JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

AUTHORITIES CONCERNED OF THE GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

TECHNICAL COOPERATION ON THE PROJECT FOR INSTITUTIONAL IMPROVEMENT AND ADVANCING NRW REDUCTION INITIATIVE OF CHITTAGONG WASA

PROGRESS REPORT – 2

APPENDIX

May 2016

NJS CONSULTANTS CO., LTD.
Tokyo, Japan

BD
JR
16-002

MINUTES OF MEETING
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
AUTHORITIES CONCERNED OF THE GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
ON
THE PROJECT FOR INSTITUTIONAL IMPROVEMENT AND ADVANCING NRW REDUCTION INITIATIVE OF CHITTAGONG WASA (PANI-2)

The Japanese Mid-term Review Team, organized by the Japan International Cooperation Agency and headed by Mr. Sadanobu SAWARA, stayed in the People's Republic of Bangladesh (hereinafter referred to as "Bangladesh") from January 9th to January 21th, 2016 for the purpose of conducting the joint mid-term review on the "Project for Institutional Improvement and Advancing NRW reduction Initiative of Chittagong WASA(PANI-2)" with the Bangladesh Mid-term Review Team, which consists of members from the Economic Relations Division, Ministry of Finance, the Local Government Division, Ministry of Local Government, Rural Development and Co-operatives and Chittagong Water Supply and Sewerage Authority.

After intensive study and discussion on the achievement of the project and its activities by both teams, both parties of the Joint Review Team agreed upon the Joint Mid-term Review Report attached hereto.

The Joint Review Team recommends the PANI-2 Project should hold a Steering Committee Meeting to report the result of the Mid-term Review by March 2016.

Dhaka, January 21, 2016

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Japanese Mid-term Review Team
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Ministry of Finance
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Attachment: Joint Mid-term Review Report

JOINT MID-TERM REVIEW REPORT

ON

THE PROJECT FOR INSTITUTIONAL IMPROVEMENT AND ADVANCING NRW REDUCTION INITIATIVE (PANI-2)
OF
CHITTAGONG WATER SUPPLY AND SEWARAGE AUTHORITY

January 2016

Bangladesh – Japan
Joint Mid-term Review Team

Abbreviation and Acronym

C/P	Counterpart
CWASA	Chittagong Water Supply and Sewerage Authority
CWSISP	Chittagong Water Supply Improvement and Sanitation Project
GIS	Geographic Information System
GOB	Government of Bangladesh
GOJ	Government of Japan
JET	JICA Expert Team
JICA	Japan International Cooperation Agency
JOCV	Japan Overseas Cooperation Volunteer
KSA	Karnaphuli Service Area
KWSP	Karnaphuli Water Supply Project
LGD	Local Government Division
MCWD	Metro Cebu Water District
MD	Managing Director
MIS	Management Information Systems
M/M	Minutes of Meeting
MOD	Maintenance, Operation & Distribution
NRW	Non Revenue Water
OJT	On the Job Training
PANI	Project for Advancing NRW Reduction Initiative
PANI-2	Project for Institutional Improvement and Advancing NRW reduction Initiative of Chittagong WASA
PD	Project Director
PDM	Project Design Matrix
PO	Plan of Operation
SCADA	Supervisory Control And Data Acquisition
SLA	Sub Loan Agreement
TAPP	Technical Assistance Project Proposal
WB	World Bank

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ANNEXES

1. Introduction

1-1 Preface

The Japanese Mid-term Review Team, organized by Japan International Cooperation Agency (JICA) and headed by Mr. Sadanobu SAWARA, stayed in the People's Republic of Bangladesh (Bangladesh) from January 9th to January 21st, 2016 for the purpose of conducting the joint mid-term review on the Project for Institutional Improvement and Advancing NRW reduction Initiative of Chittagong WASA (PANI-2) (the Project).

The Bangladesh Mid-term Review Team, which consists of members from the Economic Relations Division, Ministry of Finance (ERD), Local Government Division, Ministry of Local Government, Rural Development and Co-operatives (LGD) and Chittagong Water Supply and Sewerage Authority (CWASA), was also assigned for the purpose of conducting this review. Both Japanese and Bangladesh Review Teams organized the Joint Review Team.

This Joint Mid-term Review Report has been prepared through an intensive review study (including document review, questionnaire survey and interviews) and finalized after discussion among the Japanese and Bangladesh Review Team Members. CWASA Counterparts (C/Ps) and the JICA Expert Team (JET) were interviewed thoroughly, through individual and group discussions and through questionnaire survey to adequately review the Project.

1-2 Objectives and Methodology of the Joint Mid-term Review

1-2-1 Objectives of the Joint Mid-term Review

JICA's technical cooperation project is reviewed or evaluated at four stages, namely ex-ante, mid-term, terminal and ex-post. This time, one year and ten months after the inauguration of the Project, Mid-term review is being conducted since the Project reached half the way[1]. Specific objective of the Mid-term review are to:

1) Review the progress of the Project and evaluate the achievement from the viewpoints of the five evaluation criteria which are relevance, effectiveness, efficiency, impact, and sustainability,
2) Analyze the factors to promote/impede the effects,
3) Itemize necessary actions to be taken and make recommendation for the Project,
4) Revise the Project Design Matrix (PDM) and the Plan of Operation (PO) if necessary, and,
5) Summarize results of the study in a joint evaluation report.

1-2-2 Methodology of the Mid-term Review

[1] According to the technical assistance project proposal (TAPP), project implementation period is from July 2015 to June 2019; therefore, the project running period is 6 month so far. The Project period has practically been passed one year and ten month, according to the project period stated in PDM.

The Mid-term Review studied a planned schedule and progress of the designated activities for each output based on PDM and PO of the Project up to January 2016 (refer to Annex 5 and 6 for PDM and PO).

The implementation process of the Project was also examined from various viewpoints including the means of transferring technical skills, communication among the related parties and the monitoring of the project implementation.

Review based on the five evaluation criteria was made based on the following viewpoints:

1) Relevance: Relevance of the Project is reviewed by the validity of the Project Purpose and Overall Goal in connection with the development policy and the needs of Bangladesh.

2) Effectiveness: Effectiveness is assessed to what extent the Project has achieved its Project Purpose, clarifying the relationship between the Project Purpose and Outputs.

3) Efficiency: Efficiency of the Project implementation is analyzed with emphasis on the relationship between Outputs and Inputs in terms of timing, quality and quantity.

4) Impact: Impact of the Project is assessed in terms of positive/negative and intended/unintended changes taken place as a result of the Project.

5) Sustainability: Sustainability of the Project is assessed in terms of institutional/political, financial and technical aspects by examining the extent to which the achievement of the Project will be sustained after the Project is completed.

The Mid-term review mainly focuses on relevance and efficiency. Regarding relevance, it is important to verify whether the project strategy is valid as it is. As to how effectiveness and impacts are showing themselves, the future trends and feasibilities are examined based on the output performance and the activity status. Sustainability is examined based on prospects. Particularly with respect to effectiveness, studies are required as to whether there are prospects that effectiveness can be achieved in the remaining half-term of the project. If any negative

impact emerges while the project is under way the Project strategy is supposed to be changed based on analysis of causes.

1-3 Members of the Joint Review Team

[Bangladesh Side]

Name	Title in Relation to the Project	Designation
Mr. Monoranjan Biswas	Member of Evaluation Committee	Joint Secretary, Japan – 2, Economic Relations Division Ministry of Finance
Mr. Ratan Kumar Sarker	Member of Evaluation Committee	Deputy Managing Director (Joint Secretary) & Project Director of PANI – 2 Project CWASA
Mr. A.H.M. Kamruzzaman,	Member of Evaluation Committee	Senior Assistant Chief, Planning – 3, Local Government Division Ministry of Local Government, Rural Development and Co-operatives

[Japanese Side]

Name	Title in Relation to the Project	Occupation
Mr. Sadanobu SAWARA	Leader of the Japanese Mid-term Review Team	Senior Advisor, JICA
Mr. Koji MITOMORI	Evaluation Planning	Representative, JICA Bangladesh Office
Mr. Zahid Hossain	Evaluation Coordination	Program Officer, JICA Bangladesh Office
Mr. Hiedyuki TAKAGI	Evaluation and Analysis	Ernst & Young Sustainability Co., Ltd

1-4 Schedules of the Joint Review

No	Date	Day	Team Leader, Evaluation Planning and Evaluation Coordination	Evaluation Analysis
1	Jan. 9	Sat.		Departure from Japan Arrival in Dhaka
2	Jan. 10	Sun.		Meeting with JICA Bangladesh Courtesy visit to LGD
3	Jan. 11	Mon.		Flight from Dhaka to Chittagong Courtesy visit to the Deputy Managing Director, CWASA Interview with the experts
4	Jan. 12	Tue.		Site visit (training center) Interview with the experts

No	Date	Day	Team Leader, Evaluation Planning and Evaluation Coordination	Evaluation Analysis
5	Jan. 13	Wed.		Interview with the C/Ps (Project Director) Data collection
6	Jan. 14	Thu.		Data collection Report preparation
7	Jan. 15	Fri.		Report preparation
8	Jan. 16	Sat.	Departure from Japan (Team Leader) Arrival in Chittagong (all members)	Report preparation
			Meeting with the experts	
9	Jan. 17	Sun.	Site visit (Water facilities) JICA Evaluation Team meeting	
10	Jan. 18	Mon.	Meeting with with the C/Ps (Project Director and Project Manager) Courtegy visit to the Managing Director, CWASA Meeting with KWSP consultants Meeting with the experts	
11	Jan. 19	Tue.	Preparation of the draft mid-term review report Flight from Chittagong to Dhaka	
12	Jan. 20	Wed.	Meeting of the Joint Review Team (Bangladsh side and Japanese side)	
13	Jan. 21	Thu.	Signing on the M/M for mid-term review Report to the Embassy of Japan Report to JICA Bangladesh Departure from Dhaka (Evaluation Analysis)	
14	Jan. 22	Fri.	Arrival in Tokyo (Evaluation Analysis) Departure from Dhaka (Team Leader)	
15	Jan. 23	Sat.	Arrival in Tokyo (Team Leader)	

2. Outline of the Project

2-1 Background of the Project

Chittagong city is the second largest city in Bangladesh with a population in the order of 2.9 million. Although it is the center of the country's industry with the largest international port and the first export processing zones, its infrastructure is by no means fully developed. The existing water supply system only meets about 47 per cent of the demand, there is no sewerage system and the storm water drainage network is ineffective.

Under the circumstances, CWASA currently develops its water facilities with the JICA funded "Karnaphuli Water Supply Project (KWSP) and KWSP Phase 2", for the purpose of increasing water production and improving the distribution network by the expansion and renewal of water facilities in Karnaphuli Service Area (KSA) where the population is about 1.2 million and the area is about 75km^2. In addition, the project for advancing NRW reduction initiative (PANI) of Chittagong WASA was implemented to improve its operation, by reducing the amount of non-revenue water (NRW) through the improvement of the water leakage from distribution pipes and the collection of water tariff.

However, challenges still remain for CWASA to become an independent entity in its managerial and financial aspects, such as constructing an efficient organizational structure,

setting an appropriate tariff level, developing the capacity for maintenance of water facilities by improving technical skills, and securing sufficient number of staff. The Project was officially requested to the Government of Japan (GOJ) by the Government of Bangladesh (GOB) to provide continuous assistance to CWASA to address these challenges.

2-2 Objectives of the Project

The Project aims to contribute to the citizens of Chittagong city by providing an increased volume of safe water, through the improvement of organizational and technical capacity of CWASA and reducing NRW based on the past cooperation mentioned in the background of the Project. It has been under implementation for four years since March 2014 and is scheduled to be completed in March 2018[2]. The basic project framework is shown below.

Overall Goal	CWASA serves the citizens of Chittagong in an efficient, effective and customer focused manner.
Project Purpose	CWASA's operational and institutional capacity is strengthened.
Outputs	1. CWASA's business management capacity is improved. 2. CWASA's financial and commercial management capacity is improved. 3. CWASA's operation and maintenance system is improved.

3. Review of Progress and Achievement of the Project

3-1 Inputs to the Project

(1) Inputs from Japanese side so far are as follows:

1) Experts

- Four short-term experts including consultants on 1) team leader /operation and maintenance, 2) institutional and corporate management, 3) finance and accounting (2), 4) distribution network (2), 5) GIS database, 6) GIS database and assistant.
  (Refer to Annex 1)

2) Equipment for the implementation of the Project

- Electronic equipment including digital cameras, laser meters, etc. which totaled 216 thousand yen by the end of February 2015.

3) Oversea training

- In the preceding phase of the Project (PANI-1), third country training was carried out at Metro Cebu Water District (MCWD) in the Philippines, focusing on NRW reduction. The

[2] According to TAPP, project implementation period is from July 2015 to June 2019.

Project plans to conduct training at MCWD again around March 2016, focusing on the fields of meter reading, bill collection and customer service activities.

4) Local activity expenses of approximately 50 million yen by January 2016.

(2) Inputs from Bangladesh side so far are as follows:

1) Allocation of counterparts (C/Ps)

- One project director, one project manager and four CWASA staff as technical counterparts by the time of the mid-term review.
- The technical counterparts are allocated to GIS database and NRW activities. (Refer to Annex 1)

2) Office space and other necessary facilities.

3) Space for GIS section, NRW training center and water meter testing laboratory4) Local cost has not been allocated by the time of the mid-term review, due to the delay in the approval of the technical assistance project proposal (TAPP) by the government until June/July 2015.

3-2 Progress of Activities and Achievement of Outputs

Output 1: CWASA's business management capacity is improved

(1) The progress of each activity for Output 1 is as follows:

- Activity 1-1 "CWASA board approves the revised organization structure": The organogram for the first revision planned to be made in the middle of 2016 (reflecting the completion of construction and commencement of operation of the water treatment plant (WTP) of KWSP) is supposed to be approved by the board following the explanation to the Local Government Division, Ministry of Local Government, Rural Development and Co-operatives (LGD) on January 6, 2016; therefore, this activity has almost been completed. Whereas the draft organogram was explained by the Project to the officials and the executive personnel engaged in actual work in May 2015, the approval by the board has been delayed longer than expected. As a result, the necessary staffing in accordance with the organogram has also been delayed. Further, the delay affects other project activities and the training of the operation and maintenance staffs for WTP constructed by KWSP.

- Activity 1-2 "CWASA develops detailed transitional plan up to 2020 and implements it up to 2017": Draft organograms for the second revision planned to be made in the middle of 2018 (reflecting the completion of construction and commencement of the operation of WTPs by KWSP-2 and a World Bank (WB) funded project namely Chittagong Water Supply Improvement and Sanitation Project (CWSISP)) have been prepared and explained to the officials and the executive personnel engaged in actual work in May 2015. It is

necessary in implementing the organizational restructuring that the human resources of CWASA be strengthened further, by securing the necessary number of staffs and conducting training for them. Therefore, the Project plans to hold seminars on strengthening the operation of the restructured organization.

- Activity 1-3 "Outline planning of organogram after 2020": Draft organograms for the third revision in 2021 (reflecting the completion of all the facilities of KWSP-2) and the fourth revision in 2030 (for further improvement as the mid-term goal of the organizational structure) were explained by the Project to the officials and the executive personnel engaged in actual work in May 2015. The draft organograms will be reviewed throughout the project implementation.

- Activity 1-4 "CWASA reviews, identifies and proposes amendment of rules and regulations": Identification of the problems in its internal rules has been completed. Preparation of express provisions and consideration for the ways of internal utilization are the forthcoming challenges, as such provisions are not well organized at present. Currently, the Project is engaged in the revision of internal rules.

- Activity 1-5 "CWASA reviews the training policy, prepares and implements yearly comprehensive staff training": Consideration for the training items has been in progress, which will be included in the new comprehensive staff training program. Those items are classified into two categories: one involves the training items which need to be conducted by the Project and the other includes those items CWASA can conduct by itself. Among those training items, the Project has already prepared and conducted the trainings for leakage detection and pipeline repair which utilizes the NRW management training center through activities 3-5 and 3-7, as these trainings are highly prioritized.

- Activity 1-6 "CWASA develops the customer service division": A customer service center with the function of call center will be established. Currently, the Project is developing a geographic information system (GIS) database, customer mapping and pipeline mapping which will be used in the center, based on utilizations of resources on customer management in CWASA. The Project plans to start establishing the center in the next fiscal year starting from July 2016 after the approval of the organogram.

- Activity 1-7 "CWASA continuously and efficiently updates key management documents (annual business plan, strategic plan, MIS report, performance agreement, financial

statements)": The Project is currently developing a system utilizing data from the supervisory control and data acquisition (SCADA) and GIS database for the purpose of enabling CWASA to prepare monthly reports of the management information system (MIS). The system is supposed to provide the accurate basic management information to the managers on monthly basis after 2022, when the construction of KWSP-2 will be completed. The management information includes, among other things, the debt payment status, the volume of water production, distribution and consumption, the results of meter-reading, the status of bills collected and in arrears, and the change in the number of customers.

