GHANA WATER COMPANY LTD

Standard Operating Procedure For Distribution Operations

October, 2023

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MANAGING DIRECTOR'S MESSAGE

Organisations function well when there are laid-down processes and procedures to regulate how work is professionally done. I have travelled to, and interacted with staff of all the regions since I assumed the leadership of this company in 2017. Feedback from our hardworking technical staff, and direct experiences from such trips inspired me to constitute a Technical Advisory Committee (TAC) to develop a Standard Operating Procedure (SOP) for how we operate and manage the company's Water Distribution System to achieve excellent service delivery.

We recognize that this maiden edition of the SOP may not be exhaustive in tackling all the processes in Water Distribution activities; but its application would yield significantly higher degree of improved work processes than the current vacuum it seeks to fill. We hope it would grow through future reviews to accommodate new global best practices to make it relevant to the core mandate of the company. I urge all Regions and Districts to make this Distribution SOP their reference Manual for all related tasks and duties.

Finally, Ghana Water Limited is grateful for the tireless efforts that the TAC put into developing this pivotal document for the Operations and Maintenance Department.

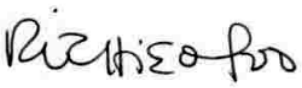
Ing. Dr. Clifford A. Braimah
Managing Director

PREFACE

A Standard Operating Procedure (SOP) for Water Distribution provides guidelines for managing tasks related to the operations of Water Distribution System in Ghana. This first edition contains globally recognized practices. As with other professions, the Procedures and knowledge contained in this document have been distilled from recognized good practices of Water Supply Engineers who have contributed to the development of this SOP.

The first two chapters talk about Bursts and Leakages which form major part of failures on the field. The subsequent chapters deal with ground conditioning for proper pipe settlement and protection. Readers will find, all the other chapters, seamlessly take one through keeping the quality of water safe, while handling field tasks to valve management. Also tackled in sub-chapters, is the New Service Connection. Job order forms have been added at the end of the document to serve as a standard for all field work related to Water Distribution. It is recommended that all Distribution staff are trained to use it as soon as possible.

At the time of writing this edition, globally, water supply engineering has witnessed the introduction of complex computer systems and advanced machine learning tools (with embedded intelligence) into hitherto pneumatic controlled systems. Even though we know about the evolution of such knowledge, we are yet to fully make such transition, except in the field of metering and pressure logging. We deliberately left out the role of intelligent agents in Water Distribution system Operations to allow this document to be practically relevant to our current routines while we hope that future revisions will recognize the burgeoning demand of Artificial Intelligence in Water Distribution Systems. Climate Change related processes on our Distribution system were also taken out because we have exhaustively tackled it in a document called Climate Resilience in Existing and Planned Projects.



Richard Appiah Otoo
Chief Manager,
Operations and Maintenance

INTRODUCTION

As the sole company mandated to provide water services to urban communities in Ghana, the Ghana Water Company Limited (GWCL) is committed to providing safe and reliable water to all customers. This is in line with the United Nations Sustainable Development Goal (SDG) 6, which aims to ensure availability and sustainable management of water and sanitation for all. To achieve this goal, Ghana Water Company Limited (GWCL) is implementing international best practices for Water Production and Distribution Operations, including water treatment, plant and equipment maintenance, transmission and distribution of potable water to customers. This document details standard operating procedures (SOPs) for GWCL's water distribution operations. The SOPs covers the following key sections:

Repair of Bursts and Leakages

This section outlines the procedures for repairing a burst on a pipeline, including any necessary flushing, disinfection, and testing to be carried out before the pipeline is put back into service.

Pipe Laying Works:

This section details the procedures for pipelaying applicable to mains extensions, replacement and reinforcement works

Flushing of Pipelines

This section details the procedures to follow for pipeline flushing after maintenance works, repair works and extension of pipe mains.

Operating Procedures for Valves, Air Valves & Fire Hydrants

This section details the procedures to follow when siting locations to install gate valves, air valves and fire hydrants. The section details procedures to follow for installation, operation and maintenance of these valves and fire hydrants.

Operating Procedures for Water Meter Installations

This section details the procedures and guidelines to follow when installing mechanical, ultrasonic and electro-magnetic meters of varying pipe sizes.

New Service Connections

This section outlines the processes that prospective clients must follow to obtain a New Service Connection (NSC) and appropriate installation procedures to effect a connection

BURSTS AND LEAKAGES

Bursts And Leakages

The purpose of this SOP is to outline the procedures for repairing a burst pipe, including any necessary flushing, disinfection, and testing to be followed before pipeline is put back into service.

Types Of Bursts And Leaks

- Leakage/burst on transmission and distribution mains.
- Leakage and overflows at utility storage tanks and reservoirs.
- Leakage/burst on service connections up to a customer water meter.
- Leaks/burst on fittings and appurtenances (i.e., gate valves, air valves, hydrants etc.)

Causes Of Bursts And Leaks

- Aged pipes
- Poor network design
- Ground and soil movement
- Corrosion
- Water hammer
- Improper backfilling
- High system pressures
- Poor workmanship
- Vandalism
- Construction activities
- Poorly maintained appurtenances

General Procedure

The following procedure shall be followed to repair a burst pipe:
1. Rapid response and Mapping
2. Mobilization to site
3. Detection of pipe failure: Inspection of the site
4. Notification of interruption in water supply and related issues
5. Site preparation
6. Repair work: Selecting the appropriate method and materials for repair
7. Testing
8. Completion

Rapid response

Dispatch rapid response team to the location of the burst or leakage and apply the following actions.
a) Map the burst/leak.
b) Repair the burst/leak if possible, based on extent of damage and map after completion or,
c) If 2.4.1 (b) is not achieved, isolate the pipeline and report to the district distribution officer for mobilization and repair works.

Mobilization

If the rapid response team is unable to repair the burst/leak, the following procedures shall be followed.

Mobilization Of Distribution Team

Assign the distribution team the following duties:
- Arrange for transport, materials, machinery, equipment, tools, etc.
- Locate the defective pipe section.
- Ensure pipeline is properly Isolated.
- Other activities (e.g., site clearing).

Notify Regional Management

Assign the distribution team the following duties:
- Inform regional management of the burst/leak on critical pipelines.
- Seek permission from the appropriate Authorities to carry out repair works in sensitive areas.

Alternative supply arrangement

Assign the distribution team the following duties:
- Provide alternative means of water supply to affected area if repair works will exceed 24 hours.

Coordination with Production Stations

For major pipelines, notify production team at Headworks and Booster Stations etc. of the planned repair works.

Requirements for Repair Works

The selection of appropriate items for repair work are situation specific and depends on the underlisted factors:
1. The function of the affected pipeline in the network.
2. Size and material of the affected pipe.
3. Depth of the pipeline.
4. Subsoil water table.
5. Other unforeseen factors.

Notification Customers

Collaborate with the Communications Department to notify affected customers and other stakeholders (i.e., Telecommunication Companies, Road agencies, Metropolitan, Municipal and District Assemblies (MMDA's) etc.) via official and unofficial communication means.

The notification shall include:
- Time of interruption to water supply and affected areas.
- A brief and simple reason for the interruption in water supply.

• Estimated time of completion of repair works and restoration of water supply.
• Contact information of the District/ Region to provide clarification.
• Advice on water conservation, flushing, etc.

Site Preparation

Location of the failure
Maps, in-house expertise and appropriate technology shall be employed to determine the exact location of burst/leak.

Site Protection
Properly secure the site using road barriers, road signs and carry out traffic diversion measures in accordance with GWCL Health and Safety Manual.

Excavation
• Select the appropriate tools and equipment for excavation depending on site condition, size of water mains and depth of pipeline.
• Care should be taken to avoid damage to other existing infrastructure.
• Excavation shall be done in accordance with the GWCL Health and Safety Manual

Detailed assessment of failure
Conduct detailed assessment of failure after excavation.

Workspace
An adequate workspace should be created to allow for:
i) detailed inspection around the pipe,
ii) provision of sump for continuous operation of a drainage pump,
iii) movement of workmen, material and equipment to be used safely and effectively.

Provide safe dewatering system and discharge points
The discharge of any dewatering apparatus must be checked to ensure free outflow and to avoid damage or inconvenience caused by flooding.

Repair Works

General rules when repairing a pipe burst:
1) Carry out correct measurements and give allowance for pipe expansion.
2) Cutting A.C. pipes should be avoided.
3) Sealing rings of couplings should be lubricated if required.
4) Ensure good alignment of couplings and pipes.
5) Tighten all bolts to required torque.
6) Grease/lubricate all bolts and nuts to avoid corrosion.
7) Restore any damaged coatings on exposed pipes and fittings.

Refer to the following tables and adopt an appropriate procedure for repair works.

Table 2-1
Repair Work Procedure for uPVC Pipes

Unplasticized Polyvinyl Chloride (uPVC)

Type of Burst/Leak	Action	Procedure
Crack, Brittle Failure, Joint Failure	Replace section	**D ≥ 50mm** • Cut out damaged section of pipe. • Replace with new section and fasten at both ends with two (2) couplings. **D < 50mm** • Cut out damaged section. • Cut new pipe (length + 3D). • Open sockets (1.5D) at both ends of the new section. • Replace the cut-out section with the new section using glue.
Defective Coupling	Replace coupling	• Loose and remove the defective coupling. • Replace with appropriate coupling.
Pinhole	Clamp	**D ≥ 50mm** • Where necessary, place insertion rubber between the opening and the clamp. • Place a clamp well centralised on the opening. • Fasten bolts to the required torque.
	Replace section	**D ≤ 50mm** • Cut out damaged section. • Cut new pipe (length + 3D). • Open sockets (1.5D) at both ends of the new section. • Replace the cut-out section with the new section using glue.

Table 2-2
Repair Work Procedure for HDPE Pipes

High Density Polyethylene (HDPE)		
Type of Burst/Leak	**Action**	**Procedure**
Crack, Brittle Failure, Joint Failure	Replace section	**D< 110mm** • Cut out damaged section of pipe. • Replace with new section and fasten at both ends with two (2) straight couplings. **D> 110mm** • Cut out damaged section. • Measure and cut a new section and align it with the existing pipe. • Trim and heat the ends of the pipe segments to be welded using the appropriate technology. • Loose and remove the defective coupling. • Replace with appropriate coupling.
Pinhole	Clamp	**D ≥ 63mm** • Where necessary, place insertion rubber between the opening and the clamp • Place a clamp well centralised on the opening. • Fasten bolts to the required torque.
	Replace section	**D ≤ 63mm** • Cut out damaged section. • Replace the cut-out section with a new pipe and couple both ends with two compression joints.

