returns to the tank after an overflow. A suitable Backflow prevention arrangement shall be considered. A suction pipe connected to the foot valve should be fitted in such a way that it can be assembled, dismantled and removed without the need to drain the tank for future maintenance and replacement works.

Annex D11 A typical connection arrangement for a Water Tanker filling station

Typical connection arrangement for a Water Tanker filling station together with Water Tanker main features.

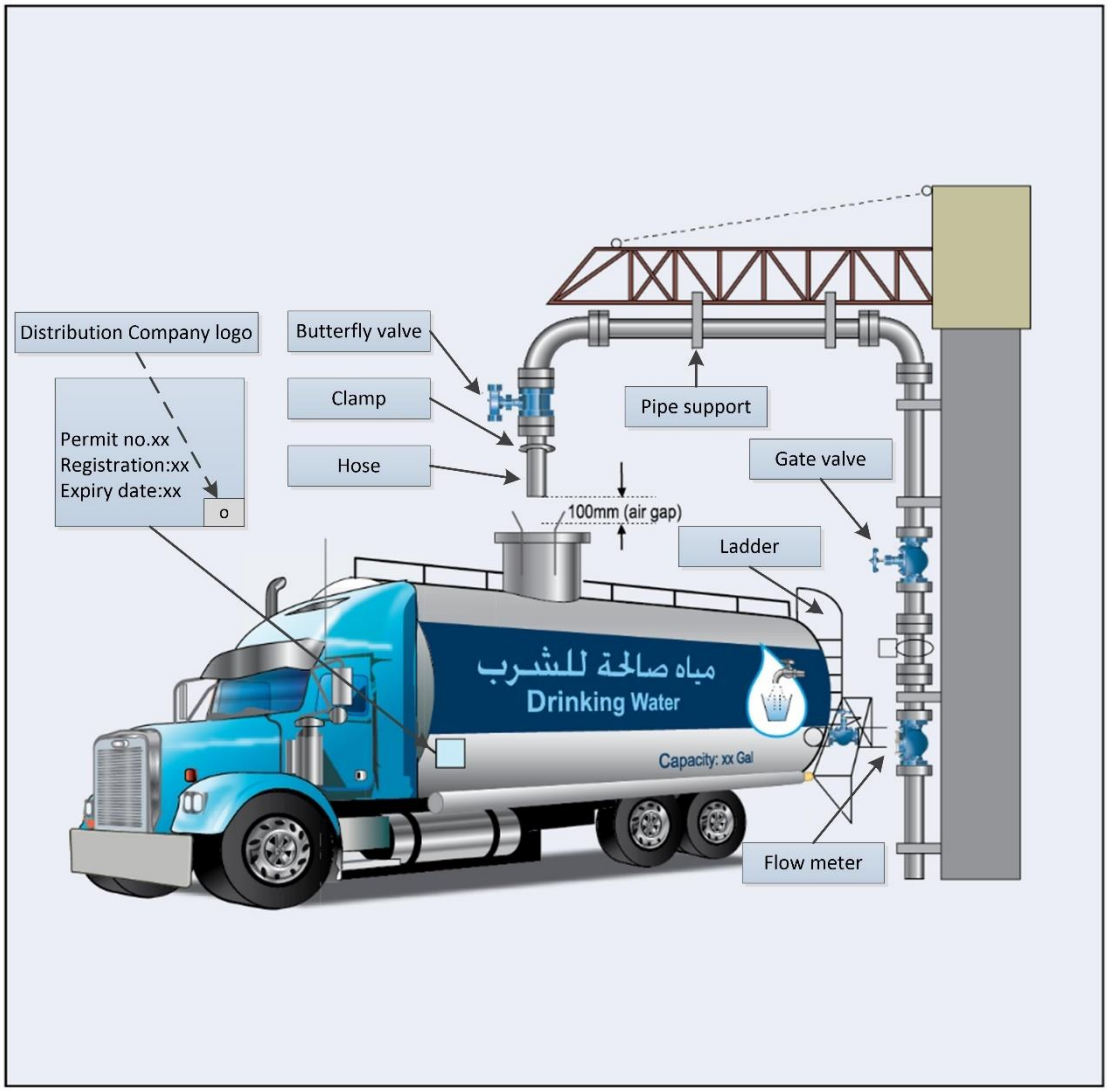

Figure D.11: A typical connection arrangement for a Water Tanker filling station

The above diagram is for illustration purposes only. All potable water tankers must comply with the relevant clauses of the Water Supply, Tankering and Water Quality Regulations, in addition to the Distribution Company's own requirements.

The main requirements are:

(i) The tanker information sticker/label must have all the required details clearly written on it on both sides.

(ii) All connection accessories must be kept in a closed cabinet along with the filling hose.

(iii) An Air Gap must be allowed for during the filling process.