- Activity 1-8 "CWASA develops and implements the HR and recruitment policy": The Project considers the allocation, policy on training and promotion of human resource and the introduction of incentives, anticipating the forthcoming business management with expanded water supply services. The HR and recruitment policy will be drafted in or around March 2016.

- Activity 1-9 "CWASA reviews and proposes measure to increase the environmental compliance capability": Although there will be a huge amount of sludge from the operation of the WTPs constructed by KWSP and KWSP-2, measures for the treatment of sludge were not clearly defined at the time of the planning of these projects. The Project plans to build and conduct remedial measures on carrying sludge to the waste disposal site operated by Chittagong city and sanitary landfill disposal in cooperation with the city government.

(2) Achievement of Output 1

There are four indicators set for output 1. Current status and expectation of the achievement of the indicators are as follows:

Indicator:

1-1 "Required posts of the revised organizational structure are filled with qualified staffs who are trained through the Project": The project plans to start allocating staffs including the recruiting of new staffs after the approval of the organogram by the activity 1-1.

1-2 "Proposed amendments of rules and regulations are approved by CWASA board": Revised rules and regulations have been drafted by activity 1-4.

1-3 "Customer service department is developed and staffs are assigned in the department": Construction of the database which will be utilized in the customer service center with the function of call center is in progress.

1-4 "CWASA's key management documents are updated on time": Works aiming for accurate and timely reporting by MIS have been in progress; however, they will not be achieved by 2022 when the construction of KWSP-2 will be completed.

The activities for output 1 have been in progress as planned in general. However, delay in the approval of organogram prepared by activity 1-1 affects the necessary staffing and other project activities, and the training of the operation and maintenance staffs for WTP constructed by KWSP also. Regarding the treatment of sludge from WTP, cooperation with other projects related to solid waste management may be necessary to solve the issue. Achievement of output indicators 1-3 (development of customer service center) and 1-4 (update of key management document) are uncertain within the project period, due to the factors described above.

Output 2: CWASA's financial and commercial management capacity is improved

(1) The progress of each activity for Output 2 is as follows:

- Activity 2-1 "CWASA restructures Long-term Debt": Currently, a simulation for restructuring the long-term debt of CWASA has been conducted, assuming that the water sales revenue will increase by the expansion of its water supply services and the improvement of bill collection efficiency through the project for the improvement of water facilities and the implementation of the Project.

- Activity 2-2 "CWASA plans and implements measures to increase revenue generation": The Project positions the improvement of bill collection efficiency by the implementation of activity 2-3 as the main measure to increase revenue generation. In addition, it plans to adopt the classification of demand type by usage and by pipe size and the progressive water tariff structure.

- Activity 2-3 "CWASA implements measures to improve bill collection efficiency": The Project plans to expand accurate and efficient ways of meter reading work, to strengthen bill collection work, and to promote registration of the citizens who have not registered as the customers of CWASA. As for the meter reading work, portable meter reading terminals will be introduced on a trial basis, for the purposes of making the meter reading work efficient, reducing input errors and preventing harmonious relationships between meter readers and customers. A customer database and customer maps will be utilized for meter reading work with the portable meter reading terminal. In addition, the Project plans to focus on the fields of meter reading, bill collection and customer services which relate to this activity.

- Activity 2-4 "CWASA maintains an overview of installation of the computerized accounting and billing system": The Project plans to connect the accounting software and the GIS database, which will enables immediate uploading of data from the portable meter reading terminal to the accounting software.

- Activity 2-5 "CWASA expands customer data base and computerizes management of asset": The Project plans to develop computerized asset ledgers per asset types and sites, which covers all the water service facilities.

- Activity 2-6 "CWASA improves Tube Well Licensing": No maps have been prepared for private deep wells, which number tens of thousands at present. Under the circumstances, the Project plans to transfer technology about the computerization of paper forms, to assist the record management on the data collection of the private deep wells to the CWASA staffs through the customer survey, so that the staff members are able to collect the basic information including location, pumping discharge, size and owner's name. The collected data of the private deep wells will be managed in a database.

- Activity 2-7 "CWASA increases water supply to the LICs": The Project planned to prepare and implement a plan for supplying water to the model low income communities from April 2015, in cooperation with the activities of a Japan Overseas Cooperation Volunteer (JOCV). However, this activity has been suspended because of Japanese Security Policy, which caused the JOCV to return to Japan. Currently, the Project expects to dispatch JOCV again, and it also plains another means for this activity by the local staff in an intensive manner.

(2) Achievement of Output 2

There are three indicators set for output 2. Current status and expectation of the achievement of the indicators are as follows:

Indicator:

2-1 "Long-term debt restructuring plan is approved": A simulation for restructuring the long-term debt of CWASA has been conducted by activity 2-1. Based on the result, a plan for water tariff revision will be prepared and submitted together to the board of CWASA.

2-2 "CWASA's revenue at the time of terminal evaluation is increased compared with the start of the Project": The usage of tap water by the citizens will be increased by the improvement of water supply after the commencement of the WTP constructed by KWSP.

The project expects to increase in revenue by supporting efficient bill collection and appropriate arrangement for the expected increase of new registrations and payments from customers in arrears for tariff payments.

2-3 "Monthly MIS report is updated monthly and year end accounts are prepared yearly on time": Financial reports have already been prepared regularly. The Project now works for accurate and timely preparation of the reports by the development of computerized systems through activities 1-7 and 2-4.

The activities for output 2 have been in progress as planned in general. However, the achievement of long-term debt restructuring set as indicator 2-1 is considered beyond the capability of a technical cooperation project but needs to be solved. Therefore, it is desirable that the indicator be modified to be practical and specific.

Output 3: CWASA's operation and maintenance system is improved

(1) The progress of each activity for Output 3 is as follows:

- Activity 3-1 "Establish water meter testing facility and conduct training": Procurement of the equipment for the meter testing facility has been completed and will be transported to Chittagong within February, 2016, and installation of the facility is planned to be completed by the middle of 2016. From the stage of equipment installation, the Project plans to start a series of on-the-job trainings (OJT) and lectures regarding the operation and maintenance of the facilities to the staff specialized in this task.

- Activity 3-2 "CWASA continues to update GIS database and map to accommodate all water supply facilities (e.g. water meter, pipeline) and customer": Update of GIS and customer databases has been continued from the preceding phase of the Project. The updated data was verified among CWASA resources including the consumer service connection completion report, the customer management ledger, and the billing database; which enables these data be updated and synchronized. It has also become possible that customer ID number are issued and utilized for customer services, through the correction of errors in the billing database such as the names and addresses of customers. It is necessary that updating of these databases be continued until the completion of KWSP-2 in 2022, especially for recording of the new pipeline network into GIS database.

- Activity 3-3 "CWASA implements a NRW reduction work plan in KSA which was developed in PANI": The Project plans first to confirm the location and mapping of the existing distribution pipelines through the assistance of leakage control measures and its

monitoring outside KSA, which will be conducted by activity 2-5. Based on the information, activities for NRW reduction work will be conducted by sending the leakage detection teams and plumbers.

- Activity 3-4 "CWASA develops a Sector-wise water distribution system management plan": The Project aims to prepare plans for pipeline management as one of the main activities in the last half period of the Project, which covers all ten sectors developed by KWSP-2.

- Activity 3-5 "CWASA conducts on-the-job training on leakage detection and repair work, and conducts NRW monitoring in DMA (District Metered Area) to be established in KSA": Capacity of the leakage detection and pipeline repair staffs has been developed through the training courses developed by activity 1-5, which utilizes the NRW management training center. Thirty CWASA staff members have completed the training course and have been issued the training course completion certificate so far. The Project plans to start practical training for leakage detection and pipeline repair work in the field from 2016. NRW monitoring will be developed for both the new distribution pipelines and the existing distribution pipelines.

- Activity 3-6 "CWASA conducts R&D activities to initiate and standardized indigenous plumbing instruments and tools": This activity was completed by providing technical advice to two domestic manufacturer so far, for the purpose of improving the quality of tapping saddle made of hard plastic, which is used for branching water from distribution lines to service connections, and a drilling tool for installing the saddle to the distribution pipelines.

- Activity 3-7 "CWASA finalizes O&M training modules and provides training to CWASA's staff, as well as plumbers of private sectors": The Project plans to start recruiting plumbers from February 2016 and developing their capacity through the training courses developed by activity 1-5, which utilizes the NRW management training center, and the trained plumbers will be sent to the field work. There has been a system of publicly certifying the skills of plumbers who have completed training by issuing the training course completion certificate with a photo ID card.

- Activity 3-8 "CWASA reviews all O&M Manuals (and revises, if necessary) and conducts necessary training to CWASA staff": The Project plans to prepare a standard manual for

the operation and maintenance of WTPs based on that for the WTP constructed by KWSP. Regarding the distribution pipelines and water meters, draft manuals for maintenance and troubleshooting have been created and used for the training of staff through OJT and workshops. In addition, draft inspection sheets for the preventive management of the distributing facilities have been created, and workshops have been held regarding the main points of facility inspection, confirmation method and how to fill in the form. In order to share these manuals among the sections, the Project supports to archive the files in an electronic library.

- Activity 3-9 "CWASA improves outsourcing procedures and develops guidelines for outsourcing": Currently, the Project extracts works suitable for outsourcing from the operation of CWASA; maintenance of the IT system, pipeline repair to the plumbers trained through activity 3-7, and meter reading have been considered as possible work to be outsourced.

- Activity 3-10 "CWASA modernizes the stores operation and improves the system of logistics support": The Project plans to construct databases of pipe materials centered on Halishahar Store, water meters and electric supplies used in WTPs. The lists of materials and equipment managed in the four main divisions of CWASA have been integrated so far. After the construction of the databases, the Project plans to construct a periodic update program.

- Activity 3-11 "CWASA establishes and updates technical standards": The Project prepares the work standards and manuals for the ordinary construction activities including the maintenance of water facilities, renewal and extension of pipelines, and the installation of water meters, by referring the design criteria and the technical standards of KWSP and KWSP-2. As a part of the activity for the technical standards, the draft O&M manuals prepared by activity 3-8 will be revised accordingly thorough the implementation of OJT.

(2) Achievement of Output 3

There are five indicators set for output 3. Current status and expectation of the achievement of the indicators are as follows:

Indicator:

3-1 "NRW ratio of existing pipe network in the KSA is not increased by the strong pressure due to commissioning of KWSP": Leakage from the existing pipelines will likely increase

when the WTP of KWSP starts its operation (scheduled for June 2016), and measures for the leakage are necessary. In specific, small diameter pipelines will be repaired by the CWASA staff for leakage detection and pipeline repair whose capacity are developed through activities 3-4 and 3-5. Large diameter pipelines with leakage (asbestos pipes) will be replaced by outsourcing the construction to external construction companies. Therefore, it is important that the budget for outsourcing the replacement work is secured; however, it is not certain at the time of the mid-term review.

3-2 "GIS database is linked with customer and tariff systems": Together with the update of GIS database by the activity 3-2, the customer database has been expanded by activity 2-5 and the accounting and bill collection systems will be linked by activity 2-4.

3-3 "CWASA adopts technical standards": The Project plans to prepare the work standards and manuals for the ordinary construction activities through activity 3-11.

3-4 "Store inventory is developed and updated monthly": The Project constructs the database for inventory management through activity 3-10.

3-5 "XX No. of CWASA staff and XX No. of private plumber receive training and 80% of them passes the technical examination to be conducted after the training": Thirty CWASA staff members have completed the training course through activity 3-5 and have been issued the training course completion certificate so far. The Project plans to train twenty more CWASA staff members through activity 3-5 and about fifty external plumbers through activity 3-7, respectively.

The activities for output 3 have been in progress as planned in general. However, the external factors described in 4-3 (Efficiency) affect the implementation of practical training for the leakage detection and pipeline repair in the field. In addition, the necessary budget has not been secured yet for outsourcing the replacement of larger diameter pipes after the WTP of KWSP start its operation.

3-3 Implementation Process

The Project has been implemented by the same JET from the previous phase, which maintains good relationship between the C/Ps. Communication between both sides has been made appropriately. Therefore, neither C/P nor JET recognizes particular issues in the implementation process of the Project. However, both C/P and JET recognize it is essential that CWASA staff in general should have higher motivation on their given tasks for the achievement of the project objectives.

4. Review based on Five Evaluation Criteria

4-1 Relevance

(1) Relevance to the national development policy

During the time from the planning to this mid-term review, the sixth five-year development plan (2011-2015) positions safe water supply and sanitation as the main purpose of urban development, which targets 100% access to safe water in the urban area by 2015 in its development strategy.

(2) Relevance to the sector development policy

The national water policy (prepared in 1999) enhances the policy on water supply including the promotion of safe drinking water at a reasonably low price and the strengthening of the authority of water utilities and local governments on controlling wasteful use and pollution of water. Based on the policy, the national water management plan was prepared in 2004, which includes the plans for the development of water source and the improvement and expansion of existing water supply system in Chittagong.

(3) Relevance to the development needs

The water supply in Chittagong before the implementation of the Project (as of 2011) was only about 47% of the demand; therefore the projects for the development of water facilities (KWSP and 2) have been executed for the purpose of improving imbalance between supply and demand. This technical assistance project was needed for the operation and maintenance of facilities being strengthened and the business operation for sustaining water supply being expanded by KWSP and KWSP-2.

(4) Relevance to Japan's ODA policy

The basic policy of the country assistance policy for the Republic of Bangladesh (2012) at the time of planning is to provide support for "Accelerating sustainable economic growth with equity and bringing people out of poverty towards becoming a middle-income country", based on the Bangladesh 6th Five-Year Plan (2011-2015), which sets a goal of "Acceleration of economic growth and poverty reduction" and puts the emphasis on employment creation, industrial development, enhancing governance and the promotion of social services across the country. The Project is consistent with assistance for the water sector within the urban development program, which is included in the priority area "Accelerating sustainable economic growth with equity and bringing people out of poverty towards becoming a middle-income country" in this country assistance policy.

(5) Comparative advantage of Japanese technological skill

In Japan, the service coverage of piped water supply is about 98%, and the water quality standards are strict in comparison to those in other countries. So for enhancing the promotion of safe drinking water, comparative advantage is high in Japan. In addition, the water supply sector is the field where Japan has achieved most results of assistance to developing countries among the donors. Therefore, it is considered meaningful that the technical assistance is provided to share Japan's technology and experience of water supply by the Project.

In light of the above, the Project is highly consistent with the development policy and development needs of Bangladesh, as well as Japan's ODA policy. In addition, Japan's technological advantages regarding water supply are high. Therefore, relevance of the Project is high.

4-2 Effectiveness

(1) Achievement of outputs

As described in 2-2. Progress of Activities and Achievement of Outputs, there have been delays in the progress of some activities. From the viewpoint of the Project as a whole, activities for the improvement of CWASA's management and operation have been implemented with the attitude of addressing challenges. As a result, the Project has been pressed by steady and huge tasks for the construction of infrastructure for management such as the database, and some output indicators will not be achieved until these tasks progress. Regarding the achievement of outputs, basically no targets were set for the completion of activities and the achievement of outputs by the intermediate time. Therefore, observing the achievement situation of some outputs such as the revised organogram, updating of GIS and customer databases which has been continued from the preceding phase of the Project, and capacity development of leakage detection and pipeline repair staffs, the Project has achieved outputs as planned in general so far. On the other hand, some outputs may be difficult to achieve within the project period.

(2) Important Assumption for the outputs

- "CWASA's organogram is revised": The organogram for the first revision planned to be made in the middle of 2016 (reflecting the completion of construction and commencement of operation of the water treatment plant (WTP) of KWSP) was supposed to have been approved by CWASA board following the explanation to LGD on January 6, 2016. As a result of delay in this assumption, the necessary related staffing has been delayed, and it also affects other project activities and the training of the operation and maintenance staffs for WTP constructed by KWSP.

(3) Expectation of achieving the project purpose

Project Purpose: CWASA's operational and institutional capacity is strengthened

One indicator is set for the project purpose.

Indicator:

1. "Targets set in Performance Agreement between LGD and CWASA at the last year of the project are achieved": Based on the observation of the achievement of activities and outputs by the time of mid-term review, the contribution of the Project to the achievement of targets set in performance agreement has been limited. These targets are established as comprehensive performance targets as a water utility.

   These comprehensive performance targets include items to which the water facility development projects contribute more on the achievement. Therefore, the performance agreement should be placed as an overall goal, and indicators set by selecting among the targets by which the effects of the Project are appropriately measured.