Table 2-3
Repair Work Procedure for Asbestos Cement (AC) Pipes

Asbestos Cement (Ac)		
Type of Burst/Leak	**Action**	**Procedure**
Crack, surface softening	Replace section	• Break the joints of the damaged pipe to remove entire pipe length. • Replace with new pipe (uPVC/HDPE pipe material) and two (2) couplings.
Circumferential failure, Pinhole	Clamp	• Where necessary, place insertion rubber between the opening and the clamp • Place a clamp well centralised over the opening/crack path. • Fasten bolts to the required torque.
	Replace section	• Break the joints of the damage pipe to remove entire pipe length. • Replace with new pipe (uPVC/HDPE pipe material) and two (2) couplings.
	Replace Joint	• Replace joint with appropriate coupling.

Table 2-4
Repair Work Procedure for Steel Pipes

Steel		
Type of Burst/Leak	**Action**	**Procedure**
Pinhole	Clamp Clamp	• Where necessary, place insertion rubber between the opening and the clamp. • Place a clamp well centralised on the opening. • Fasten bolts to the required torque.
	Patch and weld	• Cut a steel plate of the same thickness as the pipe. • Place the steel plate over the hole and weld around the edges of the plate. • Coat the repaired area with anti-rust paint.

Table 2-5
Repair Work Procedure or Combining uPVC and HDPE Pipes

uPVC / HDPE Combination Repairs		
Type of Burst/Leak	**Action**	**Procedure**
Pinhole	Replace section	**(A) 25mm ≤ D ≤ 63mm** • Cut out damaged uPVC pipe section. • Insert faucet sockets at both ends of the uPVC pipe using glue. • Screw in HDPE male adaptor to the faucet sockets. • Replace the damaged section with HDPE pipe by coupling it into the other ends of the male adaptors
		(B) 63mm < D ≤ 110mm • Cut out damaged section of uPVC pipe. • Cut equal length of HDPE pipe for replacement. • Couple both ends of HDPE section with compression flange adaptor. • Couple the HDPE section to both ends of the PVC section using maxifit adaptors.
		(C) D ≥ 125mm • Cut out damage section of uPVC pipe. • Butt weld stub end and backing ring at both ends of HDPE sections. • Couple the HDPE section to both ends of the PVC section using maxifit adaptors.

Activities which require welding & excavation operations and works on AC pipes that requires breaking shall be carried out in accordance with GWCL Health and Safety manual

Mapping and Recording of Repairs

While the repair is still visible, the details of repair should be recorded using the appropriate GIS mapping software by noting the following.

a. District

b. Specific Location

c. Nature of fault

d. Cause of burst/leak

e. Pipe size

f. Pipe material

g. Type of pipeline (i.e., transmission or distribution mains)

h. Reported time of burst or leakage

i. Completion time of repair

Testing after repairs

- Support the centre of the repaired pipe section with appropriate backfilling material.
- Restore section of the network to the normal operational regime.
- Disinfect pipeline in accordance with GWCL Standard Operating Procedure.

Completion

- Backfill using excavated material (if suitable) and compact. Foreign materials may be acquired for backfilling if necessary.
- Upon completion, all materials and protective barriers shall be removed from site and the working area must be left clean.
- Notify customers of completion and acknowledge cooperation of relevant stakeholders where necessary.

PIPE LAYING

This section details the standard operating procedure for pipe-laying.

GENERAL GUIDELINES FOR EXTENSION OF MAINS

1. Mains extensions could be funded internally or externally by donors or consumer associations.
2. Should any community/estate require an extension of mains, coverage will be extended based on the willingness of the community to adhere to GWCL's policy and guidelines on mains extension.
3. For estates or communities that require supply, GWCL shall be involved in the design and construction of the internal distribution network before connection to the GWCL system.
4. Extension of mains will also be contingent on initial cost-benefit analysis, especially when the project is funded internally.
5. Mains laid by the assistance of the community shall be taken over, owned, operated, and maintained by GWCL immediately after construction.
6. There shall be a detailed design of the network which includes the drawing, water demand of the targeted community, flow rates and pressures at the proposed take-off point(s). The network shall be hydraulically modelled to ensure that the water is supplied to targeted consumers at the required flow and pressure.

EXCAVATION

Preparation

1. Advance notice shall be given to the agencies concerned (e.g. Department of Urban Roads (DUR), Ghana Highway Authority (GHA), Electricity Company of Ghana (ECG), Telecommunication companies, etc.) and other stakeholders about the works.

2. Excavation permits, if necessary, shall be obtained from appropriate agencies.

3. Technical specifications such as the correct field location, alignment, trench and bedding specifications shall be referred to before mobilization and excavation begins.

4. Secure properly the site in accordance with GWCL Health and Safety manual.

5. The alignment of the pipeline trench shall always be at the designated Right of Way (RoW), as prescribed in the Road Reservation Management Manual; or between the

6. existing drainage and the fence wall line; or always near and adjacent to the fence wall line.

7. If the proposed location of the trench is below asphalt or concrete pavements, a concrete cutter shall be used to ensure smooth edge cuts. Jackhammers/Backhoe Breakers shall be used in breaking asphalt and concrete pavements under the supervision of the road agency. Alternatively, trenchless excavations using horizontal directional drilling (ie,e thrust boring) shall be used.

8. Asphalt/Concrete cutting and breaking shall be implemented prior to excavation and pipe laying activities. This implies all cutting shall be done and sleeves/ducts of appropriate sizes put in place to avoid future cuttings for any repair works.

9. All asphalt and concrete debris shall not be used as backfill materials.

10. All pipelines, valves and fittings, construction materials, tools, equipment, etc. must be prepared, ready and available. No excavation for any section of pipeline installation shall be performed until all materials necessary to complete the installation are on-hand.

Trench Excavation

1. Unless otherwise shown or ordered, excavation for pipelines shall be open-cut trenches. Trenches shall be straight, with vertical sides centred on the pipe center line. This would require setting out and pegging the pipeline route.

2. To avoid trench cave-ins and the resulting cost of re-excavating, trenches shall not be opened for more than two days in advance.

3. Always refer to the “Trench Excavation Detail” for the depth and width depending on the pipe sizes and location (minimum of 1m clearance from the pipe surface and the ground level).

4. The width of the trench shall not be less than the pipe diameter (i.e. + 0.4m) to allow proper side-fill compaction.

5. The trench walls shall follow excavation safety procedures based on the level of stability of the soil.

6. The trench width shall be greater than the specified width to accommodate the permissible deflection of the joints for curved alignments,

7. Trench bottom must be uniform, free from humps, abrupt change of direction, hard objects, large and/or sharp stones, and tree roots.

8. Trenches shall be over/under-excavated beyond the designed depth only when ordered by the Engineer.

9. Except where trees are shown on the drawings to be removed, trees shall be protected from injury during construction operations and no tree is to be removed without written permission or permit if necessary. Tree roots can be trimmed and cut, if it is an obstruction only with the permission of the Engineer.

10. Water must be kept out of the trench during construction to avoid contamination of the pipelines.

Sand Bedding

Sand bedding or footing aims for the permanent safety of the pipelines. It must be determined by taking full account of the ground and load conditions.

1. Bedding and side fill material shall be free draining or loose in nature and must be capable of being compacted to provide adequate support for the pipe.

2. For normal ground, a sand bed of a thickness of 100mm and a cover of 300mm is required.

3. For rocky grounds, a sand bed of a thickness of 300mm and a cover of 300mm is required.

4. Sand bedding shall be spread over the trench bottom to the full width of the trench to the thicknesses indicated above.

5. The bedding shall be compacted thoroughly in layers not exceeding 100mm thick to give a uniform bed, true to the gradient, on which the pipe will be laid. (Refer to Figure 1 below)

6. Sandbags may also be used as bedding, if necessary.

PIPE HANDLING & STORAGE

Transport

1. Pipes shall be secured and restrained during transport to ensure that no movement occurs.

2. When pipes are supplied in pallets or in containers, wooden battens or boards shall be placed between layers of pipes and all pipes shall be securely tied and wedged to avoid displacement during transport.

3. Truck and trailer beds must be free from any sharp objects or stones that could damage the pipes.

4 Ensure that there are no excessive loads on pipe sockets.

5 Larger diameter pipes shall be placed at the bottom of the load.

6 Pipes with higher pressure ratings or higher ring stiffness shall be placed at the bottom of the load.

7 Check that each individual bundle, package and pallet is securely tied.

Handling

1. If possible, pipe materials shall be loaded/unloaded using hand or mechanical lifting equipment.

2. Pipes shall be lifted with suitable straps or ropes. In handling the pipes, contact with hooks, chains, or similar metal devices shall be avoided.

3. Pipes shall never be dragged along the ground or road.

4 All pipes, fittings and gasket material shall be kept as clean as possible and be protected from any contamination.

5 The pipe shall be laid on the side opposite the excavated material or equipment, or, if trench is not yet opened, opposite where these will be positioned.

6 Pipes shall be secured against rolling into the trench and kept safe from traffic and heavy equipment.

7 The bell end of the pipe shall be placed towards the direction of the work, as during the installation the spigot end will enter the bell end of the previously laid section.

8 Lifting equipment shall be used to lower larger pipes; for which a webbing sling (belt) shall be attached to the pipe.

Storage

1. Pipes shall be stored on firm level ground without sharp objects
2. Pipes shall be stored on wooden batons.
3. Preferably, pipes in different diameters and ratings shall be stored separately. However, if this is not possible, store pipes with larger diameters and higher ratings at the bottom of the stack.
4. Maximum stack height – 2 meters
5. Stacks shall be wedged to prevent movement.
6. There shall be no excessive loads on pipe sockets.
7. Pipes and seals shall not be stored in the proximity of corrosive or dangerous materials, paints, oils, solvents, gasoline or other fuels.
8. Pipes and seals shall not be stored close to a heat source.
9. Pipes shall not be stored under direct sunlight for more than two months. If longer periods are anticipated a protective net (80% shade), tarpaulin or plastic sheet may be used to cover the pipes. Ensure free movement of air between the cover and the pipes.
10. Seals must be stored away from direct sunlight in temperatures that do not exceed 40°C
11. Maximum shelf life of seals is 3years.
12. Socketed pipes should have sockets placed alternatively whens tacking.
13. Pipes of different diameters should not benested/putinsidetheother.

PIPE LAYING

After the trench bottom has been prepared, the pipe(s) can be laid. Pipes shall be free from damage. The procedure for joining pipes varies with the pipe material. This document focuses mainly on uPVC, HDPE and DI pipes.

Joining

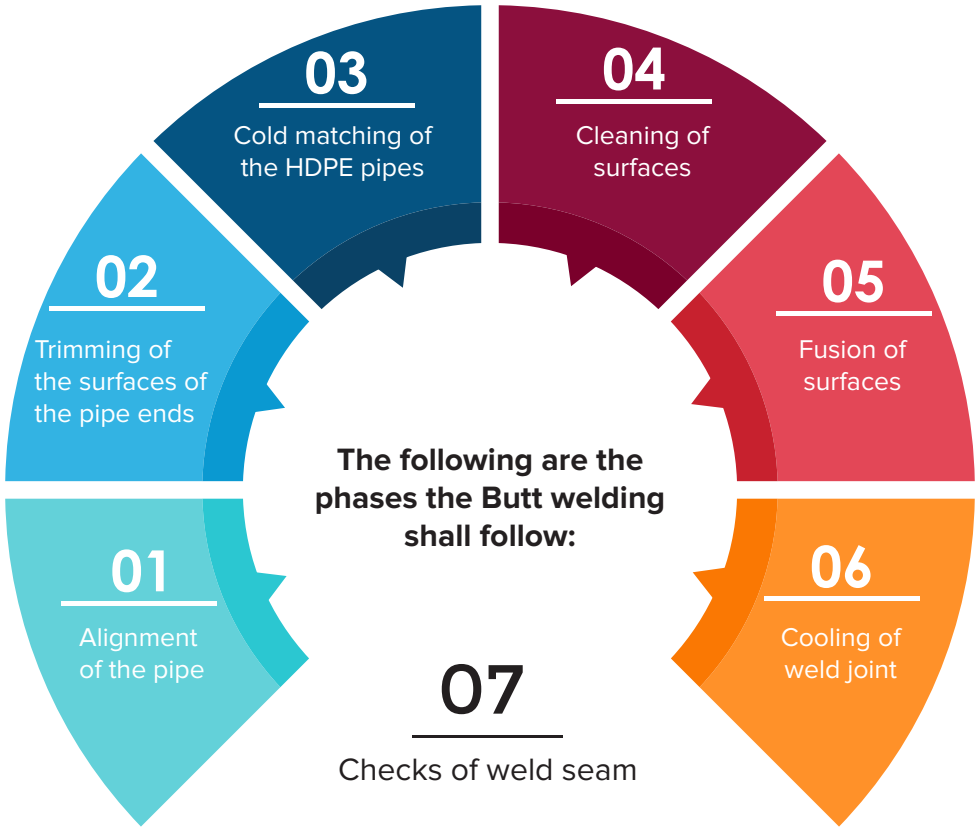
Joints shall be watertight but flexible enough to allow to a certain degree of deflection.
See Table below for allowable deflections for different pipe materials and sizes.

Pipe Material	Pipe Size (mm)	Permissible Angular Laying Deflection (°)
Ductile Iron	<150	5
	200-300	4
	350-600	3
	700-800	2
	900-1000	1.5
	All Sizes	1
HDPE		

HDPE Pipes (High-Density Polyethylene)

HDPE pipes are joined by heat fusion. The principle of heat fusion is to heat two surfaces to a designated temperature, then fuse them together by application of a sufficient pressure. The applied pressure causes the melted materials to flow and mix, thereby resulting in fusion. When fused according to the proper procedures, the joint area becomes strong enough to withstand tensile and pressure properties.

The butt-welding shall be done in several phases and by using several parameters.



The following must be strictly adhered to:

A. The procedure for butt-welding shall be in conformity to the manufacturer's direction.

B. Visually unacceptable joints shall be cut out and re-fused using the correct procedure.

C. The operation of the buttwelding machine shall be in line with GWCL's Health and Safety manual.

Alternatively, Electrofusion may be used instead of butt welding.

Laying

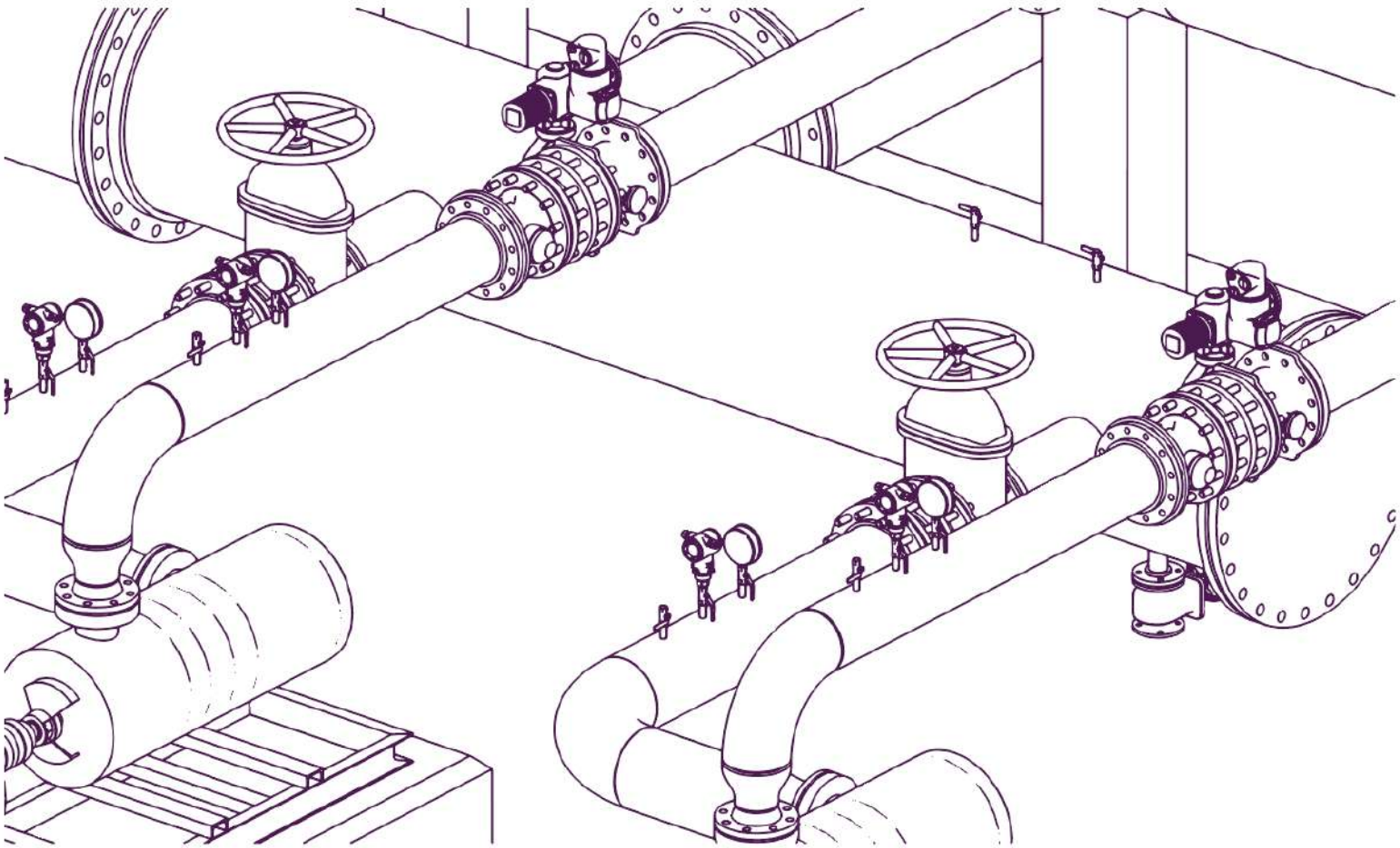
1. Lower the pipe into the trench by using a chain hoist or mechanical equipment, if possible. In smaller diameters of pipelines, pipes may be lowered into the trench by two people using ropes, one rope looped around near each end of the pipe. Do not roll the pipes into the trench from the top.

2. Larger pipe sizes are best handled with appropriate equipment. The pipe is usually supported by a sling in the middle of the pipe length when lowered by a machine. The sling must be removed once the pipe is inside the trench.

3. Make sure that the entire length of the pipe section is in contact with the ground.

4. Pipe lengths shall never be deflected in the joints to any degrees than that recommended by the manufacturer.

5. Always check the inside of the pipe. Do not leave open ends of installed pipes. It shall be plugged and secured to prevent the entry of animals, dirt, trench water and any other foreign materials.



INTERCONNECTIONS

1. Prepare all the necessary materials, fittings, tools, equipment, barricades, warning devices, etc.

2. Inspect all valves and fittings for conformance to shop drawings and technical specifications.

3. Customer Care/Communication departments of GWCL shall notify customers of the affected area(s) about interruption to water supply.

4. Locate all interconnection points as per the design.

5. Isolate the sections of the mains by closing the nearest gate valves.

6. Open hydrant/wash-out valves to drain the pipeline.

7. Expose the pipeline section.

8. Mark out the sections on the existing pipeline and cut using a pipe cutter to ensure a square end. However, a conventional wood saw or hacksaw may be used.

9. Dewater the trench where necessary.

10. Inspect the pipe flange for warping.If bolts are tightened against a warpedflange, there is a danger of cracking the cast iron valve flange.

11. Couple the valve to the centre flange of the tee. Make sure that the insertion rubber/ gasket is not damaged and is clean.

12. Fix the appropriate couplings on both sides of the pipe.

13. Align the fittings and specials into theirproper position.

14. Properly set the couplings at both sides of the fittings and tighten.

15. Nut tightening shall follow a definite diagonal sequence.

16. Thrust restraints shall be installed at each fitting where there are changes in pipe diameter or direction. Concrete thrust blocks shall be cast in-situ, poured against undisturbed soil.

17. Pre-cast blocks are not allowed.

18. Unless otherwise stated by the Engineer,all fabrications shall be ofsteelmaterials with minimum thickness of 8mm, or greater than 10mm along the coastal areas.

19. On HDPE pipes, steel tees and reducers shall have flanged ends, and installation shall be carried out with at least one loose/ flexible end. This implies using at least one flange coupling and a stub end with backing ring.

THRUST BLOCKS AND ANCHORS

Pressurized pipelines generate thrusts that create gradual movements in the pipelines which cause leakages, or completely separate the coupling or fitting.

Installation of Thrust Blocks and Pipe Anchors

1. Excavate behind the fitting and level the ground.

2. Prepare a formwork of appropriate size and shape and brace it to hold the concrete.

3. The formwork shall be kept behind the bell of the fitting.

4. Mass concrete (i.e. C15 concrete grade) shall be cast between the fitting and the undisturbed bearing soil inside the formwork.

5. The concrete shall fill in around the fitting with allowance for slight movement due to temperature and pressure changes.

6. Thrust blocks are not needed at the welded flanged joints of steel pipes.

BACKFILLING AND COMPACTION

1. Dewater trench when necessary.

2. Backfilling shall be done gently and thoroughly.

3. The first layer of the backfill must always be clean granular material such as sand. Suitable soil can be used if recommended by the Engineer.

4. The pipe shall be covered evenly to a thickness of 300mm from the pipe's surface. Manually compact the sand firmly to avoid damage or movement of the pipe.

5. The additional layers of backfill shall be selected soil materials, free from large and/or sharp stones and lumps.

6. The remainder of the trench shall be filled in layers, l00mm to 150mm thick, with each layer being carefully and thoroughly compacted before the next layer is placed.