(4) Important assumption for the project purpose

None

Achievement of the outputs has been as planned in general so far. Regarding the project purpose, there is no reasonable basis for expecting the achievement at the time of the mid-tem review. Some outputs may be difficult to achieve within the project period, and the water facility development projects contribute more on the achievement of current project purpose indicator than this Project. In light of the above, effectiveness of the Project is fair, considering the achievement of the outputs.

4-3 Efficiency

(1) Inputs to the Project

Inputs by the Japanese side have basically been made as planned. However, some parts of the inputs by the Bangladesh side have been delayed: the technical C/Ps for the activities for outputs 1 and 2 will be allocated after the mid-term review, and the local cost has not been allocated yet due to the delay in the approval of TAPP by the government. (Refer to 3-1. "Inputs to the Project" for details)

In addition, the Bangladesh side expects capacity development of younger and/or future executive officers who will play important roles in CWASA in the future. Therefore, the C/Ps should be allocated so that the Project further develops mindset and technical skills of these capable young personnel, in the last half period of the project period.

(2) Preconditions for the activities

- "CWASA's organogram is approved and CWASA is duly delegated the authority": The existing organogram was approved in October 2013. As a result, CWASA has been able to approve revision of the organogram by its Board.

  On the other hand, there has been no delegation of authority on setting the water tariff, which is one of the important items for CWASA to be an autonomous entity: currently, increase of water tariff level is limited to 5% per year, and authority for further increase has not been delegated.
- "Sub Loan Agreements (SLA) of KWSP & KWSP-2 are approved": SLA has been concluded.

(2) Contributing/Obstructing factors for the activities

Establishment of the NRW management training center, which is described in activity 3-5, was realized in collaboration with CWSISP, a WB funded project. By utilizing this training center, the Project has been able to conduct practical trainings on leakage detection and pipeline repair, under conditions where training in the field by Japanese Experts cannot be conducted due to the current Japanese security policy.

Progress of the project activities has been affected by the following external factors. Activities were temporarily behind schedule as dispatch of JET was suspended due to the repeated strikes from January through March 2015. Securing the budget for project activity cost was delayed as TAPP was not approved by the government until October 2015. Implementation of practical training for leakage detection and pipeline repair work in the field has not been in progress at the time of the Mid-term Review.

In light of the above, efficiency of the Project is fair, as some of the inputs have not been made as planned and some activities were suspended and/or restricted, affected by the external factors.

4-4 Impact

(1) Expectation of achieving the overall goal

Overall Goal: CWASA serves the citizens of Chittagong in an efficient, effective and customer focused manner

Three indicators are set for the overall goal.

Indicator:

1. "Safe water is available to XX% of residents in KSA and XX% of residents in Chittagong city": The Project plans to confirm the baseline and set the target after the preparation of

basic data, through the customer survey and the construction of a database.

Regarding the current indicator, the water facility development projects contribute more to the achievement than the Project. Therefore, it is better that this indicator is revised from the viewpoint of the objectives and the content of the Project.

2. "Water is available to customers on a 24/7 basis in KSA": Similar to indicator 1, the Project plans to confirm the baseline and set the target after the preparation of basic data.

   The water facility development projects contribute more to the achievement than the Project on this indicator as well. Therefore, it is better that this indicator is revised from the viewpoint of the objectives and the content of the Project.

3. "Customer satisfaction is improved XX% (% will be set by the baseline survey)": The Project plans to conduct a baseline survey during the last half project period in pilot areas. The target of the indicator will be set based on the result of the baseline survey.

   It is better that this indicator is also revised from the viewpoint of the objectives and the content of the Project, by choosing items from the customer satisfaction survey.

(2) Important assumption for the overall goal

- "KWSP is successfully completed and KWSP-2 is successfully going on": As for KWSP, it is planned to commence the operation from June 2016, whereas the construction has been delayed for around one year compared to the original plan. It is expected that the Project will conduct pipeline repair for the leakage after KWSP facility start supplying water. The construction of KWSP-2 has been in accordance with the plan so far.
- "CWASA can coordinate this T/C (i.e., this project) with other projects (KWSP and KWSP-2)": It was confirmed by interview with CWASA that it has been coordinating these projects appropriately.

(3) Unintended positive/negative impact

The data from GIS database constructed by the Project has been utilized in the planning of other projects for the development of infrastructure (gas, roads etc.).

Current indicators for the overall goal suggest that the water facility development projects contribute more on the achievement than the Project. Therefore, there is no reasonable basis for expecting the achievement of the overall goal indicators at the time of the mid-tem review. It is necessary that measures be taken for achieving the overall goal of the Project "CWASA serves the citizens of Chittagong in an efficient, effective and customer focused manner."

4-5 Sustainability

(1) Policy and systems aspects

Policies for water supply in Chittagong described in 4-1 "Relevance" have been sustained.

(2) Organizational aspects

The Project reorganizes the structure of CWASA. For the purpose of securing organizational sustainability, it is necessary that personnel are placed in accordance with the revised organogram promptly, and the Project supports the new organization to function effectively through the project activity in the remaining project period.

(3) Technical aspects

In the Project, the capacity of the staff for leakage detection and pipeline repair has been developed accordingly. In addition, draft manuals for the maintenance and troubleshooting of distribution pipelines and water meters have been created and used for the transfer of technical skills. As for the operation and maintenance of WTPs, the Project plans to prepare a standard manual. It is necessary that these technical standards are established in CWASA through the transfer of technical skills in the remaining project period.

(4) Financial aspects

In the Project, transfer of technical skills has been conducted using the NRW management center. In addition, it plans to establish a customer service center with the function of call center and to integrate IT systems including databases, SCADA and accounting system. From the viewpoint of financial sustainability, it is necessary that budget is secured appropriately by CWASA, for the operation of the training center and the costs for such activities as mentioned above.

In light of the above, it is necessary that challenges in terms of organizational, technical and financial aspects be solved. Measures need to be taken for these challenges through future effort in the project implementation.

5. Conclusion

Relevance of the Project is high because the plan of the Project needs to be reconsidered in some parts whereas it is highly consistent with the development policy and development needs, and Japan's technological advantages regarding water supply is high. Effectiveness of the Project is fair considering the achievement of the outputs so far, because there is no reasonable basis for expecting the achievement of the project purpose at the time of the mid-tem review. Achievement of the outputs has been as planned in general. Efficiency of the Project is fair, as

some of the inputs have not been made as planned and some activities were suspended and/or restricted, affected by the external factors. As for impact and sustainability, no decisions are made for the evaluation, because the expectation for the achievement of project purpose is not certain at the point of the mid-term review, and it is necessary to take measures for the challenges. Instead, recommendations are proposed for the activities in the remaining project period.

6. Recommendations and Lessons Learned

6-1 Recommendations

(1) Expedite the organogram approval

There is a pressing need to allocate proper number and quality of staff based on the new organogram. Since the Project is designed to have most of its activities based on the new organogram CWASA should expedite approval of the organogram and recruitment of new staff.

(2) Mid-term and Long-term financial plan of CWASA

The team confirmed that project activities address various management and operational matters of CWASA, which are expected to contribute to the sound operation and management of new water supply facilities. It is expected that KWSP, which is going to be completed in the very near future, would drastically increase CWASA's O&M expenditures including personnel costs, electricity charges and chemical costs. It is also expected that the repayment of loan principals on KWSP will start in the near future. Under the circumstances, it is strongly recommended that CWASA prepare a mid-term and a long-term financial plans (including projection of income statements and cash-flows) within the framework of this Project.

(3) Tariff collection improvement

The Team considers that increasing water tariff revenues is a key to sustainable and autonomous business management of CWASA. The Project should therefore accelerate the installation of water meters to approximately 8,000 customers in KSA who were found to have either no water meter or a malfunctioning water meter. The Project also needs to review and revise, if necessary, the meter reading, billing and collection systems that are currently put in place by CWASA with a view to increasing water tariff revenues.

(4) Operation and Management Manuals

The Team considers that the preparation of Operation and Management Manuals and Standard Operating Procedures (SOPs) by the Project is very important. It is suggested that the Project should prepare manuals and SOPs based on discussions among relevant staffs and

feedback from other development partners, and finalize them at the end of the Project.

(5) Human Resources Development

The Project contributed to CWASA's human resource development through implementation of the Project including training both in Bangladesh and Japan. The Project has been strengthening the capacity of younger generation staff who are expected to play pivotal roles in the operation and management of KWSP and KWSP-2. The Team suggests that it should be continued in the remaining period of the Project. The Team also acknowledged that the Project has been conducted without good participation of CWASA counterparts in some activities. The Project needs to designate responsible staff to each activity and encourage those staff's participation.

END

Annex 1. List of Japanese Experts and Bangladesh Counterparts

(1) Japanese Experts

Name	Task /Expertise	Approx. dispatch period (until January 2016)
Mr. Masuomi Hiroyama	Team leader /Operation and maintenance	17 MM from March 2014
Mr. Toshihiko Tamama	Institution and corporate maangement	9 MM from June 2014
Mr. Yoshio Chikamatsu	Financial and accounting 1	7 MM from June 2014
Mr. Masao Takayanagi	Financial and accounting 2	4 MM from August 2015
Mr Isao Sakaoka	Distribution network 1	14 MM from April 2014
Mr. Satoru Oniki	Distribution network 2	11 MM from April 2014
Mr. Kazumi Suwabe	GIS database	15 MM from March 2014
Mr. Hirotetsu Koike	GIS database /Assistant	7 MM from May 2014

(2) Bangladesh Counterparts (as of January, 2016)

Name	Task /Position
Mr. Ratan Kumar Sarkar	Project Director /Deputy Managing Director (Engineering)
Mr. Maksud Alam	Project Manager /Executive Engineer
Mr. Saiful Islam	GIS C/P /Assistant Engineer
Ms. Keya Chowdhury	GIS C/P /Assistant Engineer
Ms. Hasnatul Zannat Sweety	GIS C/P /Sub Assistant Engineer
Ms. Taslima Akter	GIS C/P /Sub Assistant Engineer

Annex 2. List of C/Ps who completed the leakage detection and pipeline repair training course

No.	Name	Division	Position
1	Mr. Shohel Rana	MOD-1	Helper
2	Mr. Surja Kumar Das	Sales	Assistant Plumbing Mechanics
3	Mr. Md. Ullah	MOD-1	Plumbing Mechanics
4	Mr. Abul Khair	MOD-1	Plumbing Mechanics
5	Mr. S.M. Abbas Hossen	MOD-2	Assistant Plumbing Mechanics
6	Mr. Sekander Meah	MOD-1	Plumbing Mechanics
7	Mr. Md. Riazul Islam	MOD-2	Helper
8	Mr. Yousup Mirza	MOD-1	Helper
9	Mr. Sonjoy Bossu	CD-1	Helper
10	Mr. Mohammad Akhtar Hossein	MOD-1	Helper
11	Mr. Nasir Uddin Ahmed	PANI	Field Survey Guidance Asst.
12	Mr. Md. Mostafa	PANI	Field Survey Guidance Asst.
13	Mr. Md. Rasel Mia	MOD-2	Helper
14	Mr. Nurul Islam	MOD-1	Plumbing Mechanics
15	Mr. Md. Afsar	MOD-2	Assistant Plumbing Mechanics
16	Mr. Md. Aourongojeb Mondal	PANI	Supervision Engr.
17	Mr. Zahidul Islam	PANI	Supervision Engr.
18	Mr. Md. Mortoza Alli Hyder	PANI	Service Connection Expert
19	Mr. Syed Mohammad Taiyab Hossain	PANI	Leakage Detection Specialist
20	Mr. NURUL AMIN	Sales	Assistant Plumbing Mechanics
21	Mr. RATAN KUMAR DAS GUPTA	MOD-1	Plumbing Mechanics
22	Mr. IDRISH MIAH	MOD-1	Assistant Plumbing Mechanics
23	Mr. MD. HANUNUR RASHID	MOD-2	Plumbing Mechanics
24	Mr. NURUL ALAM	MOD-2	Plumbing Mechanics
25	Mr. MD. FARUK	Sales	Plumbing Mechanics
26	Mr. RICHARD NELSON PENHEIRO	Sales	Sub-Assistant Engineer
27	Mr. MD. JAMAL UDDIN	Sales	Assistant Plumbing Mechanics
28	Mr. ANOWAR HOSSEN	Mod-2	Assistant Plumbing Mechanics
29	Mr. MD. MOHIUDDIN	Sales	Plumbing Mechanics
30	Mr. MD. DELOWAR HOSSEN	Mod-2	Assistant Plumbing Mechanics

Annex 3. Project Design Matrix (PDM)
Technical Assistance Project for Institutional Improvement and Advancing NRW Reduction Initiative (PANI-2)
Project Site: Chittagong City
Project Implementation Period: From March 2014 to March 2018 (48 months)
Implementing Agency (Counterpart: C/P): Chittagong Water Supply and Sewerage Authority (CWASA)

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal CWASA serves the citizens of Chittagong in an efficient, effective and customer focused manner.	1. Safe water is available to XX% of residents in KSA and XX% of residents in Chittagong city 2. Water is available to customers on a 24/7 basis in KSA 3. Customer satisfaction is improved XX% (% will be set by the baseline survey)	1. CWASA's annual reports 2. MIS report 3. Customer surveys	
Project Purpose CWASA's operational and institutional capacity is strengthened.	1. Targets set in Performance Agreement between LGD and CWASA at the last year of the project are achieved	1. CWASA's performance agreement	1. Karnaphuri Water Supply Project (KWSP) - Phase1 is successfully completed and KWSP-Phase 2 is successfully going on. 2. CWASA can coordinate this T/C with other project (KWSP-1&2)
Outputs 1. CWASA's business management capacity is improved.	1.1 Required posts of the revised organizational structure are filled with qualified staffs who are trained through the Project 1.2 Proposed amendments of rules and regulations are approved by CWASA board 1.3 Customer service department is developed and staffs are assigned in the department 1.4 CWASA's key management documents are updated on time	1.1 CWASA's annual reports and list of training participants 1.2 CWASA's board Memo 1.3 Project Record 1.4 Key management documents 1.5 Project Record	
2. CWASA's financial and commercial management capacity is improved.	2.1 Long-term debt restructuring plan is approved 2.2 CWASA's revenue at the time of terminal evaluation is increased compared with the start of the project 2.3 Monthly MIS report is updated monthly and year end accounts are prepared yearly on time	2.1 Approval letter from LGD 2.2 MIS report 2.3 MIS report and CWASA's financial statements	
3. CWASA's operation and maintenance system is improved.	3.1 NRW ratio of existing pipe network in the KSA is not increased by the strong pressure due to commissioning of KWSP 1 3.2 GIS database is linked with other customer and tariff systems 3.3 CWASA adopts Technical standards 3.4 Store inventory is developed and updated monthly 3.5 XX No. of CWASA staff and XX No. of private plumber receive training and 80% of them passes the technical examination to be conducted after the training	3.1 MIS report and project record 3.2 Project record 3.3 Project record 3.4 Stores inventory 3.5 List of Training Participants	

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Activities	Inputs (Japanese side)	(Bangladesh side)	
1-1. CWASA board approves the revised organization structure. 1-2. CWASA develops detailed transitional plan up to 2020 and implements it up to 2017. 1-3. Outline planning of organogram after 2020 1-4. CWASA reviews, identifies and proposes amendment of rules and regulations. 1-5. CWASA reviews the training policy, prepares and implements yearly comprehensive staff training program. 1-6. CWASA develops the customer service division. 1-7. CWASA continuously and efficiently updates key management documents (*1). 1-8. CWASA develops and implements the HR and recruitment policy. 1-9. CWASA reviews and proposes measure to increase the environmental compliance capability.	1. Dispatch of Experts • Team Leader and Operations and Maintenance Specialist • Business Management Specialist • Financial and Commercial Specialist • Water Distribution Management Specialist and other experts based on the necessity 2. Equipment • Additional Computers, printers, photocopier and scanner for the T/C office (Continuous use of equipment provided under PANI-1) • Water meter testing equipment including installation and commissioning & initial training 3. Renovation of water meter testing laboratory including water meter database and OJT for CWASA staffs 4. Oversea Training Oversea trainings for improving	1. Counterpart Staff • Project Director (PD) in charge on a daily basis • 2 Project Managers (PM) 2. Facilities • Office space, furniture and facility with the office cleaning service at CWASA's Dampara headquarters building • Training facilities 3. Local cost • O&M equipment • Project management cost 4. Others • GIS settings	CWASA's organogram is revised. **Preconditions** 1. CWASA's organogram is approved and CWASA is duly delegated the authority. 2. SLA of KWSP-1&2 are approved.
2-1. CWASA restructures Long-term Debt. 2-2. CWASA plans and implements measures to increase revenue generation. 2-3. CWASA implements measures to improve bill collection efficiency. 2-4. CWASA maintains an overview of installation of the computerized accounting and billing system. 2-5. CWASA expands customer data base and computerizes management of asset. 2-6. CWASA improves Tube Well Licensing. 2-7. CWASA increases water supply to the LICs.			