7. If trenches are in a road right-of-way or where there will be a sidewalk, the completed backfill must meet the compaction requirements of the road agency concerned. Backfill in other trenches need not be compacted to such a degree.

WASHOUTS AND VALVES

Sizing, Siting and Installing Washouts

1. Washouts shall be placed at low points of the pipeline profile.

2. Preferably, they should be placed at points where they can drain water from both directions.

3. Washouts shall be installed such that water will be emptied into a drain or stream. As much as possible, avoid emptying into roadways and towards properties.

Siting Centre and Branch Valves

1. Valves should be sited at junctions (as Branch Valves) and at most 1km intervals (as Centre Valves) on the distribution network for efficient isolation of pipelines for repairs and maintenance.

2. Gate valves should be used for pipes of relatively smaller diameters (i.e. 100m m to 300mm) while butterfly valves should be used mainly for larger pipes (i.e. above 300mm) to ensure effective flow modulation / throttling

3. Resilient seal valves can be used in locations where they must be opened frequently. However, critical valves that are closed most of the time, such as scour or DMA isolation valves, should use metal-to-metal seals.

4. At every junction with “n” branches, number of valves to be installed shall be minimum “n-1”.

STREAM CROSSINGS

Steel truss bridge shall be used for crossing streams and other water bodies, however in some instances an open-cut excavation may be considered using the procedure detailed below.

1. Crossing of streams can be done with open-cut (i.e. excavation).
2. If the watercourse is shallow in the case of ditches or minor watercourses, an open-cut method can be implemented by using either PE or DI pipes.
3. An appropriate size HDPE sleeve shall be provided to protect the pipe.
4. Pressure gauges shall be installed on both ends of the crossing to monitor pressure drop and detect leakages.
5. The minimum cover over the top of the pipe should be 1000mm from the lowest profile grade.
6. Restrain all joints at an appreciable distance away from the edge of the bank to prevent possible contamination.
7. Provide valves on both ends of the crossing.
8. Ensure that pipe joints are not in the water course for open cut method.

CHAMBERS

1. The recommended minimum chamber size is 1200mm x 1200mm.
2. Chambers for air valves shall be vented for air movement.
3. Chambers shall have a clearance of about 400mm from the finished grade to prevent stormwater from entering.
4. Access to chambers can be a reinforced concrete slab or glass reinforced plastic cover.

NB: *Opening of chambers shall be done strictly according to the GWCL Health & Safety Manual.*

Alternatively, guard pipes of appropriate diameters shall be used.

WATER INFRASTRUCTURE ASSET MARKING

1. Marker posts shall be placed along pipelines every 200m, except where they follow permanent roads.

2. Markers shall be placed at sluice valves, air valves, washouts, hydrants, and road crossings.

3. Markers shall display the type of asset, size, material, pipe ID, depth at which they have been installed and the slope between that marker and the succeeding marker.

SURFACE REINSTATEMENT

1. Damaged and disturbed areas due to pipe laying activities shall be restored to their original condition. However, reinstatement of damaged concrete/asphalt pavement shall be done upon the completion of hydro (pressure) testing activities.

2. Area shall be secured using the barricades, warning signs as per GWCL safety regulations to protect the newly restored portion until the concrete is cured.

PRESSURE TESTING OF WATER PIPELINES

Water mains shall be subjected to a pressure testing after installation is completed. This is to ensure safety, reliability, and the water tightness of the network. Pressure testing shall be done per the nominal pressure of the pipeline. The test pump and the pressure gauge shall be connected to the pipe at the lowest point.

Hydrostatic testing is a process that ensures the safety and structural integrity of pipelines using hydro-testing equipment. It is an industrial pressure testing technique that lets you identify leakages on pipelines by applying pressure, thereby examining their strengths.

HDPE (PRESSURE TESTING INSIDE TRENCH):

1. The Engineer shall ensure all thrust blocks and pipe anchors cure as per design specifications before pressure test is conducted.

2. Fill the pipeline completely with water; bleed off trapped air.

3. Subject the lowest point in the pipe system to a test pressure that is 1.5 times the design pressure, and check for leakage.

4. Commence the test procedure by adding sufficient water at hourly intervals for 3 hours to maintain the test pressure. After about 4 hours, initial expansion shall be complete and the actual test can start.

The pressure test procedure shall be followed in the steps below:

- Fill the pipeline with water.

- Apply pressure to the pipeline to bring it to its acceptable test pressure. This pressure is usually greater than the pipeline's design working pressure.

- Hold the pressure for a required timeframe to examine the pipeline for possible leakages.

- Depressurize the pipeline after confirming that the test is complete and meets the specifications and industry standards.

NB:

- *Under no circumstances shall the total time under test exceed 8 hours at 1.5 times the system pressure rating. If the test is not complete within this time limit (due to leakage, equipment failure, etc.), the test section shall be permitted to "relax" for 8 hours prior to the next test sequence.*
- *Air testing in water pipelines is not recommended since additional safety precautions may be required.*
- *Pressure testing shall be done in sections not exceeding 500m.*

DISINFECTION

Scope: This standard describes procedure for disinfecting new water mains, and repaired pipes.
Purpose: The purpose is to meet the standard requirement for mains disinfection, post burst repair disinfection, and distribution of safe and potable drinking water to the consuming public.
Application: The method is applicable to new mains, repaired pipes and water reservoirs.

Procedure

1. Close all valves on the pipeline /mains prior to the laying or repair works.
2. Fill the mains to full bore with water to eliminate air pockets after the pipe has been laid or the repair works are done.
3. Flush at 0.8m/s velocity for 15 minutes to purge the line of dirt and debris.
4. Calculate the capacity of the pipeline or the volume of water that the pipeline can take to completely fill. This will help in determining the quantity of the disinfectant required.
5. Weigh the quantity of the disinfectant required to give you a dosage of 50mg/L.
6. Completely dissolve the disinfectant in water.
7. Fill the pipeline to half the carrying capacity.
8. Close the inlet valve to prevent back flow.
9. Dose the dissolved chemical in the pipeline.
10. Refill the pipeline now to full bore.
11. Take a sample of water from the pipeline for initial Chlorine residual test.
12. Allow the water to remain in the pipeline for 24 hours contact time.
13. Take a sample of the chlorinated water and carry out a residual chlorine test.
14. Drain and refill the pipeline if the residual chlorine value exceeds 10mg/l.
15. Take another sample of the water for Bacteriological, pH, Turbidity, and residual chlorine analysis after 24 hours.
16. Put the pipeline into service if the final residual chlorine value is between 0.2 to 1 .0 mg/l.
17. If the final residual chlorine value is beyond the 1.0mg/L, the pipeline needs to be flushed again and refilled with fresh supply of drinking water. Repeat the residual chlorine test to see if it is within the range of 0.2 to 1.0mg/L and then put the pipeline into service.


Desinfecting
OH⁻
Contaminated water
Disinfected water

FLUSHING OF PIPELINES

Purpose
The main purpose of flushing is to provide safe and quality water to the customer. The key benefits of flushing in the distribution network are as follows:

- Remove accumulated debris from the water distribution system.
- Eliminate suspended particles in water.
- Clear water of objectionable odour.
- Remove potential contaminants from water supplies in the event of a pipe burst or repair.

Possible Factors that Compromise Water Quality

- Non-Potable Water Intrusion into the distribution system via pressure loss.
- Sediments build-up in pipes
- Pipe wall Biofilms
- Vandalism
- Exposure of pipelines to bacteria or filth sources during repairs

PRE – FLUSHING

For an effective flushing program, the following are needed.

- A flushing plan from the water quality department
- A distribution map
- A flushing form (Refer to Appendix)
- Location of Valves, Hydrants and Washouts
- Valve Key or Pipe wrench.

FLUSHING PROCEDURE

- Identify areas to be flushed as per the flushing program.
- Notify customers who will be affected before the flushing is executed.
- Isolate the area being flushed.
- Open washout valve or hydrant slowly to prevent water hammer.
- Washout valves or hydrants should be opened fully.

- Ensure that there is adequate pressure and velocity in the network before flushing is executed.
- Direct flushed water into storm drains.
- Record on the flushing form the time flushing commenced.
- Carry out flushing until the underlisted conditions are met:
  a. Water is clear with no visible sediment.
  b. No objectionable odour
- For routine flushing, flush for 10min.
- In reference to water quality sampling report, flush affected area per recommendations from the water quality department and submit report for resampling and analysis.
- After repair works, flush until conditions in 4.2a&b are met.
- Opened Hydrant or washout valve should be closed slowly and time recorded.
- Signages indicating “Pipeline flushing by GWCL” should be placed at flushing locations.

NB:

The above procedures should be carried out in compliance with GWCL’s Health and Safety Standards

VALVES AND FIRE HYDRANTS

GATE / SLUICE VALVES

Application of Valves

1. Gate valves shall be installed in the network to shut off or allow flow of treated water through a pipeline within a certain permitted pressure and temperature limits.

2. Gate valves shall be used for isolation of small diameter pipes (<400mm), while butterfly valves are used for large diameter pipes.

3. Isolation valves shall be installed at junctions in pipe networks and at regular intervals of one kilometre on distribution pipelines.

4. All isolation valves in a system shall be operated in the same direction (i.e clockwise direction for closing and anti-clockwise for opening).

5. Resilient seal valves shall be used in locations where valves are opened frequently, or will be open most of the time. However, critical valves that are closed most of the time, such as scour or DMA isolation valves, should use a metal-to-metal seals.

Transport and Storage of Valves

1. The valve must be kept in the factory packaging in an opened condition until installation.

2. The valve shall not continuously be exposed to direct sunlight.

Installation Procedure for Valves on uPVC Pipelines

1. Ensure the materials (flange adaptor couplings, valve, insertion rubber etc.) meet technical specifications.

2. Identify position on the pipeline for the installation of the new valve.

3. Isolate the required section of the network by closing the nearest isolation valve(s).

4. Drain the pipeline by opening the nearest wash-out valve (if available).

5. Expose the distribution mains on which the valve is to be installed.

6. Measure, mark, and cut out the pipe section for the new valve installation.

7. Slide maxi fit adaptor onto one end of the cut pipe.

8. Insert the gasket between the other maxi-fit adaptor and one side of the valve and tighten bolt to the required torque.

9. Carefully position the coupled valve and maxi-fit adaptor vertically and slide it onto the other end of the cut pipe.

10. Tighten the bolts of the Maxi fit adaptor to secure the grip to the pipe.

11. Insert/attach the gasket to the other end of the valve.

12. Slide the maxi-fit adaptor on the other cut end of the pipe and tighten it to the valve by bolting to the required torque.

13. Tighten the bolts of the Maxi fit adaptor to secure the grip to pipe.

14. Dewater the trench where necessary.

15. Subject installation to low pressure to check for leakage.

16. Open the valve 100% to flush the pipeline clean.

17. Provide concrete thrust blocks to support/hold the valve into position.

18. Ensure thrust blocks are cured and then backfill and compact.

19. A Guard pipe and cover or a valve chamber should be used to protect the valve.

Installation Procedure for Valves on HDPE Pipelines

1. Ensure the materials (couplings, valves, etc.) meet technical specifications.

2. Identify the position on the pipeline for the installation of the new valve.

3. Isolate the required section of the network by closing the nearest isolation valve(s).

4. Drain the pipeline by opening the nearest wash-out valve (if available).

5 Expose the distribution mains on which the valve is to be installed.

6. Measure, mark, and cut out the pipe section for the new valve installation.

7. For pipe diameter 125mm and above, weld the stub end and backing ring at one end to create a fixed end at one section of the pipe using the appropriate technology.

8. Slide flange adaptor coupling/maxi fit adaptor (with internal ring) onto the other end of the pipe

9. Carefully align the valve between the two flanges.

10. Insert a gasket between the stub end and the backing ring. Tighten the bolt and nuts to the required torque.

11. Insert the second gasket between the valve flange and that of the coupling and tighten to the required torque.

12. Dewater the trench where necessary.

13. Subject installation to low pressure to check for leakage. Increase the pressure gradually.

14. Open the valve 100% to flush the pipeline clean.

15. Provide concrete thrust blocks to prevent the movement of valves where necessary.

16. Let the thrust block cure and prepare the area for backfilling and compaction.

17. A guard pipe and cover or a valve chamber should be used to protect the valve.

Installation Procedure for Valves on Steel Pipelines

1. Ensure the materials (couplings, valves, etc.) meet technical specifications.
2. Identify the position on the pipeline for the installation of the new valve.
3. Isolate the required section of the network by closing the nearest isolation valve(s).
4. Drain the pipeline by opening the nearest wash-out valve (if available).
5. Expose the distribution mains on which the valve is to be installed.
6. Measure, mark, and cut out the pipe section using the appropriate cutting device.
7. Weld the flange at one end to create a fixed end at one section of the pipe.
8. Slide maxi fit adaptor onto the other end of the pipe
9. Carefully align the valve between the two flanges.
10. Insert a gasket between the welded flange and the valve flange. Tighten the bolt and nuts to the required torque.
11. Insert the second gasket between the valve flange and that of the Maxi fit adopter. Tighten to the required torque.
12. Dewater the trench where necessary.
13. Subject installation to low pressure to check for leakage. Increase the pressure gradually.
14. Open the valve 100% to flush the pipeline clean.
15. Provide concrete thrust blocks to prevent the movement of valves where necessary.
16. Let the thrust block cure and prepare the area for backfilling and compaction.
17. A guard pipe and cover or valve chamber should be used to protect the valve.

Operational Requirements

1. Isolation valves shall only be operated by staff trained and authorised to do this, and all changes in valve setting should be recorded on a form designed for this purpose.
2. Gate valves shall not be used to isolate pipes for pressure testing when the testing pressures exceed the operational rating of the valve, as this can damage the valve seals.
3. Isolation valves shall be opened and closed slowly, especially on large pipelines to prevent water hammer.
4. Valves on pipes with a water hammer risk shall be fitted with gearboxes or actuators that regulate the valve closing speed.
5. Isolation valves shall be opened and closed slowly, especially on large pipelines to prevent water hammer.

AIR VALVES

Application of Valves

1. Air valves shall be installed on pipelines to control air in and out of the system.

2. Pipe mains require air valves at high points in the pipe profile, where the pipe bends downwards and at regular intervals on straight pipe sections.

3. As a rule of thumb, a high point is pronounced if it is 3m more than the low points preceding or succeeding it.

4. In sizing air valves, use (0.25 x DN) as a guide, where DN is the nominal diameter of the pipe.

5. When selecting fittings for the installation of air valves, the cost must be factored in, and alternatives reviewed.

6. Air valves shall be installed near isolation and check valves where negative pressures may occur when draining the pipeline.

Installation Procedure for Air Valves

Diameters less than 50mm

The following items are required: A saddle of appropriate size, 2 No. Nipples of appropriate size, stop cork, tread tape, insertion rubber, and the Air valve.

1. Apply tread tape to both treaded ends of the nipples.
2. Firmly tighten one side of one nipple to the socket of the saddle and tighten the stopcock to the other side. All tightening shall be done using a pipe wrench.
3. Tighten one part of the second nipple to the other side of the stop cork (quarter-turn).
4. Install the Air valve on the other side of the nipple.
5. Follow the procedure for installation of the saddle on the pipeline as indicated for New Service Connections SOP to complete the installation.
4. Protect the Air valve with 280mm HDPE guard pipe and fiberglass cover with a vent. (Refer to pipe laying SOP)

Diameters greater than 50mm

The following items are required: Air valve, Sluice valve, flanged-tee of appropriate type and size, insertion rubber, bolt and nuts and couplings (for Upvc and AC) or maxi fit adaptor and stub end and backing ring (for HDPE)

1. Install the tee following the procedure outlined in the SOP for pipelaying and valve installation.
2. Properly clean the flange on the tee, put the gasket into position, and install the sluice valve by fastening the bolts and nuts to the required torque.
3. Place the second gasket properly on the Sluice valve flange after cleaning.
4. Position the Air Valve on top of the Sluice valve and properly align and fasten the bolt and nuts to the required torque to complete the installation.
5. Appropriate anchorage should be provided for the tee.

4 Construct a chamber with vent or use a 450mm HDPE guard pipe and fiberglass cover with vent to protect the Air valve. (refer to pipe laying SOP)

Operational Requirements for Air Valves

Install the tee following the procedure outlined in the SOP for pipelaying and valve installation.

FIRE HYDRANTS

Operational Requirements for Air Valves

1. Fire hydrants shall be provided in the distribution system for firefighting and also used for operation and maintenance functions in water distribution systems, such as flushing pipes, releasing air and logging pressures.

2. Fire hydrants shall be installed in networks on 75 mm diameter and larger pipes.

Siting of Fire Hydrants

1. GWCL shall engage the national fire service in the siting of fire hydrants.

2. Depending on location, hydrants shall be provided at all dead ends and lower points of the network to allow these pipes to be flushed.

3. Fire hydrants should be installed on pipes with diameters 75mm or larger.

4. They should be able to provide at least the following flow rates:

Installation Procedure for Fire Hydrants

Fire hydrants are installed on center flanged tees or duck foot bends. Installation on the tee or duck foot varies depending on the pipe material as indicated in the pipelaying SOP for branch valve installation.

To install Fire Hydrant on duck foot bends, the duck foot bend shall be coupled/bolted to a flange at the dead end of the pipeline. The side to be coupled to the pipeline shall have a flange of the pipeline diameter and the side perpendicular to the pipeline should have a flange of diameter 75mm to hold the fire hydrant.

The following items are required: 75mm Fire Hydrant, Tee of appropriate type and size with a center flange of 75mm/ Duck foot bend, insertion rubber, bolt and nuts and couplings (for uPVC and AC) or maxi fit adaptor and stub end and backing ring (for HDPE)

1. Install the tee following the procedure outlined in the SOP for pipelaying and valve installation.

2. Clean the surface of the flange on the tee and the Fire Hydrant and place the gasket on top of the flange on the tee.

3. Position the Fire Hydrant and properly fasten the bolt and nuts.

4. Appropriate anchorage should be provided for the tee.

5. Construct a Reinforced Concrete chamber or use a 450mm HDPE guard pipe with appropriate sized fiberglass cover to protect the Fire Hydrant. (Refer to pipe laying SOP).

Fire hydrant installation on Duck foot bend

1. Expose the dead end of the pipeline and properly wash it with clean water and clean it with dry rug.

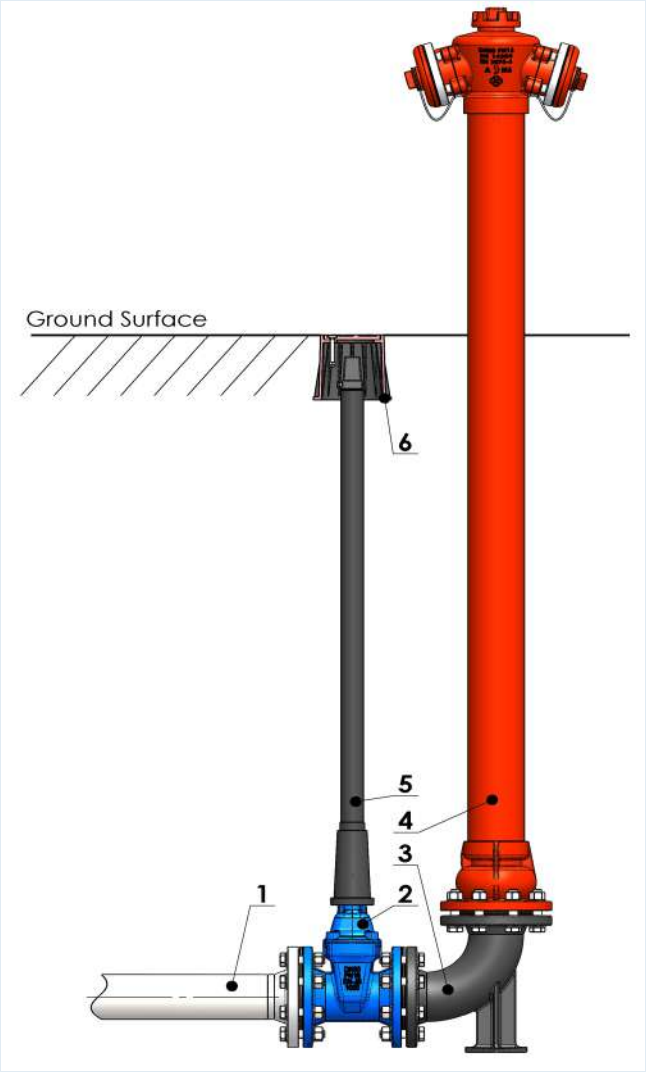
2. Align, put in place, and fasten the Maxi fit adaptor bolts to make it firm on the pipeline (for u PVC and AC). Butt weld the stub end to the pipe (for HDPE)

3. Align the duck foot bend to the flange on the pipeline, insert the gasket after cleaning both flanges and fasten the bolt and nuts to the required torque.

4. Clean the 75mm flange, place the gasket on top. Position the Fire hydrant on top of the gasket and fasten the bolt and nuts to the required torque to complete the installation.