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3-1. Establish water meter testing facility and conduct training. 3-2. CWASA continues to update GIS database and map to accommodate all water supply facilities (e.g. water meter, pipeline) and customer. 3-3. CWASA implements a NRW reduction work plan in KSA which was developed in PANI. 3-4. CWASA develops a Sector-wise water distribution system management plan. 3-5. CWASA conducts on-the-job training on leakage detection and repair work, and conducts NRW monitoring in DMA (District Metered Area) to be established in KSA. 3-6. CWASA conducts R&D activities to initiate and standardized indigenous plumbing instruments and tools. 3-7. CWASA finalizes O&M training modules and provides training to CWASA's staff, as well as plumbers of private sectors. 3-8. CWASA reviews all O&M Manuals (and revises, if necessary) and conducts necessary training to CWASA staff. 3-9. CWASA improves outsourcing procedures and develops guidelines for outsourcing. 3-10. CWASA modernizes the stores operation and improves the system of logistics support. 3-11. CWASA establishes and updates technical standards.	external relationships and strengthening management and techniques		

*1: Key Management Documents: Annual business plan, Strategic plan, MIS report, Performance agreement, Financial statements

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Annex 4. Ideas for the revision of Project Design Matrix (PDM)
Technical Assistance Project for Institutional Improvement and Advancing NRW Reduction Initiative (PANI-2)
Project Site: Chittagong City
Project Implementation Period: From March 2014 to March 2018 (48 months)
Implementing Agency (Counterpart: C/P): Chittagong Water Supply and Sewerage Authority (CWASA)

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal CWASA serves the citizens of Chittagong in an efficient, effective and customer focused manner.	1. Following targets set in MIS are achieved • Collection period • No. of permanent employee per connection • Functioning meter rate of installed meter • Leakage complaints received and attended	1. CWASA's performance report (data from MIS reports and annual reports)	
Project Purpose CWASA's operational and institutional capacity is strengthened.	1. KWSP water supply system is operated on a stable and continuous basis 2. No. of leakage in KSA after commissioning of KWSP water supply system will not significantly increase 3. Quality of water supply to the dwellers is ensured	1. Operation record of KWSP water supply system 2. MIS report (Leakage occurrence) 3. MIS report (Water quality sample)	1. Karnaphuri Water Supply Project (KWSP) - Phase1 is successfully completed and KWSP-Phase 2 is successfully going on. 2. CWASA can coordinate this T/C with other project (KWSP-1&2)
Outputs 1. CWASA's business management capacity is improved.	1.1 Required posts of the revised organizational structure are filled with qualified staffs who are trained through the Project 1.2 Proposed amendments of rules and regulations are approved by CWASA board 1.3 Customer service department is developed and staffs are assigned in the department 1.4 CWASA's key management documents are updated on time	1.1 CWASA's annual reports and list of training participants 1.2 CWASA's board Memo 1.3 Project Record 1.4 Key management documents 1.5 Project Record	
2. CWASA's financial and commercial management capacity is improved.	2.1 Mid-long term financial plan including long-term debt restructure is approved by CWASA board 2.2 Revenue collection efficiency is improved from XX to XX 2.3 Monthly MIS report is updated monthly and year end accounts are prepared yearly on time	2.1 Approval by CWASA board 2.2 MIS report and CWASA's financial statements 2.3 MIS report and CWASA's financial statements	
3. CWASA's operation and maintenance system is improved.	3.1 Average leakage attendance time (including repair work) is reduced from XX hours to XX hours 3.2 GIS database is linked with other customer and tariff systems 3.3 CWASA adopts Technical standards 3.4 Store inventory is developed and updated monthly 3.5 50 CWASA staff and 50 private plumbers receive training and 80% of them passes the technical examination to be conducted after the training	3.1 MIS report and project record 3.2 Project record 3.3 Project record 3.4 Stores inventory 3.5 List of Training Participants	
Activities	**Inputs**		

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	(Japanese side)	(Bangladesh side)	
1-1. CWASA board approves the revised organization structure. 1-2. CWASA develops detailed transitional plan up to 2020 and implements it up to 2017. 1-3. Outline planning of organogram after 2020 1-4. CWASA reviews, identifies and proposes amendment of rules and regulations. 1-5. CWASA reviews the training policy, prepares and implements yearly comprehensive staff training program. 1-6. CWASA develops the customer service division. 1-7. CWASA continuously and efficiently updates key management documents (*1). 1-8. CWASA develops and implements the HR and recruitment policy. 1-9. CWASA reviews and proposes measure to increase the environmental compliance capability. (this activity is recommended to be deleted from the PDM)	1. Dispatch of Experts • Team Leader and Operations and Maintenance Specialist • Business Management Specialist • Financial and Commercial Specialist • Water Distribution Management Specialist and other experts based on the necessity 2. Equipment • Additional Computers, printers, photocopier and scanner for the T/C office (Continuous use of equipment provided under PANI-1) • Water meter testing equipment including installation and commissioning & initial training 3. Renovation of water meter testing laboratory including water meter database and OJT for CWASA staffs 4. Oversea Training Oversea trainings for improving external relationships and strengthening management and	1. Counterpart Staff • Project Director (PD) in charge on a daily basis • 2 Project Managers (PM) 2. Facilities • Office space, furniture and facility with the office cleaning service at CWASA's Dampara headquarters building • Training facilities 3. Local cost • O&M equipment • Project management cost 4. Others • GIS settings	CWASA's organogram is revised. **Preconditions** 1. CWASA's organogram is approved and CWASA is duly delegated the authority. 2. SLA of KWSP-1&2 are approved.
2-1. CWASA prepares a mid-long term financial plan including long-term debt restructure. 2-2. CWASA plans and implements measures to increase revenue generation. 2-3. CWASA implements measures to improve bill collection efficiency. 2-4. CWASA continues to utilize the computerized accounting and billing system. 2-5. CWASA expands customer data base. 2-6. CWASA improves management of asset. 2-7. CWASA develops electronic database of licensed Tube Wells. 2-8. CWASA increases water supply to the LICs.			

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3-1. Establish water meter testing facility and conduct training. 3-2. CWASA continues to update GIS database and map to accommodate all water supply facilities (e.g. water meter, pipeline) and customer. 3-3. CWASA implements a NRW reduction work plan in KSA which was developed in PANI. 3-4. CWASA develops a Sector-wise water distribution system management plan. 3-5. CWASA conducts on-the-job training on leakage detection and repair work, and conducts NRW monitoring in DMA (District Metered Area) to be established in KSA. 3-6. CWASA conducts R&D activities to initiate and standardized indigenous plumbing instruments and tools. 3-7. CWASA finalizes O&M training modules and provides training to CWASA's staff, as well as plumbers of private sectors. 3-8. CWASA reviews all O&M Manuals (and revises, if necessary) and conducts necessary training to CWASA staff. 3-9. CWASA improves outsourcing procedures and develops guidelines for outsourcing. 3-10. CWASA modernizes the stores operation and improves the system of logistics support. 3-11. CWASA establishes and updates technical standards.	techniques		

*1: Key Management Documents: Annual business plan, Strategic plan, MIS report, Performance agreement, Financial statements

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Annex 5. Plan of Operation (PO)

Activities	Person In Charge	1st year (2013-2014)	2nd year (2014-2015)	3rd year (2015-2016)	4th year (2016-2017)
		10 11 12 1 2 3 4 5 6 7 8 9	10 11 12 1 2 3 4 5 6 7 8 9	10 11 12 1 2 3 4 5 6 7 8 9	10 11 12 1 2 3 4 5 6 7 8 9
Business Management Activities					
1-1. CWASA board approves the revised organization structure	MD & DMD Admin				
1-2. CWASA develops detailed transitional plan up to 2020 and implements it up to 2017	Secretary				
1-3. Outline planning of organogram after 2020.	DMD Admin				
1-4. CWASA reviews, identifies and proposes amendment of rules and regulations.	DMD Admin & Sec				
1-5. CWASA reviews the training policy, prepares and implements yearly comprehensive staff training program.	Sec & Dty Sec				
1-6. CWASA develops the customer service division	DMD Fin				
1-7. CWASA continuously and efficiently updates key management documents (*1).	DMD Fin & DMD Eng				
1-8. CWASA develops and implements the HR and recruitment policy.	Sec & Dty Sec				
1-9. CWASA reviews and proposes measure to increase the environmental compliance capability.	Dty Chief of Plan				
Financial and Commercial Management Activities					
2-1. CWASA restructures Long-term Debt	Com Mgr & Chief Acc				
2-2. CWASA plans and implements measures to increase revenue generation.	DMD Fin & CRO				
2-3. CWASA implements measures to improve bill collection efficiency.	Com Mgr & CRO				
2-4 CWASA maintains an overview of installation of the computerized accounting and billing system.	Com Mgr & Comp Prog				
2-5 CWASA expands customer data base and computerizes management of asset	Chief Acc				
2-6. CWASA improves Tube Well Licensing	CRO & Rev Officer				
2-7 CWASA increases water supply to the LICs	Dty Chief of Plan & EE of MODs				
Operations and Maintenance Activities					
3-1. Establish water meter testing facility and conduct training	EE of MOD1 & Design				
3-2. CWASA continues to update GIS database and map to accommodate all water supply facilities (e.g. water meter, pipeline) and customer.	EE of Proc & MOD1, GIS				
3-3. CWASA implements a NRW reduction work plan in KSA which was developed in PANI	EE of Proc & MOD1				
3-4. CWASA develops a Sector-wise water distribution system management plan.	DMD Eng & EE of MODs				
3-5 CWASA conducts on-the-job training on leakage detection and repair work, and conducts NRW monitoring in DMA (District Metered Area) to be established in KSA	EE of Proc & MOD1				
3-6. CWASA conducts R&D activities to initiate and standardized indigenous plumbing instruments and tools	EE of Mohara, Store & MOD2				
3-7. CWASA finalizes O&M training modules and provides training to CWASA's staff, as well as plumbers of private sectors	EE of MOD1 & Proc				
3-8. CWASA reviews all O&M Manuals (and revises, if necessary) and conducts necessary training to CWASA staff.	EE of Mohara, MOD2 & Proc				
3-9. CWASA improves outsourcing procedures and develops guidelines for outsourcing	EE of Mohara, MOD2 & Proc				
3-10. CWASA modernizes the stores operation and improves the system of logistics support	EE of Store, Proc & Trans PO				
3-11 CWASA establishes and updates technical standards.	EE of Mohara, Proc, MOD2 & Design				
Survey team, etc.					
Mid-term / Final evaluation					
		10 11 12 1 2 3 4 5 6 7 8 9	10 11 12 1 2 3 4 5 6 7 8 9	10 11 12 1 2 3 4 5 6 7 8 9	10 11 12 1 2 3 4 5 6 7 8 9

App- 35

The Draft Standard Operating Procedure (SOP) on O&M of Water Distribution Facilities and Water Meter

1. Water Distribution Facilities

Water facilities consist principally of intake facility, raw water transmission pipe, water treatment plant, transmission pipe, elevated tank for water storage and distribution pipe.
Regular check of water distribution facilities is accomplished, targets for O&M.

A water distribution facility consists of pipes, service reservoirs, elevated tanks, pumps, valves, washouts and other accessory equipment.
The water distribution facility is required to be arranged under a rational plan, be able to supply water required by customers with a proper water pressure, and be easy in maintenance. Furthermore, keeping the quality of treated water flowing in the distribution pipelines is also required to be adequately taken into account.
Elements of typical treated water storage and distribution system are shown in **Figure 1.1**.

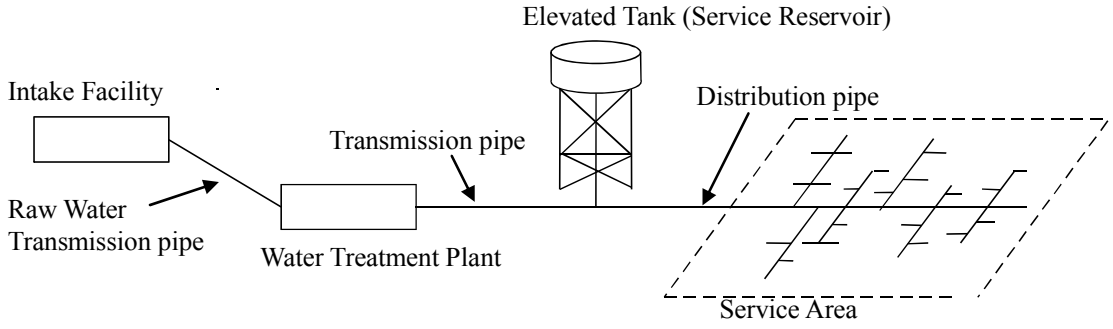


Figure 1.1 Element of typical Water Supply Facilities

2. Distribution Network System

The distribution system can be classified into gravity flow type and pump boosting type, depending on the height relation between the service reservoir and the distribution area.

2.1 Network Type

The distribution network system consists of all pipeline routes, the locations, sizes and elevated tanks. Two types of distribution systems may be mainly used tree type distribution system or grid type one as shown in **Figure 2.1** and **Figure2.2.**

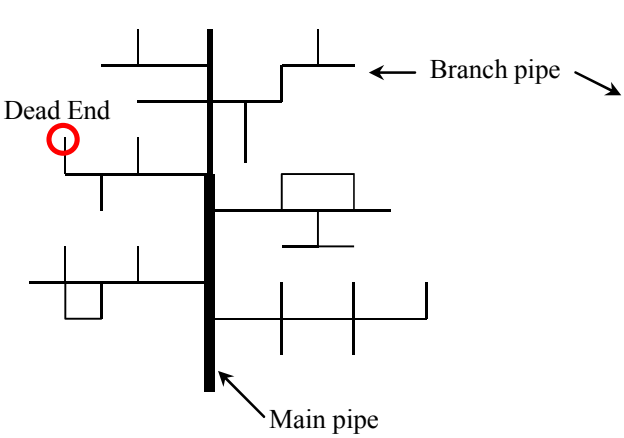


Figure 2.1 Tree Type Distribution System

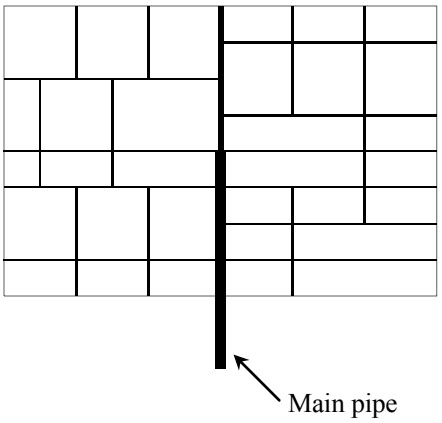


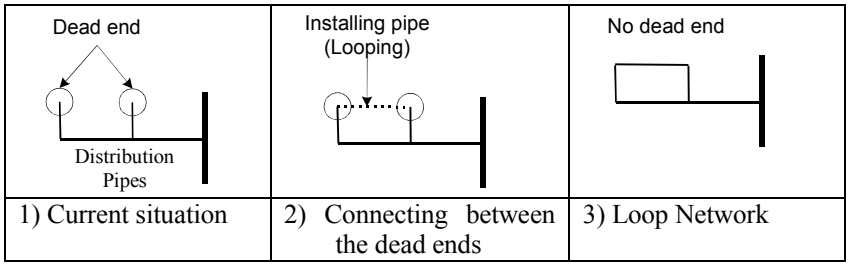
Figure 2.2 Grid Type Distribution System

1) Tree Type System

A single main is used that reduces in size with increasing distance from the source. Branch lines emanate from main pipe. Tree type system has dead ends which are the potential for stagnation and deterioration of water quality, and periodic flushing is required to remove deposits in dead points.
A dead end pipe where water threatens to be retained should be avoided as much as possible.