5. Appropriate anchorage should be provided for the duck foot bend.

6. Construct a chamber with or use a 450mm HDPE guard pipe and fiberglass cover to protect the Fire Hydrant. (refer to pipe laying SOP)



Operation and Maintenance of Fire Hydrants

1. Connect fire hydrants only to water mains adequately sized to handle fire flows.

2. Hydrant locations shall be clearly marked to allow fire services to find them.

3. Fire hydrants shall be protected against obstruction, for instance by vehicles parking over them.

4. Hydrants must be well protected against damage by vandalism, traffic and construction activities.

5. Hydrants in high fire-risk areas shall be inspected on a regular basis (i.e. quarterly) and in other areas annually to ensure they are ready to perform in case of a fire emergency

6. Hydrants shall be serviced and flow rate checked to comply with the required flow rate at least once per year.

7. Obstacles and plants around hydrants must be cleared.

8. The hydrant box or chamber shall be cleared of sand and debris, and the valve opened to check that it operates correctly.

9. Stems and nozzles shall be checked and flange bolts tightened if necessary.

10. The hydrant body shall be kept clean and corrosion protection applied if required.

PREVENTIVE MAINTENANCE SCHEDULE FOR PIPES AND SPECIALS

No.	Maintenance Action	Maintenance Interval
1.0	**Pipeline**	
1.1	Check for Leakages (by routes)	Weekly
1.2	Check and clean chambers	Monthly
1.3	Flushing	After repairs and when needed
1.4	Check marker posts	Annually
2.0	**Valves**	
2.1	Open and close isolating valves	Monthly
2.2	Check functionality of scour valves	Monthly
2.3	Check functionality of air valves	Monthly
2.4	Maintain valve equipment and accessories	Annually
2.5	Check for leakages	Monthly
3.0	**Fire Hydrants**	
3.1	Check for leakages	Monthly
3.2	Check functionality of hydrants	Quarterly
3.3	Test flow rate of fire hydrants	Annually
4.0	**Standpipes**	
4.1	Check for leakages	Daily
4.2	Maintain standpipe equipment and accessories	Weekly
5.0	**Bulk Meters**	
5.1	Cleaning of Chambers	Monthly
5.2	Check for leakages	Monthly
5.3	Calibration of meters	Annually
5.4	Check and empty all strainers	Monthly


+005.45
X1M

WATER METER INSTALLATION

GENERAL GUIDELINES TO INSTALLATION OF WATER METERS

1. All Meters should receive certification prior to installation.

2. Ensure all fittings required for standard meter installation are available.

3. Refer to meter manual to ensure that the meter is installed in a way to attain a wetted perimeter of 1.

4. Ensure arrow on the meter body is in line with the direction of water flow.

5. Ensure meter diameter is lower than the diameter of pipeline to be metered (as shown in table 6-1).

6. Ensure a strainer is installed upstream of the meter to protect it at all times from debris

7. Meter shall not be coupled to stopcock or safety valve for accurate measurement.

8. Ensure meter is installed at least 100mm above ground level to avoid it from being buried.

9. All meters should be installed according to manufacturers' standards.

Item No.	Size of pipe (mm)	Size of metre (mm)
1	19mm (3⁄4")	15mm
2	25mm (1")	20mm
3	32mm (11⁄4")	25mm
4	40mm (11⁄2")	32mm
5	50mm (2")	40mm
6	75mm (3")	50mm
7	100mm (4")	80mm
8	160mm (6")	100mm
9	200mm (8")	150mm
10	250mm (10")	200mm

METER INSTALLATION (BELOW DN50)

The following items are required: Swan neck, HDPE and PVC pipe, stopcock, valve socket, faucet socket, GWCL certified water meter, safety valve, safety valve protective kit, HDPE male adapter, thread tape and pipe glue.

Procedure

1. Thread and install faucet socket at both ends of the meter.

2. Thread and install valve sockets at both ends of the stopcock.

3. Thread and install valve socket on one end of the safety valve and HDPE male adapter on the other end.

4. Expose, clean and cut section of service line for the meter installation.

5. Couple the service pipeline (HDPE pipe) to the safety valve (male adapter).

6. Divide swanneck into two equal halves, fix one end to the safety valve (down) and the other end to the stopcock (up).

7. Fix piece uPVC pipe, at least 5times diameter of pipe between stopcock and meter.

8. Open stopcock to flush the pipeline.

9. Lock stopcock and install the meter with the arrow pointing in the correct direction of flow.

10. Install other end of swanneck to the meter.

11. Cover safety valve with the safety valve protective kit and backfill.

12. Run water through the meter to verify that the meter is functioning properly.

MECHANICAL METER INSTALLATION (DN50 AND ABOVE)

The following items are required: Steel Reducer Swan neck (S/F), Coupling, Sluice Valve, Strainer, 5D Spacer (S/F), Maxifit Adapter, GWCL certified water meter, 3D Spacer (D/F), Bolts and nuts (varies with size of meter) and insertion rubber.

Standard Procedure

1. Cut and perforate insertion rubber to fit for installation.

2. Expose, clean and cut section of service line for the meter installation.

3. Couple on arm of the swanneck to the pipe with appropriate coupling.

4. Install sluice valve to the upper/flanged end of swanneck.

5. Install strainer after the sluice valve.

6. Install the flanged side of the 5D S/F Spacer to the other end of the strainer.

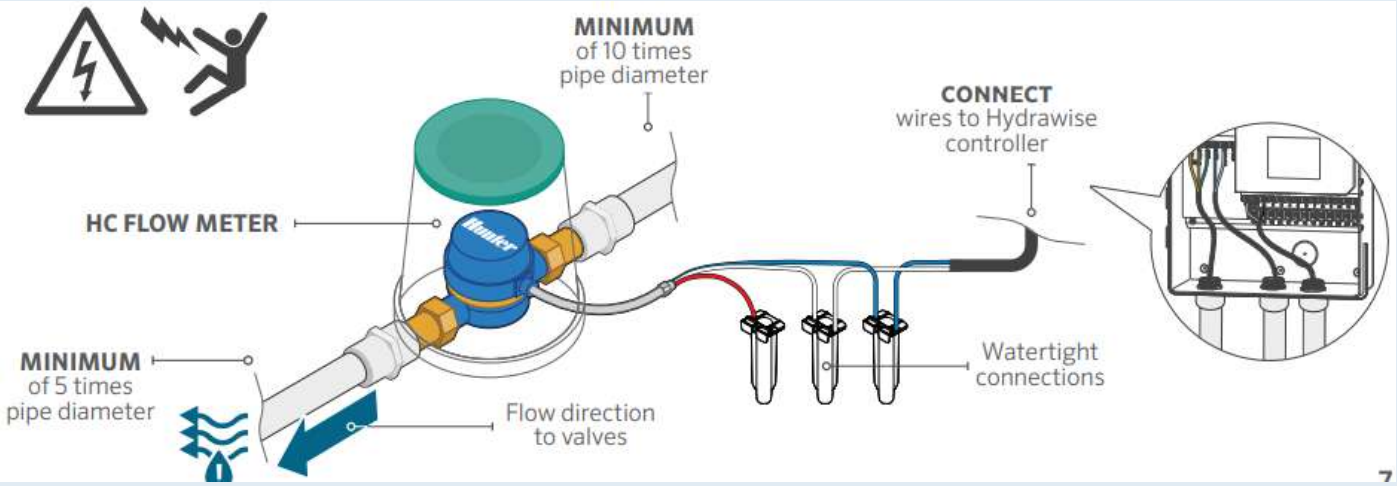
7. Install the meter with the arrow pointing in the correct direction of flow by coupling the plain end of the 5D spacer using a maxifit adapter.

8. Install the 3D D/F Spacer in front of the meter.

9. Install a sluice valve or a non-return valve to the spacer.

11. Install the other arm of the swanneck to the sluice valve or the non-return valve

12. Run water through the meter to verify that the meter is functioning properly.



ELECTROMAGNETIC METER INSTALLATION (DN50 AND ABOVE)

Installation Guide

Locating the sensor:

Ensure that the sensor is located in the most optimum place where no magnetic field is present.

Flow direction:

Ensure that the sensor is located in the most optimum place where no magnetic field is present.

Inlet and outlet condition

To achieve most accurate flow measurement, it is essential to have certain straight inlet and outlet pipe lengths as shown in figure 6-2 below (Di: sensor diameter).

Inlet and outlet condition

To achieve most accurate flow measurement, it is essential to have certain straight inlet and outlet pipe lengths as shown in figure 6-2 below (Di: sensor diameter).

Sensor must be completely full of water

Therefore avoid:

1. Air in pipe.
2. Installation at the highest point in pipe system.
3. Installation in vertical pipes with free outlet.

Orienting the sensor

Sensor must be mounted as shown in upper part of figure 12. Do not mount sensor as shown in lower part of figure 12 as electrodes then will be positioned at top where air bubbles may occur, and at the bottom, where mud, sludge, sand etc. may deposit and cover the electrode, thus impacting the measurement.

Orienting with Vertical pipes

Recommended installation is in a vertical/inclined pipe to minimize wear and deposits in sensor.

Installation in large pipes

The water meter can be installed between two reducers

Installation in large pipes

1. Install gaskets.
2. Ensure connection flange has a smooth surface and is in line with sensor.

Gasket Application

Gaskets are recommended but not included in water meter delivery.

Advice for gasket selection:

1. Only use flat rubber gaskets.
2. Thickness 1 to 6 mm (0.0 to 0.02 ft) dependent on gap/tolerance.
3. Inner diameter must be larger than bore of water meter.
4. Material should be compatible with process fluid.

Maximum allowable torques

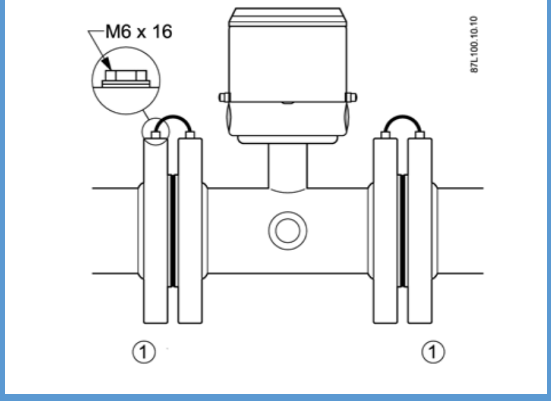
Standard bolts must be well lubricated and tightened evenly around gasket. Leakage/ damage to water meter or piping may arise if bolts are overtightened.

Grounding

The sensor body must be grounded using grounding/bonding straps and/or grounding rings to protect flow signal against stray electrical noise and/or lightning. This ensures that noise is carried through sensor body and that the measuring area within sensor body is noise-free.

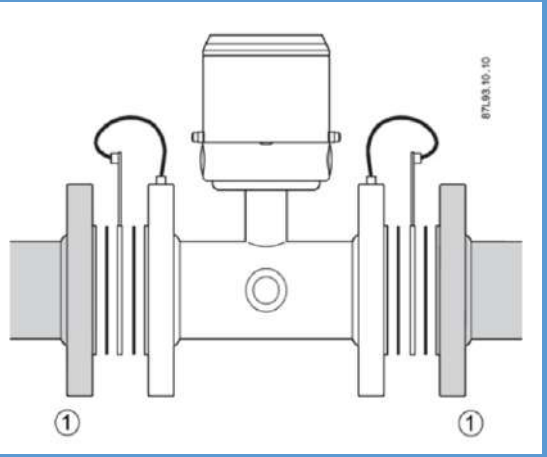
Metal pipes

Connect straps to both flanges with 6 mm (1/4”) screws.