How to eliminate a dead end or to avoid generating rust-colored water at a dead end

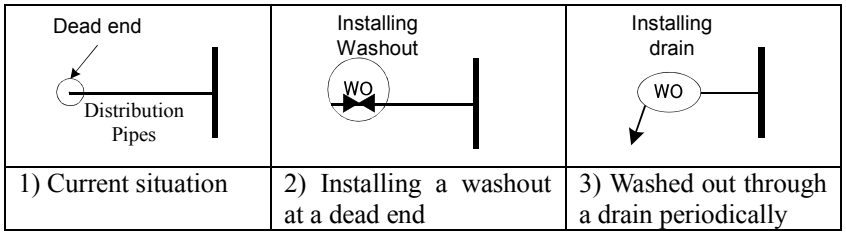
a) To loop a pipe network



1) Current situation	2) Connecting between the dead ends	3) Loop Network

Figure 2.3 Elimination of Dead Point Procedure

b) To install a washout drain at a dead end



1) Current situation	2) Installing a washout at a dead end	3) Washed out through a drain periodically

Figure 2.4 Mitigation of Dead Point Procedure

2) Grid Type System

This pipeline system is laid out in a lattice-shaped, with the piping usually deceasing in size as the distance increasing from source. In grid type system, headloss will generally be less compared with a tree type system. Looping network eliminates dead ends in the distribution system. Therefore, the potential for stagnation and deterioration of water quality can be reduced.

A major problem of water quality caused by a distribution pipeline is red water caused by rust generated on the inner surfaces of the distribution pipes.
The cast-iron pipes and steel pipes deteriorated in painting and lining with the lapse of years cause red water. Therefore, such proper measures must be taken as replacing pipes by any other kind of pipes or rehabilitating pipes.

2.2 Accessory Equipment

The accessory equipment of distribution pipelines can be classified into air valves, valves, fire hydrants, washout, flow meter and manholes. As the accessory equipment, the most appropriate devices must be arranged at proper places, considering the arrangement of distribution pipelines, the topographical and geographical conditions of the distribution area and water demand.
The accessory equipment which have been used for long periods may be functionally degraded due to the wear at sliding portions and the deterioration of paint at wetted portions, to cause trouble in stable water supply. The accessory equipment must be rehabilitated and improved at opportune timing, to restore or improve the functions.

2.2.1 Air Valves

Air valves are located on all high points in the distribution pipelines to allow trapped air to be release from pipelines without loss of water. Trapped air, if allowed to accumulate at a high point, carries out restrictions and reduces the capacity of the pipeline due to increasing headloss.
When a pipeline is filled with water, the air in the pipeline must be properly eliminated, and when water in a pipeline must be eliminated for the necessity of construction or other work, proper air suction is necessary.

Schematic illustrating placement of air valves on distribution system is shown in **Figure 2.5**.

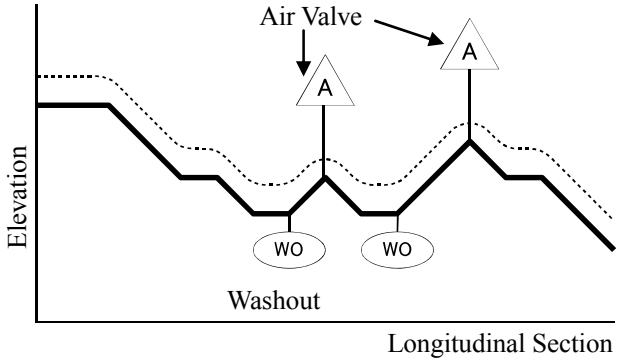


Figure 2.5 Locations of Air Valves and Washouts

2.2.2 Gate Valve and Butterfly Valve Location

Valves are provided throughout water distribution network to control flows and maintain pipelines. Valves will allow sections of the distribution network to be isolated for leakage, repair and replacement. Shutoff of flow on the distribution pipeline is usually achieved by using gate valves or butterfly valves. Isolation valves shall be of the gate valve for 300 mm diameters below, and butterfly valves for 300 mm above. Valve will be installed at intervals of about 500m, but not exceeding 1000 m in the distribution network.

For the distribution network, sufficient isolation valves will be provided so as to provide adequate isolation for purpose of maintenance and repairs. Where gate valves are provided at branches, more than 3 valves will not be provided at crosses and more than 2 valves will not be provided at tees.

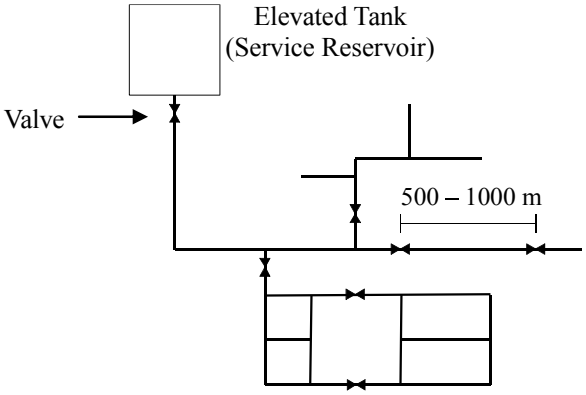
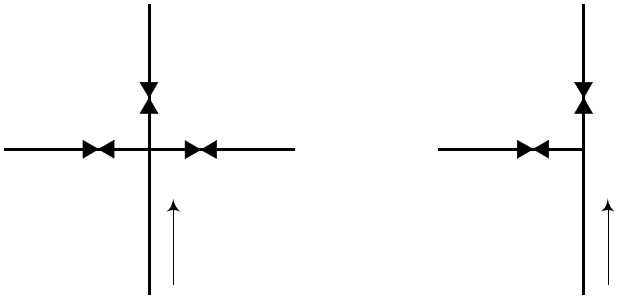


Figure 2.6 General Valve Locations



(a) At Cross **(b) At Tee**

Figure 2.7 Valve Location

2.2.3 Precautions of Valve Operation

1) Do not turn a handle of a valve at excessive power when a gate position is either full open or full close.
2) Avoid opening and closing rapidly a valve because it cases a water hummer which damage a pipe and pump.
3) Confirm to stop flow completely by appearance, hearing and pressure after closing off fully.
4) Operate a handle after confirming an open-and-close direction of a valve. In case of a valve with an opening gauge, confirm whether the gauge and actual valve opening reconcile.
5) As an open-and-close of a valve, while around to the left is opening, around to the right is closing

(1) Butterfly Valve

Butterfly valve functions are control, interception and protection for pipes. Inside valve box, a valve disc rotates on a valve rod (vertical axis) and opens/closes.

1) When a valve with a rubber valve seat is operated under dry condition of the valve seat, the rubber valve seat may be damaged by abnormal dry friction and/or torque limit switch working. In case of valve operation with an empty inside pipe (no water)

(2) Gate Valve

Gate valve functions are interception and discharge. Inside valve box, a valve disc which sets at right angle against flow direction moves to top and bottom and opens/closes. The valve disc position in the valve box is either full open or tight close. A middle position between open and close is undesirable.

1) Adjustment of a gland packing in a valve box should not be strong tight and uneven clamping. Check a leakage from the gland packing part.

2) A gate valve seat is a metal. A valve disc should not be broken into the metal seat.

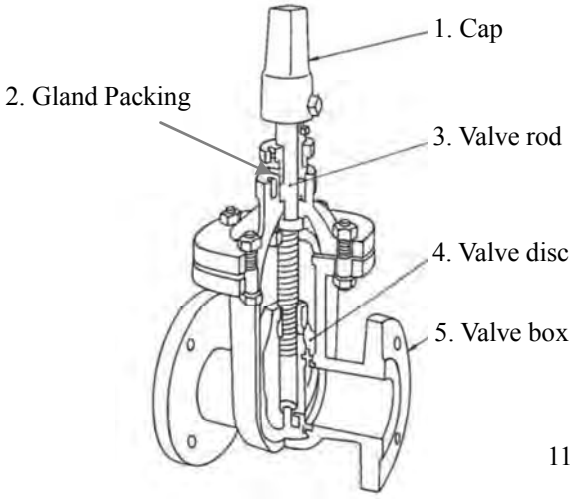


Figure 2.8 Gate Valve

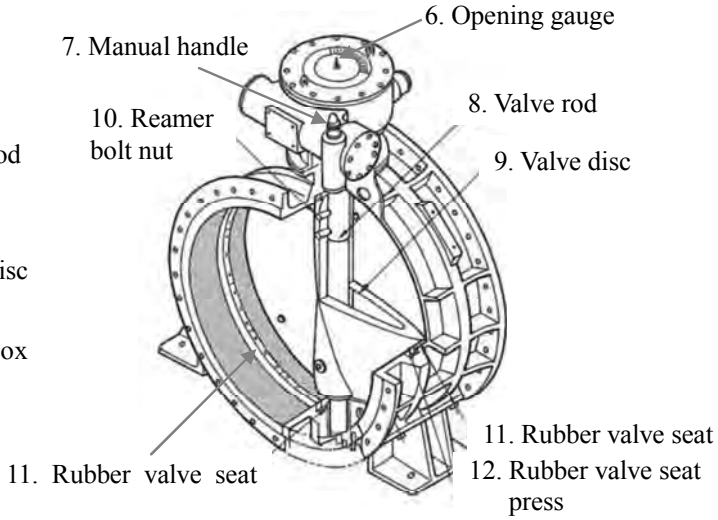


Figure 2.9 Butterfly Valve

Table 2.1 Precautions of Valve Operation

No.	Item	Precaution
Gate Valve		
1	Cap	Caution of a rotation direction. The clockwise rotation makes close a valve, while counterclockwise rotation makes open a valve. A cap damaged and deformed by an excessive power. A key handle cannot be attached with corrosion
2	Gland packing	Caution against deformation of a gland packing and leakage
3	Valve rod	Caution against deformation in an attachment, garbage and rust at an exposed part
4	Valve disc	Caution against deformation, abrasion and thrusting a disc to a seat
5	Valve box	Possibility of damage to a valve box with an excessive power
Butterfly Valve		
6	Opening gauge	Difference between an opening gauge and actual opening, damage of the gauge
7	Manual handle	Caution against rotation direction and not exert an excessive power
8	Valve rod	Confirmation of a faulty coupling and fastening to a valve disc
9	Valve disc	Caution against a strange sound and vibration by cavitation
10	Reamer bolt nut	Caution against looseness of a nut, nut falling off in case of a light load to manual handle
11	Rubber valve seat	Caution against jammed extraneous matters, broken into the metal seat and seat ablation
12	Rubber valve seat press	Damage by rubber sheet ablation

2.2.3 Washout:

Washouts are small pipe connections with valve located at dead ends and low spots in the distribution pipelines to allow accumulated sediment to be cleaned by flushing and the pipeline drained.

1) Location of washout drain: washout drain should be installed nearby drainage canal or river
2) Drain pipe diameter is normally 1/2 – 1/4 size of main pipe diameter
3) Washout drain should be built strongly at the spillway so as not to erode or to be destroyed by draining. If the place near a washout drain is likely to be eroded or damaged by discharge, protective

work especially by concrete, rubble mound, etc. must be provided.

4) Washout drain is set at a position higher than the high water level of the water channel to prevent the backflow of sanitary wastewater from the water channel.

2.2.4 Fire Hydrant

These fire hydrants can be used in case of fire. Fire hydrant will be located in the distribution network on all pipelines of at least 150 mm nominal diameter, otherwise, negative pressure may occur in small diameter such as less than 100 mm. Spacing will be at about 200 m and at street corners if practicable and at locations to avoid obstruction to property owners.

2.3 Service Reservoirs and Elevated Tanks

Service reservoir and elevated tank are a reservoir for receiving water from a water treatment plant and distributing in response to the demand of the distribution area, and must have function to respond to the hourly change of distributed amount and also a function to be able to maintain a predetermined amount and water pressure even when an accident occurs upstream of the service reservoir and/or the elevated tank.
The service reservoir and the elevated tank must be water-tight, sanitary, and sufficiently durable in structure to avoid contamination from outside.

When in great depth in a service reservoir and elevated tank, water is likely to leak from expansion joints, construction joints due to water pressure. It is necessary to adopt a highly water-tight and durable concrete structure. For this purpose, it is necessary to apply a water shut plate of PVC or rubber to the expansion joints and construction joints as required, or coat the concrete on the inside surface of the service reservoir and the elevated tank with waterproof mortar or epoxy resin paint, for securing water tightness and preventing the deterioration of concrete by chlorine.

2.4 Operation and Maintenance (O&M) of Distribution Facilities

Distribution facilities require proper operation and maintenance to maintain reliable service to the water users. O&M of pipeline include periodic flushing of the pipes to maintain water quality, regular checking of disinfection residuals throughout the system to prevent deterioration water quality.

Important method of maintaining water quality is to institute a program of periodic flushing of water distribution mains. Flushing can be accomplished by using fire hydrant and washout drain at low points and dead ends in distribution system. Flushing water can be discharged to cannels or local waterways with permission of administrator.

Further important O&M function for distribution systems is a program of regular exercising of the valves and fire hydrants. Valves and fire hydrants should be operated at least once annually to ensure their proper operation.

Washout drains are provided to keep the pipelines free from blockade. It shall be washed out at least once in 3 month in dry season and once a month in rainy season with enough water to flush the deposited dirt until clear water at washout is observed

3. Service Pipe

3.1 Location and Depth of Pipe Laying

In case distribution mains are laid across or in the vicinity of other buried objects, more than 0.3 m of space shall be provided between them.
Maintenance and repair work are difficult unless there is some space between the distribution main and other buried objects. The minimum space for laying is set at more than 0.3 m.
Although under the specifications and drawings of the KWSP-1, the earth cover is set at 1.2 m, it can be reduced to 0.6 m in case the prescribed earth cover cannot be realized with regard to the relationship with intersection with other buried objects.

3.2 Water Service Fittings

The water service fittings in general consist of service pipe, water service apparatus and water meter. Although water meters are the property of the water utility, they are understood as falling under the category of water service fittings from the view point of the water service system.

1) Connection point from distribution pipe should be surveyed sufficiently to avoid cross connections.
2) Service pipe diameter should be smaller in principle than distribution (main) pipe diameter.
3) Not to connect from joint and/or fitting point on main pipe.
4) Clean the surface of main pipe when service pipe is connected. During the installation of service saddle, fasten equally with bolts on the main pipe.

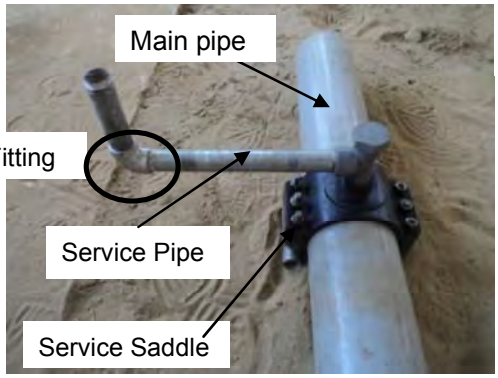


Photo 3.1 Service Pipe

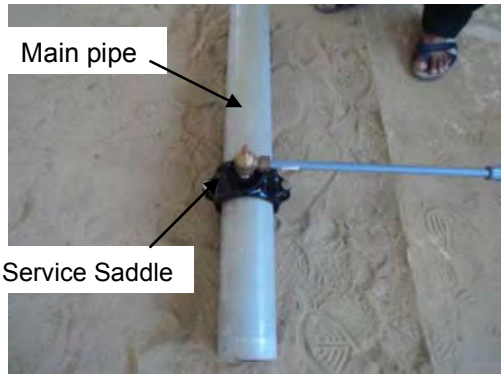


Photo 3.2 Service Saddle

3.3 Branching of the service pipe from the distribution main

1) Tapping on the distribution main by drilling shall not cause adverse effects to the strength of the pipe and its inside coating.
   For drilling tapping holes on the distribution main, the interval of the holes and their diameter shall carefully be chosen so that the strength of the main is not reduced.
   A drill bit suitable for the coating on the inside wall of the main shall be used so that the coating is not peeled off.

2) For the purpose of branching of the service pipe from the distribution main, the corporation cock, the corporation cock with saddle, the plastic tee fitting (for hard PVC or polyethylene main), the tee fitting or the separate tee fitting for other pipe materials in accordance with the pipe material and diameter of the distribution main and the diameter of the service pipe.
   In case a branch is made from the distribution main for a service pipe, a corporation cock or a corporation cock with saddle shall be used for a service pipe of a diameter of smaller than 50 mm.
   No corporation cock shall be tapped on special fittings. When tapping a corporation cock near a pipe joint, a space of more than 30 cm shall be provided from the joint in consideration of maintenance work.

3) In case taping is made using a corporation cock or a corporation cock with saddle, the interval of tapping shall be more than 30 cm.
   In case making a branch from a distribution main by means of the corporation cock, it is prescribed under the Ordinance that more than 30cm of space between two cocks shall be maintained to prevent the impairment in pipe strength caused by drilling holes; avoid the adverse influence to the flow of one tap to be caused by that of another tap; and make maintenance easy.

3.4 Service Pipe Working

3.4.1 Pipe Laying

1) When laying a water service pipe in a road, the location and the depth of exclusive occupation of the pipe shall not be mistaken. Besides, more than 30 cm of space shall be maintained between the pipe and other buried objects.

2) Backfilling shall be made with soil of good quality or sand; and the backfill shall properly be compacted to protect the pipe.

3) In case the pipe is laid in the premises of a house, the location of the curb cock and the water meter shall be selected to facilitate their maintenance; and the pipe shall be laid in a straight line as much as possible even in the premises.
The curb cock and water meter shall be installed in locations, with which no trouble for maintenance is caused in future, and the water service pipe shall be laid in a straight line as much as possible. In case there is such an object as a sewage box in the halfway of the pipe, since there is a risk of contamination in an occasion of breakage of the pipe, the pipe shall be laid far enough from the object to avoid its influence.

4) In the occasion of crossing an open channel, the pipe shall be laid underneath the channel as much as possible.
In the occasion of crossing a gutter or an open channel, the pipe shall be laid inside a sleeve of steel pipe placed underneath the channel etc. as much as possible. If such a measure is impossible, the pipe shall be laid above the high water level.

3.4.2 Foundation of Service Pipe

1) The foundation of an underground service pipe shall be designed, sufficiently considering the conditions of the ground, loading conditions and the properties of the pipes used.

2) The backfilling earth shall be selected to allow proper compaction when the pipes are buried.

3) When a pipeline is laid in poor subsoil, the ground conditions and pipeline settlement shall be sufficiently examined, to use an execution method, pipes and joints suitable

The quality of the nature of backfill soil affects the execution convenience of backfill and compaction, and also greatly affects the safety of the pipeline. Especially for steel pipes and PVC pipes, cobble stones and rock debris which threaten to damage the pipe should not be contained, and if excavated soil is not good enough to satisfy the design conditions, soil dressing is necessary.

3.4.3 Precaution of Pipe Working

1) Distance of service pipe and other embedded pipes should be kept at least 30 cm to avoid accidents such as cross connection and pipe damage.

2) Underground pipe works should be kept in a straight line as much as possible as it is easier to understand and locate the pipes later and such pipe laying is much economical.

3) Put a stopper at pipe end with plug to avoid filthy water from flowing into pipe when pipe stops working temporary or daily.

4) In drilling the distribution pipe, it shall not adversely affect the strength and inner coat.

5) When the service pipe is branched from the distribution pipe, corporation stop, saddled corporations stop and T-pipes shall be used.

6) A stop valve and a water meter should be provided at position facilitating future maintenance, and service pipe should be laid as straight as possible.

7) Pipes are exposed along building/house columns and walls, where pipes are susceptible to damage due

to deflection and vibrations by external forces, the pipes' own weight and water pressure, pipes should be fixed to the building/house using brackets at 1 – 2 m intervals.

8) When piping is completed, it is desirable that pipes are flushed and undergo flow before attaching meters.

3.4.4 Storage Tank for Building

The storage tank is a type of tank that once receives water in a tank, and serves water from it; can, as a merit, maintain water service pressure and volume constant downstream of the tank; can feed a large quantity of water at a time; can secure water even at the times of suspension of water supply and a disaster and so forth. On the other hand, it needs such proper management as regular inspection and cleaning, and water temperature goes up in summer, which are the factors to give consumers anxiety about water quality.
The elevated tank shall regularly be cleaned like the storage tank; otherwise there is a risk of water pollution

4. Installation of Service pipe and Water Meter

Water service installation should be given such that service pipes with adequate size and devices are reasonably combined so as to stably supply the water volume needed by users and supply a safe water.

For the exact measurement of water consumption, proper selection, installation and control of water meters are essential.

Even when service pipes are properly designed and executed, it is not possible to secure stable water supply and water quality if the method of use is not proper, improper devices are installed, or rebuilding is made upon users' discretion. Therefore, instruction and guidance should be given to users on the proper use and maintenance of water service pipe installation.

4.1 Location of Water Meter

1) Water meter is principally located inside the ground for easy inspection and/or replacement and where the probability of meter damage is low.

2) In case of installing a water meter underground, use a meter box.

3) In case of installing water meter, inflow direction sign on a meter should be confirmed and set in the horizontal position.

4) There are two types of a meter position. One is the order of a stop valve and a meter (Type-1), the other is a meter and a stop valve (Type-2).

4.2 Required Water Meter Product

Water meters are attached to water service equipment and used to integrate water volume consumed by users, and the measured water volume forms a basis of water to control water charges and revenue earning water rates.

Additionally, conditions required for water meters are followings;

a) Good measuring accuracy, b) Durability, c) Sufficient capacity, d) Good sensitivity, e) Wide measuring range, f) Ease in reading, g) Ease in handling, h) Relatively failure-free

Photo 4.1 Installed water meter

Photo 4.2 Water meter

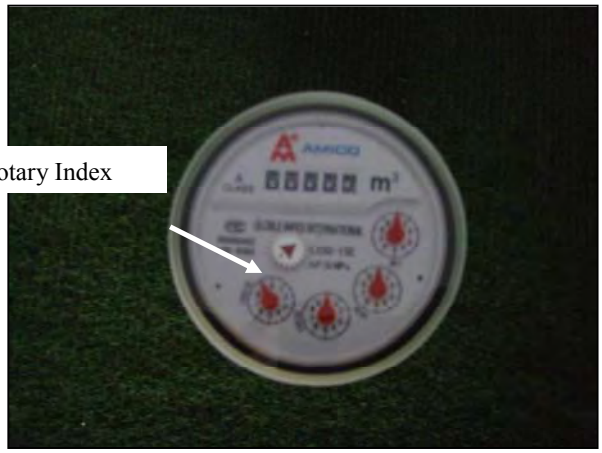


Photo 4.3 Meter indicator

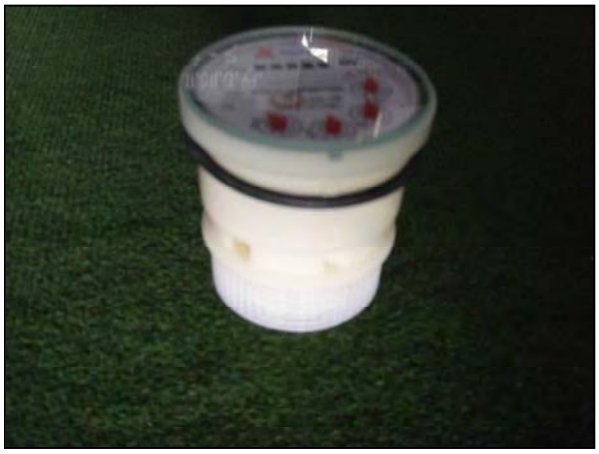


Photo 4.4 Impeller and Gear wheel

4.3 Water Meter Type

Water meters measure the water consumption of which the working condition is diverse. For the domestic water meter type, there is estimation type in view of the proportionality of the vane wheel revolution and the volume of passing water.

Water meters are generally vane wheel jet type. Meter mounts are threaded for diameters 15 – 40 mm and flanged for diameters 50 – 350 mm, in general.

4.3.1 Vane wheel jet type water meter

This water meter type is designed so that the vane wheel built in the meter chamber is rotated by water flow to integrate the volume of passing water.

Single jet type water meter refers to a structure by which the water flown to the meter case is directly given to the vane wheel.

Multi jet type water meter refers to a structure in which another meter case (inner case) is provided in the meter case, and water is supplied as a jet flow from one nozzle to the vane wheel.

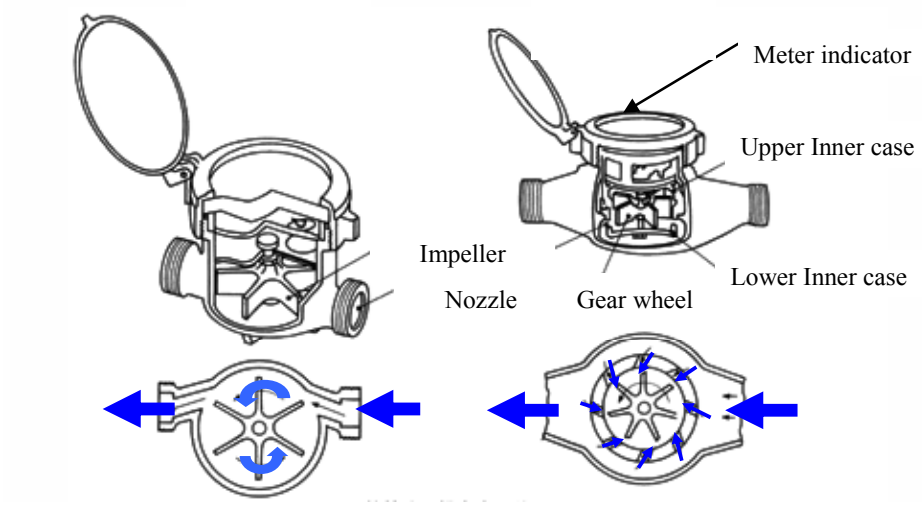


Figure 4.1 Single jet type water meter

Figure 4.2 Multi jet type water meter

4.3.2 Wet Type and Dry Type

The wet type refers to meters of which the indicating mechanism, including the scale plate, is entirely submerged in the water.

The dry type refers to meters of which the scale plate and indicating mechanism are isolated from the flow unit by board. The vane wheel rotation is transmitted to the indicating mechanism.

4.3.3 Rotary Index

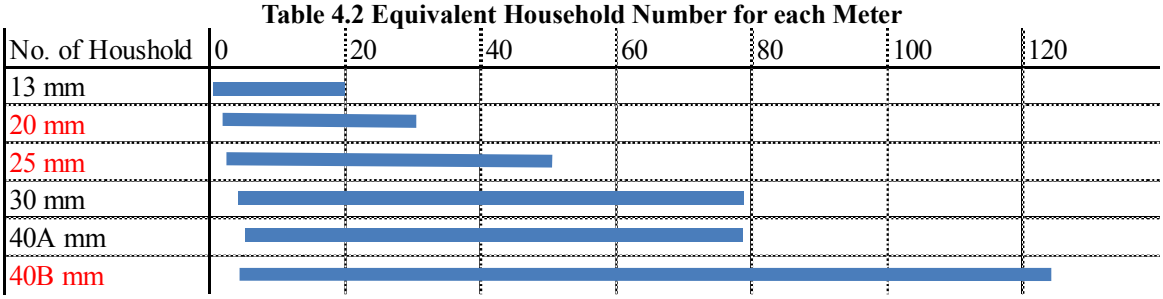
Rotary index is used to find out the flow rate at which rotary index of water meter starts sensitivity, and flow rates of trace flows such as water leakage.

4.4 Selection of Water Meter

Table 4.1 Water Meter Performance

	Diameter		Flow Range (m^3/hr)		Equivalent Household Number	
	(mm)	(inch)	Minimum	Maximum	Minimum	Maximum
Vane wheel jet type (Single jet)	13	1/2	0.10	1.0	1	19
Vane wheel jet type (Multi jet)	20	3/4	0.20	1.6	3	30
	25	1	0.23	2.5	4	48
	30	1.18	0.40	4.0	7	77
	40A	1.5	0.50	4.0	9	77
Vertical shaft type axial (Multi jet)	40B	1.5	0.40	6.5	7	125

Table 4.2 Equivalent Household Number for each Meter



4.4 Proper treatment of a water meter and suggestion of water meter installation

(1) Precaution for safety's sake

- To pay attention while carrying heavy equipment and installing water meters since there are possibilities of injury.
- Not to touch directly a screw joint part on a meter case because there is a possibility of injury. To put on cotton work gloves to help prevent injury.

Photo 4.5 Work Glove

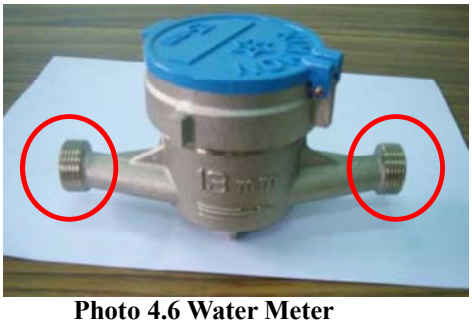


Photo 4.6 Water Meter

- To use appropriate tools such as wrenches for plumbing. Hindrance and accident may be caused by using inappropriate tools for plumbing.
- Not to pour hot or boiling water into the water meter. When hot water of more than 40 degrees flows in a water meter, there is a possibility to damage the inside plastic parts of the water meter.

Photo 4.7 Inner Case

Figure 4.3 Wrenches

(2) Precaution for water meter management during meter storage

- Not to give water meter a strong shock. When a water meter falls, there is a possibility of meter damage and might be difficult to measure the amount of flow because the shaft bearing of the impeller will be damaged.
- Not to give water meter vibration. When a water meter receives vibration for many hours, it might be difficult to measure the amount of flow because the shaft bearing of the impeller will be damaged.

Figure 4.4 Not Strong Shock

- To cover gateway of water meter to prevent the wind blowing through the meter during water meter storage. When air blows through the water meter, it is possible that measured value can progress or revert because impeller rotates due to the wind. To put caps on the gateway of water meter to prevent this from happening.
- To cover gateway of water meter to prevent unwanted substances entering water meter during meter storage. When unwanted substances entered meter, it might be difficult to measure since the unwanted substance obstructs the rotation of the impeller.

Photo 4.8 Covered Gateway of Water Meter

(3) Precaution for water meter and installation

a) Precaution for location of water meter installation.

Water meters should be installed in places which meet the following factors.

- A water meter for domestic (15 mm diameter, i.e. vane wheel jet type water meter) shall be installed horizontally in accordance with ISO 4064 in each house.
- To install water meter in horizontal position. To set the meter horizontally with indicator upward according to the arrow shown on the meter.
- To select the place where installation and removal of a water meter are easy. Since it is necessary to replace water meter periodically (recommended in every 8 years), appropriate place for installing and removing a water meter is required.

Photo 4.9 Horizontal Position

- To select the place where meter reading is easy. Since it is necessary to conduct meter reading periodically, appropriate place, which is dry condition and not submerged, is required.
- To select the place where momentary pressure variation is low. It might be difficult to measure accurately because the rotation of the impeller will be increased by momentary pressure variation. The maximum working pressure, however, is 1 MPa.
- To select a place where there is no influence on vibration. It might be difficult to measure accurately because the rotation of the impeller is increased by vibration.
- Not to install water meter at a submerged location.

Photo 4.10 Low Position of Water Meter

Photo 4.11 High Position of Water Mater

b) Precaution for water meter installation

Water meter installation conditions sometimes have an influence on the performance of the meter. Observe the following factors in order to keep accurate performance of water meter.

- Water meter installation fitting should be the total length of the meter and packing. In case of bad measurement, such as short or long, the meter can not be installed to pipes.
- When a welding junction is conducted at a pipe joint part, detach the water meter from the pipes. The plastic parts inside the water meter may be damaged by the high temperature of the welding.

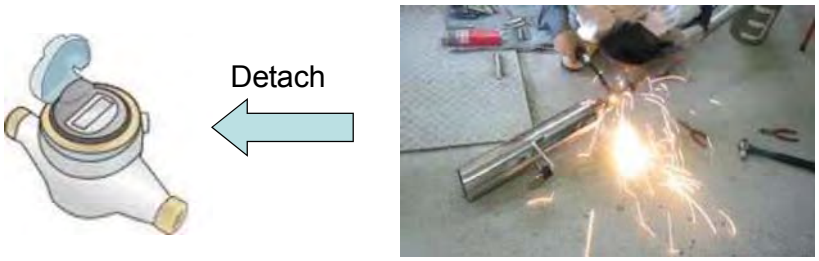


Figure 4.5 Treatment of Meter with high temperature of the welding

- Pipe length of more than 5 times of a pipe diameter in the upper stream of a water meter and the pipe length of more than 3 times in the downstream are required on a pipe arrangement. When the pipe length is shorter than above mentioned length, it might be difficult to measure accurately due to the influence of a valve or a bent pipe.

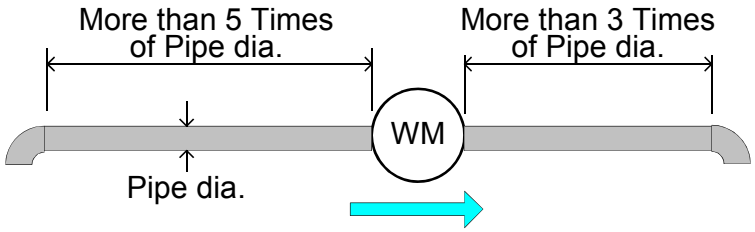


Figure 4.6 Proper Meter Position

- To use proper packing to fit a pipe diameter during meter installation. Water leakage at joint parts and/or water measuring error may occur due to different dimensions of packing.
- The inside of the pipe should always be cleaned by flowing water before installing water meter. It might be difficult to measure accuracy because unwanted substances inside the pipe might obstruct the rotation of the impeller or even destroy the meter.
- To open a stop valve slowly when feeding water. When opening a stop valve hastily, the water meter might be damage due to water hammer.