(1) Metal pipes:
Bonding/grounding straps are part of delivery and pre-mounted on water meter.

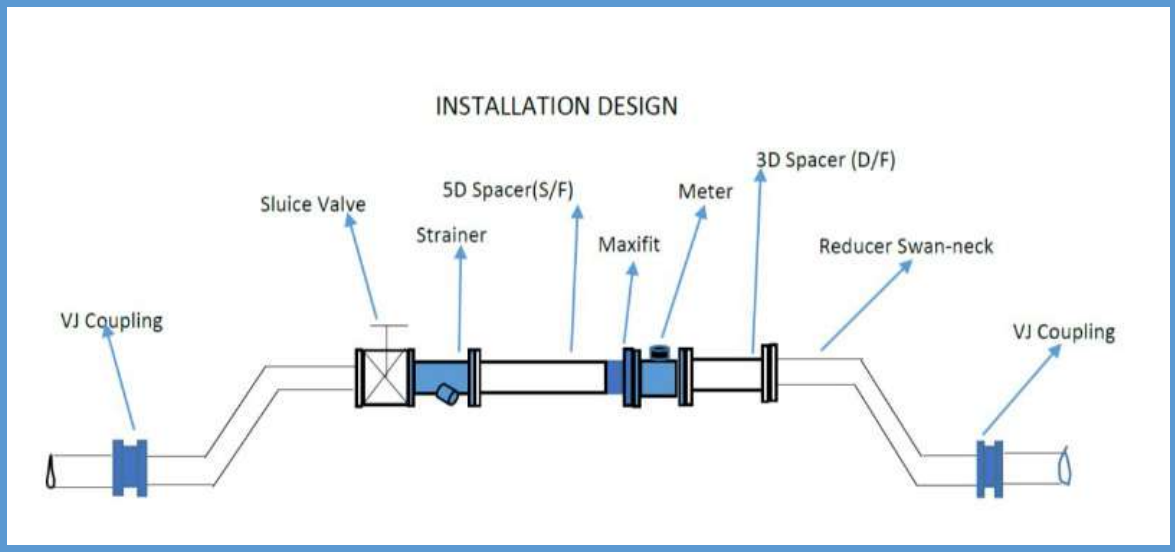
For Plastic pipes and lined metal pipes
Use optional grounding rings at both ends.



(1) Plastic pipes or lined metal pipes
Grounding rings are not included in delivery.

Combination of metal and plastic pipes
Use straps for metal pipe and grounding rings for plastic pipe.

(1) Metal pipe
(2) Plastic pipe
Bonding/grounding straps, grounding rings and straps are not included in delivery.



NEW SERVICE CONNECTIONS (NSC)

A New Service Connection (NSC) is a link pipeline between GWCL's mains and the premises of the consumer that connects the customer to the network for supply. Consumers are however responsible for the laying of internal service lines up to the boundary of their premises. The size of the NSC is dependent on the estimated demand of the consumer. The maximum length of NSC should be 120m long. It is therefore incumbent on GWCL to carry out mains extensions which would ensure these distances are adhered to. The depth of pipe for NSC should be a minimum of 0.45m (18") depending on the pipe diameter.

NEW SERVICE CONNECTION (NSC) PROCEDURE

1. The prospective customer shall apply for a NSC to the district office in charge of the area where the property is located, together with a copy of an approved site plan and a valid building permit (if required).

2. The applicant shall give the necessary information for the completion of Form A by the GWCL personnel assigned to register applications, including name, Ghana post address, the purpose of service (for example, domestic), and other required details.

3. Using the portal, the GWCL personnel then creates an assignment for the NSC Estimator

4. The NSC Estimator then follows up with an inspection of the customer's premises within 5 working days after completion of Form A for mapping and estimation on condition that the applicant meets the field requirements.

5. The estimate is then sent to the regional office for confirmation of mapping by the GIS officer and approved by the regional distribution manager on behalf of the regional chief manager.

6. The qualified applicant shall receive an invoice within another 5 working days from the day of the inspection.

7. The service connection shall be carried out within 10 working days from the date of payment.

8. The connection is effected using any of the processes below:

9. A pre-qualified private contractor, who has met set GWCL safety standards, is engaged to excavate and lay service pipes and GWCL authorized staff will do tapping on the mains and meter installation to complete the NSC

10. Where the Region has not registered pre-qualified private contractors for the purpose, GWCL staff will carry out the connection works, (Excavation, laying and tapping of mains).

11. Alternatively, casual labor which could be an individual or a small, organized group could be used for the excavation and backfilling only, and authorized GWCL staff will undertake the pipelaying, and connection on the main and meter installation.

OPERATING PROCEDURE FOR WATER CONNECTION

1. Expose the main and excavate to a minimum depth of 18", lay and backfill the service line from the main distribution line to the boundary of the customer.

2. For the new connection, maintain a minimum distance of 2m from an existing tapping point on the mains, where applicable.

3. Clean with fresh water the exposed section of the main pipeline.

4. Cut insertion rubber to size and fix it between the saddle and pipe at the point of connection.

5. Fix the saddle around the main pipe with the socket on top of the main pipe and fasten it properly with bolts and nuts.

6. Remove the ferrule body, apply yarn on the male of the main ferrule and install in the socket of the saddle.

7. Remove the tongue of the ferrule using a ferrule key and perforate the pipe with a drill.

8. Fix back the tongue and body of the ferrule and lock the ferrule.

9. Fix the male coupling on the ferrule outlet.

10. Couple the male coupling to the service line.

11. Open the stalk of the ferrule to flush the service line.

12. Fix the stop cork.

13. Fix one side of the swan neck on the stop cork.

14. Fix safety valve and meter.

15. Fix 6" guard pipes with caps on the safety valve and meter.

16. Liaise with the customer and join the internal pipe network to the other side of the swan neck to complete the connection.

17. Check the main pipe and along the service line for leakages and rectify if any.

18. Backfill the main connection point.

19. Advice the customer to open taps to flush the internal pipe system before water usage.

ROAD CROSSING

In the event of road crossing, The District shall ensure that the customer acquires a permit from DUR for road crossing and may facilitate it where necessary.

NB:

The above procedure should be carried out in compliance with GWCL's Health and Safety Standards

MATERIAL SCHEDULE

SR. No.	ABBREVIATION	DESCRIPTION	QTY
01	S	Saddle	1NO.
02	BN	Bolts & Nuts	2NO.
03	F	Ferrule	1NO.
04	MC	Male Coupler / Adapter	2NO.
05	HDPE	HDPE Pipe	TBD
06	SV	Mechanical Safety Valve	1NO.
07	VS	Valve Socket	3NO.
08	SN	Swan Neck	1NO.
09	PSC	Plastic Stop Cock	1NO.
10	PP	uPVC Pipe	TBD
11	FS	Faucet Socket	2NO.
12	WM	Water Meter	1NO.
13	G	Glue	TBD
14	TT	Thread Tape	TBD
15	IR	Insertion Rubber	TBD
16	PVC G.	PVC GUARD	2NO.
17	PVC G. Cap	PVC GUARD CAP	2NO.
18	AD	ADAPTER	1NO.

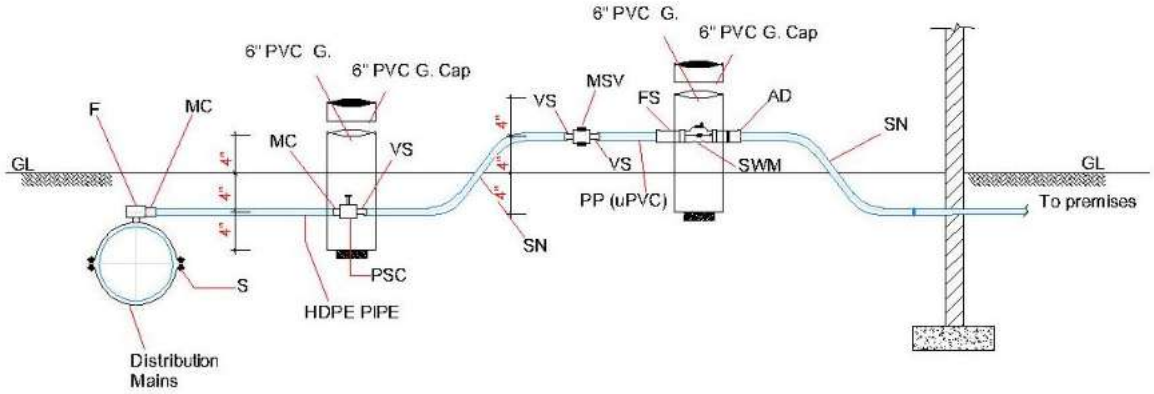


Figure 21: Typical Smart Water Meter New Service Connection (using Brass Stop Cock)

MATERIAL SCHEDULE

SR. No.	ABBREVIATION	DESCRIPTION	QTY
01	S	Saddle	1NO.
02	BN	Bolts & Nuts	2NO.
03	F	Ferrule	1NO.
04	MC	Male Coupler / Adapter	2NO.
05	HDPE	HDPE Pipe	TBD
06	SV	Mechanical Safety Valve	1NO.
07	VS	Valve Socket	3NO.
08	SN	Swan Neck	1NO.
09	PSC	Plastic Stop Cock	1NO.
10	PP	uPVC Pipe	TBD
11	FS	Faucet Socket	2NO.
12	WM	Water Meter	1NO.
13	G	Glue	TBD
14	TT	Thread Tape	TBD
15	IR	Insertion Rubber	TBD
16	PVC G.	PVC GUARD	2NO.
17	PVC G. Cap	PVC GUARD CAP	2NO.
18	AD	ADAPTER	1NO.