Photo 4.12 Cleaning Inside Service Pipe

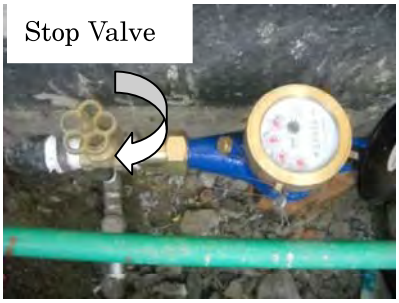


Photo 4.13 Opening Slowly

5.7 Outline of Meter Reading

Meter reading is the foundation of water tariff. It is necessary to keep conditions for easy reading and replacement, and effort should be made to improve accuracy of meter reading.

The direct reading type integrates and digitally displays measured values.

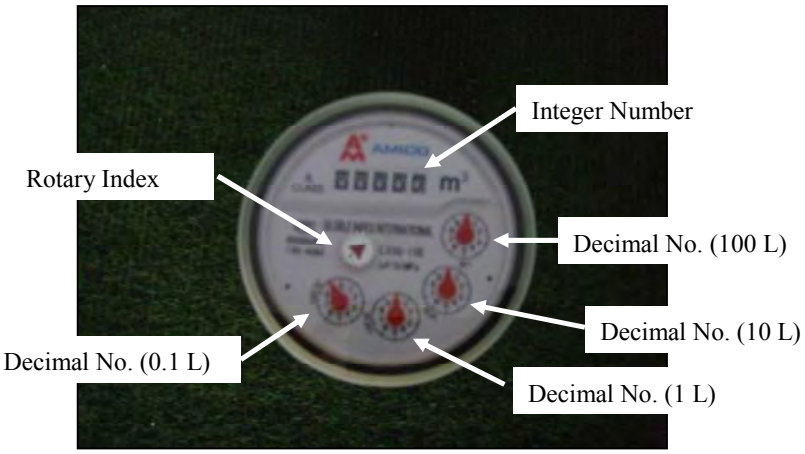


Photo 4.14 Meter Reading

Meter Reading: Integer number only, not to calculate the decimal places.

5.8 Responsibility of installation fee and maintenance of water meter

When water meters and house connections (water service pipes) are installed in houses, CWASA and/or customers have responsibilities of installation and maintenance for a water meter and house connection. The division of roles for installation and maintenance are shown in **Table 5.1**.

Table 5.1 Responsibilities of CWASA and Customers

		CWASA	Customers	Remarks
House Connection (Water service pipe)	Install	Preparation of material and Work	-	Up to water meter is CWASA's properties
	Pay	Payment includes pipes and fittings-	-	
Water meter	Install	Supply and Work	-	
	Pay	-	Customer payment	
Suction Pump	Remove	Remove	Report to CWASA	Prohibition
Storage Tank for building		-	Maintenance	Customer's property
Charge of repair		-	Customer payment	
Maintenance		CWASA	-	

5.9 Management of Water Meter

A suitable record of meters is one that provides full and complete information on the installation, repair and testing of each meter with a minimum of expense. The time and effort devoted to maintaining meter records are considerable because of the number of units involved and because meters do not remain at one location during their useful life bur frequently moved.

Information of water meter is managed and recorded properly. The contents of the record sheet are as follows:

[Management Items]

Installation date, meter size, registration number, make, type, date of purchase, manufacturer's serial number or utility's number, user name, installation location (Word No., address), etc.

6. Leakage Control

6.1 Leakage Prevention Plan

1) Setting Target Goal

In order to prevent effectively leakage from water distribution and service pipes, implementation of a leakage preventive plan which is formulated based on a basic survey for distributed volume analysis and grasp of water pressure/leakage volume is necessary.

2) Leakage Prevention Measures

Leakage prevention measures consist of basic measure, countermeasure and preventive measure. Concreate measures are shown in Table 6.1.

Table 6.1 Leakage Prevention Measures

Measure	Item	Concrete Measure
Basic Measure	Preparation	Establishment of construction organization, Preparation of drawings, documents and equipment
	Basic Survey	Grasp of distributed volume, leakage volume and water pressure
	Technical Development	Improvement of pipe and apparatus, development of leakage detection method, buried pipe detection method and leakage volume measurement
Countermeasure	Agile work (Repair aboveground leakage)	Agile repair
	Planned patrol work (Repair underground leakage)	Early detection and repair
Preventive Measure	Attendance of other constructions	Patrol of pipelines and attendance at a site
	Improvement of distribution and service pipes	Pipe replacement, service pipe installation, anticorrosive
	Water pressure control	Maintenance of water distribution pipe, block of pipeline network, installation of pressure reducing valve

6.2 Basic Measure

6.2.1 Water distributed volume analysis

A water distributed volume analysis classifies distributed water consumption/use/loss systematically. An analysis result can be vital indicators for a water business and necessary to formulate a leakage prevention plan. Water distributed volume analysis is shown in Table 6.2.

Table 6.2 Water Distributed Volume Analysis

Water Distributed Volume use	Effective Water Volume	Revenue Water Volume	Revenue water	(1) Water volume of revenue from a water tariff (2) Water consumption volume from fixed charge taps
			Subdistribution	Volume for water supply to another water supplier
			Others	(1) Water for a park use (2) Water for public flush toilet (3) Water for fire protection use (4) Other (revenue water from another accounts as maintenance fee)
		Non-Revenue Water Volume	Meter insensitive water volume	Water for non-revenue due to an insensitive meter
			Water volume for business use	Flushing water for a pipe, water for business use on leakage repair/preventive works in distribution facilities
			Others	(1) Water for a park use (2) Water for public flush toilet (3) Water for fire protection use (4) Other (non-revenue water)
	Ineffective Water Volume		Deduced consumption by settlement	Water for reduced cost due to rusty water and so on
			Leakage Volume	(1) Leakage volume from water main distribution pipe (2) Leakage volume from water branch distribution pipe (3) Leakage volume from the upper service pipe of a water meter
			Others	Ineffective water caused by damaged facilities

Points to note for measuring accurately each water volume in Table yy are as follows;

a) A water meter which measures distributed water should be suitable for actual flow.

b) In case that no water meter is in water for public use, a meter should be installed.

c) Since meter insensitive water volume depends on a flow of water, a meter which adapts to the flow should be used.

6.2.3 Measure of Leakage Volume

a) Close all control valves such as gate and butterfly valves on distribution pipelines of a target block's circumference

b) Confirm what water from other blocks is not flowing

c) Feed water to the block from one point, and then close all stop valves and water taps within the block

d) Measure the flow at the feeding point by a mobile electromagnetic flow-meter

e) The value indicated by the flow-meter is leakage volume

There are two ways of measuring leakage volume.

1) Rotation Method

A target area is whole water supply service area. Divided service areas (blocks) are measured according to above mentioned method one at a time. Total of measured flow for all blocks is total leakage volume. This method is the most accurate.

2) Selection Method

A model block is selected from a whole service area, and then leakage volume is measured with the same method of the above mentioned direct measure. The total leakage volume is estimated based on

the result of the model block. This method makes an error much difference in case of inappropriate selected bloc. A proper selected block area contains approximately 3 to 5% of total water distribution pipe length

6.3 Leakage Analysis

A leakage analysis is vital to formulate a leakage prevention plan because the analysis classifies actual leakage and grasps the condition. Since accuracy information of distribution pipes and regional conditions is essential for the leakage analysis, it is necessary to collect the information. In a leakage repair work, records and statistical analysis of leakage conditions are conducted according to the following table.

Table 6.3 Leakage Analysis Item

1. Form	leakage from aboveground and/or underground
2. Facility	Transmission pipe, distribution main pipe, distribution branch pipe, service pipe, reservoir, others
3. Cause	Leakage (pipe material, diameter, construction date, joint, crack, disconnected pipe, corrosion, valves, rubber packing, fire hydrant, others) Leakage caused by damage (pipe material, diameter, construction date, damage, others)
4. Area	Ground (corrosive soil, soft ground, filled-up land, others), traffic volume, road (public, private, others), paved road (pavement thick, gravel road, others)

6.4 Countermeasures of Leakage

(1) Agile work (Repair aboveground leakage)

An agile work is repairing aboveground leakage with early appropriate detection. Detecting a leakage aboveground is comparatively easy, however, places such as a bridge-attached pipe and inside valve box are not observable. Therefore, a patrol and attendance at a construction site are necessary to detect a leakage.

(2) Planned patrol work (Repair underground leakage)

A planned patrol work is detecting underground leakage and repairing it systematically to the divided survey area in consideration of working efficiency.

5. Consideration of Facility Survey

Items that CWASA staffs must always be aware of O&M for water supply facilities are shown below.
As for the first target, CWASA confirms the current status of distribution facilities included in the existing facilities, and makes inspection, flow and repair records of facilities such as raw water transmission pipe, transmission pipe, valves and elevated tank. Main purpose of these activities is to inspect them regularly.

As for the second target, water distribution maps that consist of pipe routes and locations of valves and washout drain and fire hydrant, pipe diameter and pipe material is to be created. This information map is necessary for maintenance and repair of facilities.

The primary factors of distribution facilities include the location and required demand of the water users. The principal facilities needed for the delivery of treated water are an elevated tank for storage, transmission and distribution pipes.
Object facilities of inspection and check sheet are shown below.

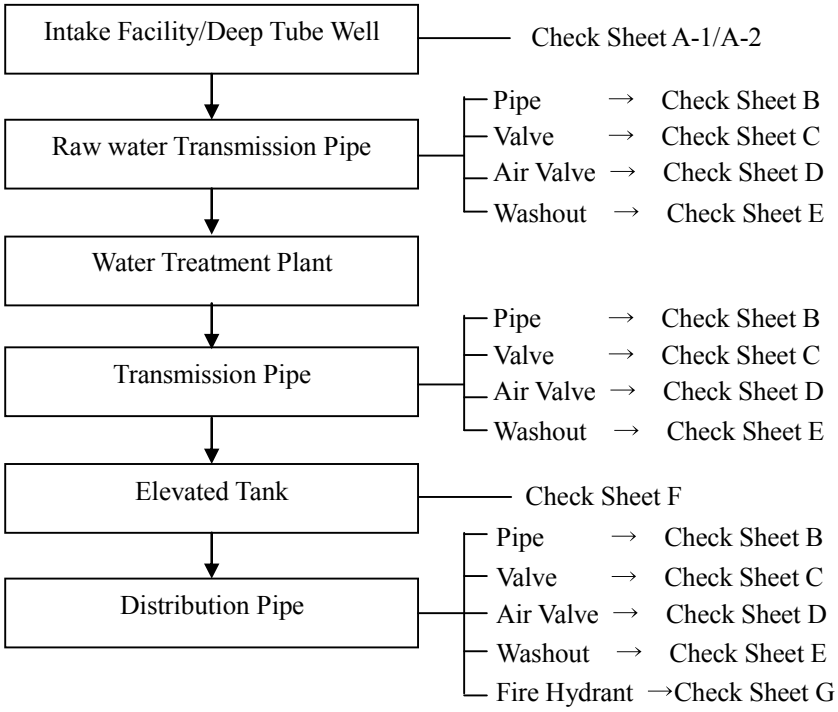


Figure 5.1 Target water supply facilities and check sheet of inspection

5.2 Consideration of Conditions of Distribution Network

Confirmation of the following pipe conditions in pipe planning.

1) Pipe Diameter: Investigation of main pipe and branch pipe diameters.

2) Pipe Routes: Confirmation of pipe route and pipe position with map of the existing pipe network.

3) The distribution network layout for new areas to be served will be formed by loops of pipelines to the extent practicable, thereby minimizing dead ends and providing flexibility in operation.

4) Pipe Connecting Node: Confirmation of position of pipe connecting node with map of the existing pipe network.

5) Determination of diversion culvert location: method of installation of pipe at diversion points is decided after confirming other existing buried objects.

5.2.1 Provision of Survey

Required items in facilities inspection are shown below

- ✓ Inspection Sheets
- ✓ (Digital) Camera
- ✓ Cover Opener (T key)
- ✓ Wrench, spanner, Screw driver, cotton work gloves and so on
- ✓ Maps

5.2.2 Intake Facility/Deep Tube Well

1) Observational items are mainly Fence, Concrete degradation, Facility condition (Appearance), Water quality (turbidity, unusual odor), Screen (Rust, trash-filled), Sedimentation in canal, and so on.

2) CWASA staffs conduct the intake facility survey periodically. The inspectors contact the CWASA when discovering malfunction of the facility.

3) The Guard always supervises the fence to prevent trespassing.

4) CWASA displays Keep Off of general people in the bulletin board and signs at the intake site.

5.2.3 Pipelines and Valves

1) Raw Water Transmission and Transmission Pipes:

There is little information of pipe from residents since raw water transmission pipes are located far from the management office (WTP) such as the paddy fields and mountainous region. It is thought of behind in the discovery when the pipe has a malfunction. Therefore, CWASA staffs make periodical inspection.

2) Distribution Pipes:

a) CWASA staffs prevent leakage of water in pipes, especially leakage from joints.
b) CWASA replaces an old pipes when there is too much water leakage from pipe and not from the joints.
c) CWASA staffs monitor and maintain pipes where it is possible to generate rust-colored water by stagnation of water at dead ends.

3) Valve:

a) Gate Valve: Gate valve is mainly used by on-off control. In case of opening only some position of valve disc, use of the gate valve is not advised. Valve disc in valve box moves up and down, and opens and shuts.
b) Butterfly Valve: Valve disc in the valve box makes a valve rod in an axis, turns and opens and shuts.

4) Air Valve:

Air valves are located on all high points in the distribution pipelines to allow trapped air to be release from pipelines without loss of water.

5) Washout:

Washout: Washout drains are provided to keep the pipelines free from blockade. It shall be washed out at least once in 3 month in dry season and once a month in rainy season with enough water to flush the deposited dirt until clear water at washout is observed

5.2.4 Elevated Tank

a) CWASA staffs clean the inside of the tank once a year.
b) In case of cleaning inside the tank, staffs confirm leakage of water from the concrete crack and joint inside the tank.

Table 5.1 Check Items of Water Facilities

Facilities	Check Items	Remarks
Intake	Date, Fence, Concrete degradation, Condition (appearance), Water quality, Screen, Sedimentation, etc.	Repair record, Sketch, Photograph
Pipe	Location, Diameter, pipe material, Condition (appearance), Water quality, Leakage, Sound, Customer complaints, etc.	Repair record, Sketch, Photograph
Valve, Air valve, Washout, Fire Hydrant	Type, Location, Main pipe dia., Condition (appearance), Working, Leakage, Sound, Valve status, etc.	Repair record, Sketch, Photograph
Elevated Tank	Location, Crack of concrete, Condition (appearance), Water quality, Leakage, Sound, Cleaning, etc.	Repair record, Sketch, Photograph

5.3 Procedures of investigation and report to CWASA

At the time of the regular investigation of the water supply facilities, CWASA staffs make inspection record, and report to CWASA. When the abnormality and problem in the water facilities are discovered, staffs will repair it and inform CWASA of its result.

1.5.1 Routine Work Procedures

Procedures of investigation and report under the normal situation are shown below.

1.5.2 Emergency Situation Procedures

In emergency, as the priority is given to protect life of residents and to secure safety, establishment of liaison system is described in the Manual. In order to inform quickly, CWASA staff need to identify emergent incidence properly and inform it to the manager/board members as early as possible. The manager/board members must decide to inform to residents, collection proper information and grasping the proper situation of the incident. Liaison system in CWASA needs to establish, since residents may provide information to CWASA.

Emergency situations will be classified into;

1. Stop of water supply function (large scale power failure, damage of facilities, water contamination)
2. Natural disaster (earthquake, damages caused by floods, landslide, fire disaster, abnormal climate, infectious disease)
3. Terrorism (threat, destructive activities)

The emergency in this context is defined as 1) stop of water supply function.

The Manual describes that when emergency situation takes place, response will be made to protect life of residents and to secure safety, to protect water supply facilities, to secure continuance and safety of facility operation.

Procedures under the emergency situation are shown below.