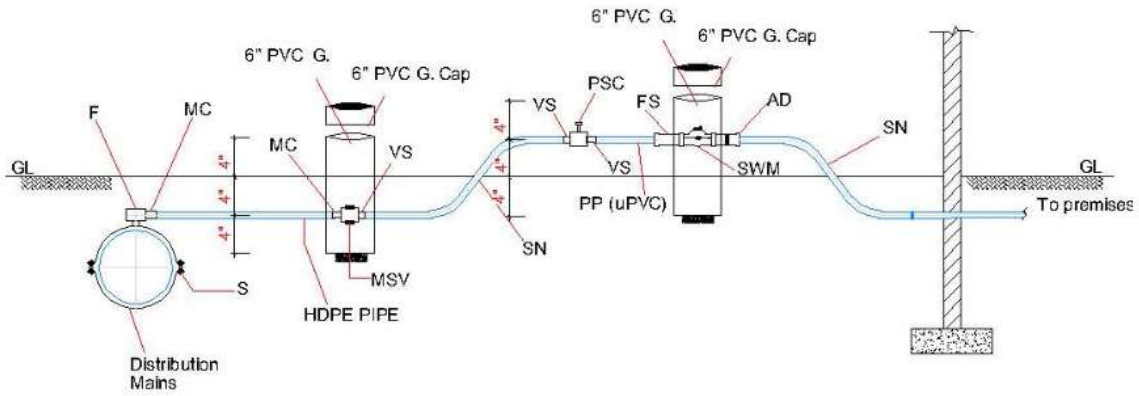


Figure 22: Typical Smart Water Meter New Service Connection (using Plastic Stop Cock)

Appendix

Item No.	Date	Location	Size of Pipeline	Hydrant/ valve size	Officer In Charge	Purpose of Flashing

Item No.	Date	Location	Size of Pipeline	Hydrant/ valve size	Officer In Charge	Purpose of Flashing

Glossary

A.C Pipe
(Asbestos cement) pipe, is a cement liquid transportation vessel that is tubular in shape. The asbestos in asbestos cement pipe is used to enhance its mechanical properties.

Air Valves
Hydromechanical devices with an internal float mechanism designed to release trapped gases during filling and operation of a piping system. They contribute to reduction in energy consumption and operation costs. Reduce delays when filling the pipe system and reduced risk of water hammer. Usually placed on high elevations of pipelines.

Bell (Of A pipe)
Larger end of a pipe described as “belled”. This flared out end is designed to fit directly onto the next length of pipe you are attaching.

Burst (Of A Pipe)
A sudden break or split open of a pipeline due to internal or external pressure stresses.

Butt-Fusion/ Butt-Welding
Butt-fusion jointing is a thermo-fusion process that is commonly used for welding PE pipes. It involves the are then brought together under controlled pressure for a specific cooling time and homogeneous fusion if formed upon cooling. The resultant joint is resistant to end thrust and has comparable performance under pressure to the pipe.

Butterfly Valve
A valve that isolates or regulates the flow of water on a pipeline. The closing mechanism is a disk that rotates.

Chlorination (Of A Pipeline)
Involves adding a chlorine solution to the water in a pipeline for disinfection. The chlorine solution stays in the pipe for a set time period before removed through flushing of the pipeline.

Disinfection (Of a Pipeline)
The removal, deactivation or killing of pathogenic microorganisms in water pipelines using chemicals added to the water . Microorganisms are destroyed or deactivated, resulting in termination of growth and reproduction.

D.I Pipes
(Ductileiron) pipesaremade ofductile cast iron and are commonly used for potable water transmission and distribution simultaneous heating of the ends of two components which are to be joined until a melt state is attained on each contact surface. Two surfaces

DUR
(Department of Urban Roads) is a body under the Ministry of Roads and Highways mandated to construct, maintain and manage traffic on the urban road network of Ghana

Electromagnetic Water Meters
Types of water flow meters that use a magnetic field to measure the speed of a fluid flowing in the pipe to measure volumetric flow.

Excavation
Work involving the removal of soil or rock from a site to form an open face, hole or cavity manually using tools or machinery.

Gate Valve
A valve that opens by lifting a barrier (gate) out of the path of the fluid. They are used to open or shut off the flow of liquids. Also known as a sluice valve.

GWCL
(Ghana Water Company Limited) is a utility company, fully owned by the state, responsible for potable water production and supply to all urban communities in Ghana.

DN (Of A Pipe)
(Diametre nominal), also known as the nominal pipe size, which denotes the size of a pipe (specifically, its inside diameter) in millimeters (mm).

density polyethylene), they have a high level of impermeability, light weight, corrosion resistance, toughness and strong molecular bond, making them suitable for high pressure pipelines.

Insertion Rubber
Also known as the Rubber gasket. It is an elastic component used for mechanically sealing the microscopic gap between two mating surfaces or joints.

Leakage
An amount of water that is escaping from a pipe or fitting by means of a crack, hole, or other fault.

Mains
Water main is the primary pipe in a water distribution system of a particular locality. It supplies water to other connected secondary pipes on the way to the consumers

Mechanical Water Meters
Water flow meters that work by measuring the speed of flowing water running through the pipe that causes a turbine or piston to rotate. The volumetric flow rate of the water is proportional to the rotational speed of the blades.

HDPE Pipes
(High-Density Polyethylene) pipes are a type of flexible plastic pipe used for fluid transfer and are often used to replace ageing concrete or steel mains pipelines.

NSC
A New Service Connection (NSC) is a link pipeline between GWCL's mains and the premises of the consumer that connects the customer to the network for water supply.

PE Pipes
(Polyethylene) pipe is a broader term that refers to any thermoplastic pipe made from ethylene gas.

Pipe Laying
The process by which long sections of pipe are installed and aligned so that they can be joined either through use of joint fittings or welded together. The laid pipes pipelines serve as a conduit for water transport.

PVC Pipes
(Polyvinyl Chloride) Pipes are commonly used for distribution pipes. They are light weight, easy to install and require very little maintenance, making them good for water supply.

Non-Return Valve
A valve which allows a water to flow in only one directionand is fitted to ensure that the medium flows through a pipe in the right direction, where pressure conditions may otherwise cause reversed flow.

Steel Pipes
They are strong and durable for use as water supply pipes. They can withstand high water pressure and are used for high pressure pipelines.

Socket
A socket is a fitting that goes over the end of a pipe.

Spigot
The end connection of a fitting to be assembled into another fitting. The spigot end of a fitting has the same outside diameter as the pipe.

Thrust Block
A concrete pipe and fitting restraint that prevents the mainline from moving by transferring pipe loads (mainly due to pressure thrust) to a wider load-bearing surface.

Sand Bedding
The bedding is the material placed in the bottom of the trench on which the pipe is laid. For rigid pipe, the bedding sand helps distribute the load over the soil. For flexible pipe, the bedding sand resists the deflection of the pipe due to load.

Water Hammer
A phenomenon that can occur in any piping system where valves are used to control the flow of liquids. Water hammer is the result of a pressure surge, or high- pressure shockwave that propagates through a piping system when a fluid in motion is forced to change direction or stop abruptly.

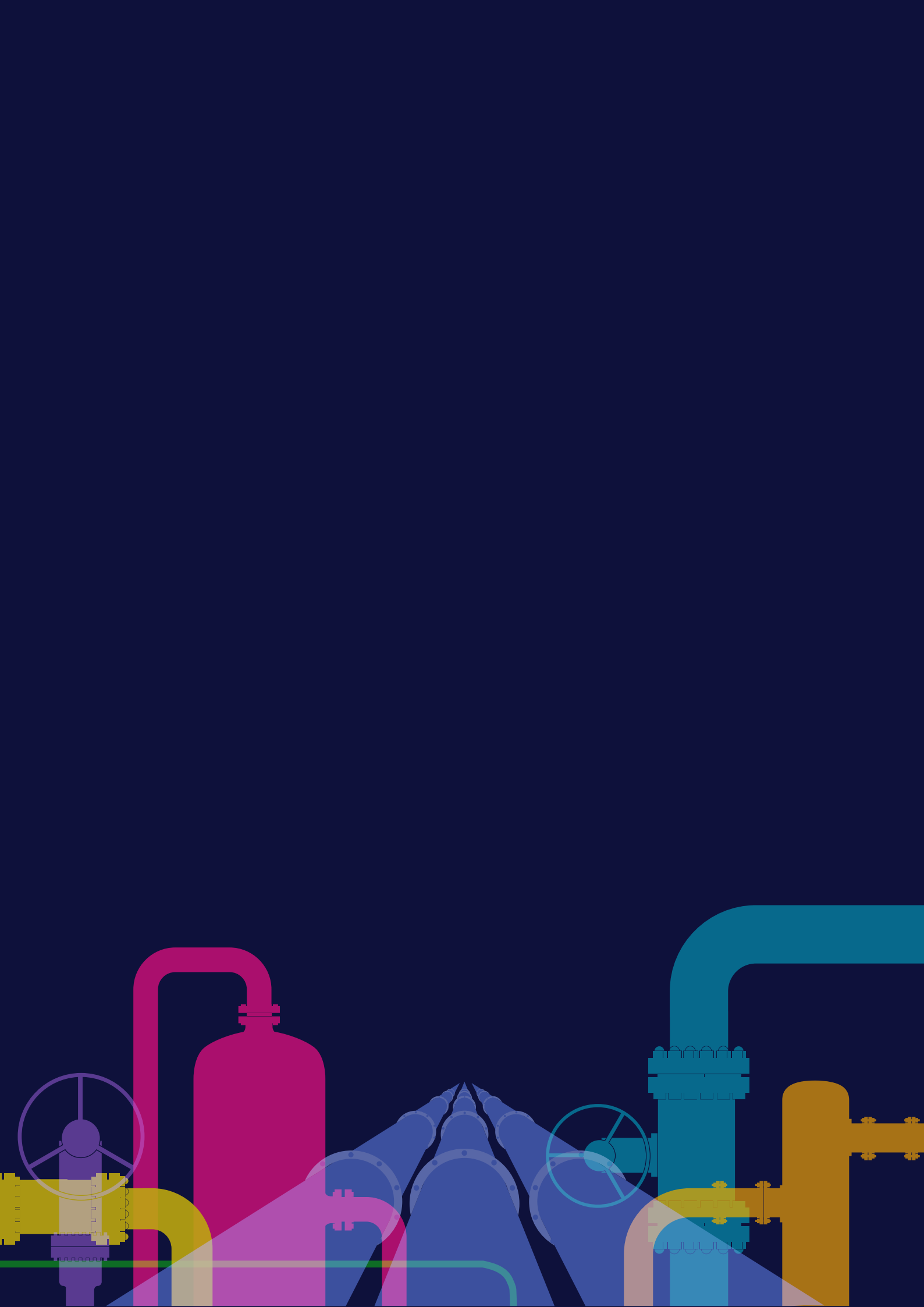
Water Supply Network
A system of engineered hydrologic and hydraulic components that carry potable water from water treatment plants and supply to consumers.

Water Meter
A device used to measure the volume of water supplied to a consumer or a geographic area. Water metering can also be used to determine flows at a certain point in the water system.

Transmission Line
A pipeline that conveys water under pressure from a source, usually a water treatment plant, to areas where water supply is needed.

Ultrasonic Water Meters
Type of water flow meters that use ultrasound to measure the speed of a fluid flowing in the pipe to measure volumetric flow.

Washout Valve
An accessible valve in a water supply main that is used to run dirty water out of a system following repair work.



October, 2023

GWCL Standard Operating Procedures for Water Distribution