Troubleshooting
on
Valves and Water Meter

1.4 Out of Order and Measures of Valve

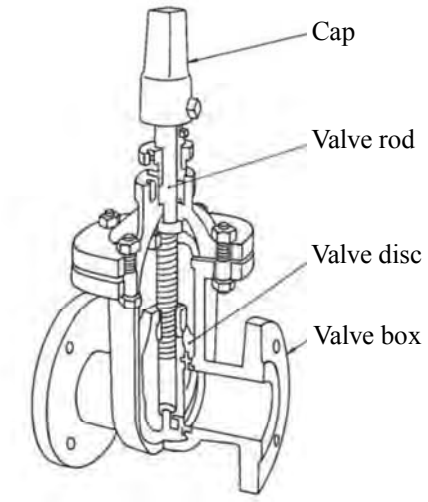


Figure 1.4.1 Gate Valve

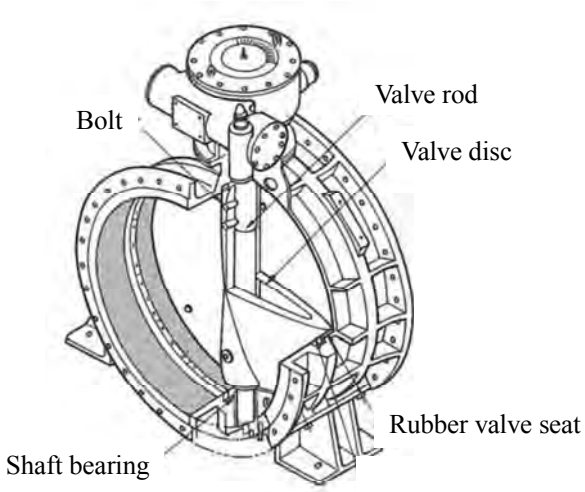


Figure 1.4.2 Butterfly Valve

Table 1.4.1 Out of Order and Measures of Valve

	Malfunction	Causes	Measures
Gate Valve	It is impossible to open and shut a valve.	The valve seat is filled with alien substance such as garbage and sand.	Removes alien substance.
		Abnormal abrasion of valve rod joint	Adjustment and repair of valve joint
		Twist and distortion of valve rod	Replacement of valve rod
		Abnormal abrasion of valve rod and valve box guide	Repair of valve box edge.
		Malfunction of reduction gears	Decomposition and parts cleaning. Replacement of parts of reduction gears
	Torque generates strongly in case of operation of the valve. Leakage of water from ground of valve	The valve seat and valve rod are filled with alien substance	Remove alien substance.
		Packing gland tighten up too much.	Adjustment of packing gland nut.
		Valve disc digs deep into	Adjustment of valve

	Malfunction	Causes	Measures
		valve seat.	opening.
		Abnormal abrasion of packing, bad fastening of packing	Adjustment or replacement of packing
		Dirt and so on adhere to a outcrop of valve rod, and surface of rod is a flaw.	Grinding or replacement of valve rod
	Leakage of water in spite of indicating close on opening gauge	Abnormal abrasion or damage of valve seat	Repair or replacement of valve seat
		Bad opening gauge	Inspection, replacement of valve and gauge
		Bad adjustment with valve	Readjustment with valve
	Vibration and/or noise from valve	Generation of cavitation in valve box	Set the valve opening with no generation of cavitation.
Butterfly Valve	It is impossible to open and shut a valve.	The valve seat is filled with alien substance such as garbage and sand.	Remove alien substance. Repair rubber valve seat Repair a edge of valve disc.
		Malfunction of reduction gears	Decomposition and parts cleaning. Replacement of parts of reduction gears.
	Torque generates strongly in case of operation of the valve.	Bad shaft bearing of valve disc	Replacement of shaft bearing
		Valve disc moved down	Adjustment of valve disc position with adjusting-bolt
		Valve disc digs deep into valve seat.	Adjustment of valve opening.
	Leakage of water from valve seat with abnormal torque when closing valve.	Separation of rubber valve seat	Replacement of rubber valve seat
		The valve seat and valve rod are filled with alien substance	Remove alien substance.
	Leakage of water in spite of indicating close on opening	Damage of rubber valve seat	Replacement of rubber valve seat

	Malfunction	Causes	Measures
	gauge	Bad opening gauge	Conducting inspection of valve and gauge
		Bad adjustment with valve	Readjustment with valve
	Vibration and/or noise from valve	Backlash of gear in second reduction gears	Adjustment and/or replacement of gear
		Generation of cavitation in valve box	Inspect a cause of cavitation, and remove it.

5. Out of Order and Measures of Water Meter

Water meter failures are categorized such as no proceeding indicator, delay of indicator, inverse rotation of indicator, derangement, leakage from meter, unclearness of meter and meter damage.

1) No proceeding indicator: Indicators stop after installing or during use.
2) Delay of indicator: Phenomenon that indiscrete value decreases temporary or continuously during use.
   a. In case of indiscrete value decrease since no proceeding indicator occurred temporarily.
   b. In case of inaccurate of meter: since water meter is damaged.
3) Inverse rotation of indicator: Phenomenon of indiscrete value subtraction due to inverse rotation of indicator.
4) Derangement of indicator: Phenomenon that indicator sometimes moves inversely, unstable due to damaged meter parts.
5) Leakage from meter: Phenomenon of leakage from meter or surroundings of meter.
6) Unclearness of meter: It is not easy to read a meter due to unclearness of meter indicator and plate glass.
7) Meter damage: Phenomenon that water meter is partially damaged due to external factors such as collision.

1. No indicator proceeding		
Cause	Instance	Measure
Alien substance such as sands, rust and pipe material get into gear portion and stops meter	✓ Indicator stops immediately after opening the valve. ✓ Meter indicator d stops suddenly. ✓ No indicator proceeding after water is cutoff.	Pipe cleaning is always conducted after pipe works.
Over flow causes abnormal abrasion of meter parts and damage them.	Abrasion is caused by heavy water flow	Change meter to big rating one.
Damage by water hammer	When opening a valve forcefully after meter installation, there is a dash in the plumbing and the meter indicator will not work.	Open the stop valve slowly.
The transformation of the meter parts by hydrothermal, hot water	Plastic meter plastic parts are transformed and become immovable due to hydrothermal.	Replacement of meter parts
No proceeding indicator by circumgyration by rapid inflow of air	In case of beginning the flow of water after meter installation and/or upstream side plumbing, a lot of air makes the impeller rotate at a high-speed and the plastic parts are transformed due to generation of heat.	✓ Air should be released gradually. ✓ Stop valve in a meter should be opened slowly.

Meter parts are damaged by dropping and impact	Indicator plate and gear wheel are damage and its turn becomes impossible to operate.	✓ Meters should be handled carefully especially during transportation. ✓ Damaged meters should be checked to confirm the meter functions.

2. Delay of indicator		
Case	Instance	Measure
Alien substance such as sands, rust and pipe material get into impeller portion and stop meter temporally.	Alien substances are crowded at impeller makes it temporarily immovable, but due to pressure fluctuation the clog is recovered.	Pipe cleaning is always conducted after pipe working.
Over flow causes abnormal abrasion of meter parts and damage them.	Abnormal abrasion of rotation axes and gear wheel causes unstable condition.	Change meter to big rating one.
Delay of indicator by too little flow	In case the flow rate is below the minimum flow rate.	Change meter to suitable rating one.
Bad meter installation posture	The installed meter is leaning extremely.	Install meter on horizontal pipes
Accumulation of scale inside the meter	Smooth turn of impeller is obstructed due to the accumulation of alien substances such as sand.	Cleaning regularly

3. Inverse rotation of indicator		
Cause	Instance	Measure
Reverse installation	-	Meter should be installed in the direction as indicated in the case.
Backflow in service pipe	Water flows backward by siphon when pump is stopped.	Check valve should be installed to prevent backflow
Influence of ventilation	Ventilation from exit side of meter backlashes and indicated value decreases.	Entrance and exit of meter should be covered by caps or a vinyl bag.

4. Derangement of indicator		
Cause	Instance	Measure
Cause of water hummer	Indicator plate is damaged, and gear wheels are dislocated and make irregular turn.	Stop valve in a meter should be opened slowly.

Cause of over flow	Gear wheels were dislocated and make irregular turn due to abnormal abrasion of meter parts.	Change meter to big rating one.

5. Leakage from meter		
Cause	Instance	Measure
Destruction by water hummer	When opening a valve forcefully, there is a dash in plumbing and the windowpane destroyed.	Stop valve in a meter should be opened slowly
Transformation and deterioration of gasket in meter	Fastening is too strong and causes crack.	Appropriate fastening.

6. Unclearness of meter		
Cause	Instance	Measure
Accumulation of alien substance such as sands, rust inside the meter	Iron rust and other substances get accumulate inside the meter and meter reading becomes difficult.	Clean regularly
Adhesion of water inside the meter	The register box of the dry-meter is cracked by water hammer, and moisture was trapped inside it.	The Stop valve in a the meter should be opened slowly to prevent impact of water hammer

7. Meter damage		
Cause	Instance	Measure
Falling meter	Indicator plate and gear wheel are damaged.	✓ The meter should be handled carefully during the transportation and installment. ✓ Damaged meters should not be used.

The draft Manual
on
Water Meter Calibration Control

1. Water Meter Calibration Control

The performance of water meters shall be such that they can accurately measure as wide a flow range as possible and are durable.

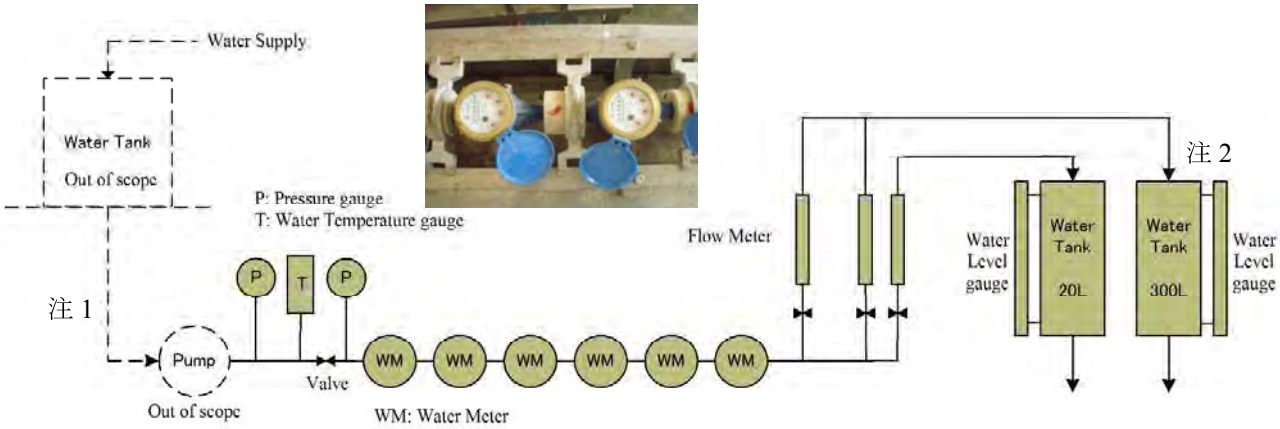
Two methods of a water meter calibration are introduced herein. One is using the water meter calibration equipment at Chittagong WASA Central Store in Halishahar (refer to **section 1.1**), the other is examination of instrumental error to an existing water meter (refer to **section 1.2 (1)**).

1.1 Water Meter Accuracy Management Equipment

A master meter can be set in order to calibrate water meters.

- Purpose of establishment
  Improvement in performance of repair meter of CWASA
- Principle of equipment
  a) Typical size of the water meter to authorize is 20 mm (3/4 inch) and 25mm (1 inch).
  b) Measurement of theoretical amount of water is calculated from a water gauge.
  c) Accuracy management is evaluated from the difference of the measurement value of water amount and water meter (Refer to **Figure 1.2**)
  d) The range of an allowable error of measurement may be from ±5% to ±2%.

Verification tolerance is used in this method (refer to **section 1.2 (2)**).



Tested Water Meters

Flow Meters (3)

Water Tank

Figure 1.1 Flow sheet of Water Meter Accuracy Management Equipment (Reference)

(1) Verification Tolerance

Verification tolerance is a permitted limit to judge acceptance or rejection of the water meter test. The range is shown in **Figure 1.2**.

(2) Simple check of water meter

・As for the operation of the water meter, it confirms that the impeller operates with breath.

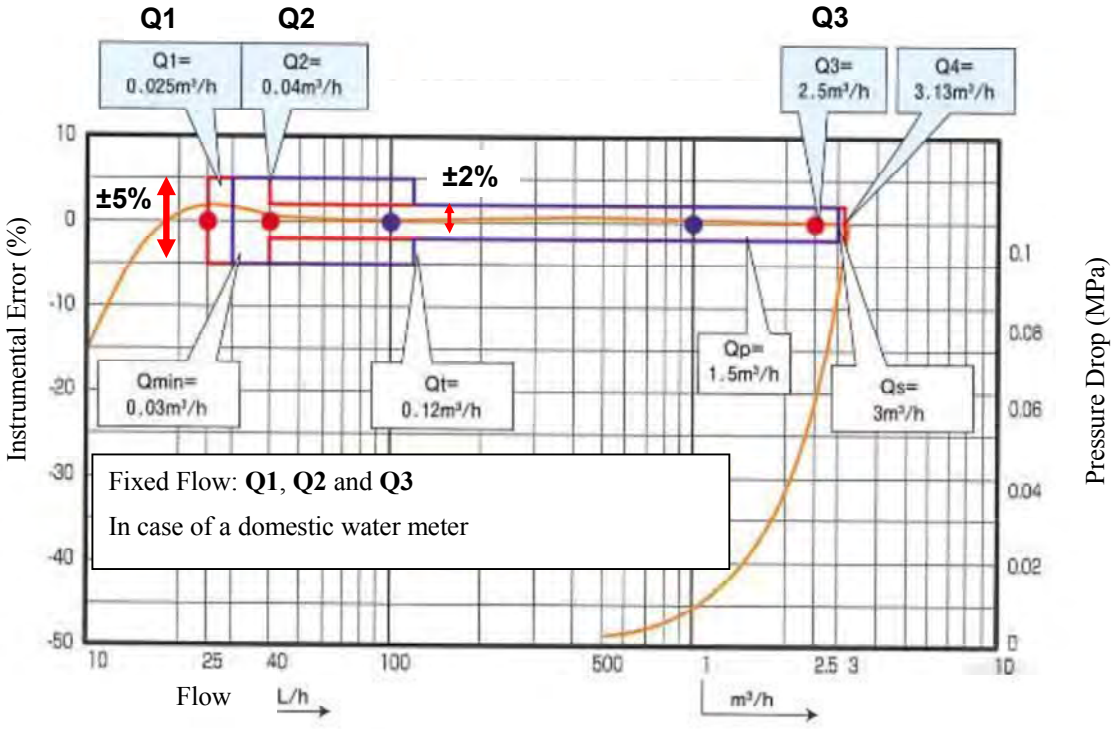


Figure 1.2 Range of Verification Tolerance for Domestic Water Meter (15 mm)

In delivery inspection, there are 3 points to check the flow rate.

Q1: Minimum Flow Rate: The flow is a required minimum flow under meter movement conditions.
Q2: Transitional Flow Rate: The flow is a border value between small flow rang and big flow rang.
Q3: Permanent Flow Rate: The flow is a required maximum flow under meter movement conditions.
Q4: Overload Flow Rate: This is maximum flow to maintain a meter performance.

The performance of flow rate shall comply with **Table 1.1**.

Table 1.1 Performance of Flow Rate

	Meter Size	
	20 mm	25 mm
Minimum Flow Rate: Q1	0.05 m^3/hr	0.08 m^3/hr
Transitional Flow Rate: Q2	0.08 m^3/hr	0.13 m^3/hr
Permanent Flow Rate: Q3	4 m^3/hr	6.3 m^3/hr
Overload Flow Rate: Q4	5 m^3/hr	7.8 m^3/hr

1.2 Examination of Instrumental Error with Master (Standard) Water Meter

Tolerance is the range of allowable instrumental error. There are 2 kinds of tolerance, users' tolerance and verification tolerance.

(1) Users' Tolerance

Engineer confirms whether indiscrete value of a tested water meter is within users' tolerance (±10 %) or not. (Note: verification tolerance is ±2 - ±5 %.)

Users' tolerance is an allowable error of active water meter during the period of examination validity (5 years).

Examination of Instrumental error (%) with Master (standard) water meter is conducted by using equipment shown in **Figure 1.3**. Process of examination is shown below.

1. Engineer excludes air by running water through the meter and service pipe.
2. Fully open the stop valve of Master (standard) water meter
3. Open the faucet slowly.
4. Fully close off the stop valve of Master (standard) water meter, and read indiscrete values of 2 meters.
5. Fully open the stop valve of Master (standard) water meter.
   Again fully close off the stop valve of Master (standard) water meter after running water up to fixed test flow.
   Read indiscrete values of 2 meters.
   (i.e. flow is 50 L in case of 40 mm diameter.)

Calculation method of instrumental error is shown below.

E (%) = (I-Q)/Q x 100

E: Instrumental error (%)
I: Indiscrete value of tested water meter (L)
Q: Indiscrete value of Master (standard) water meter (L)

The range of an allowable instrumental error of measurement may be ±10 % (i.e. in case of 100 L, the range of an allowable is ±10 L.)

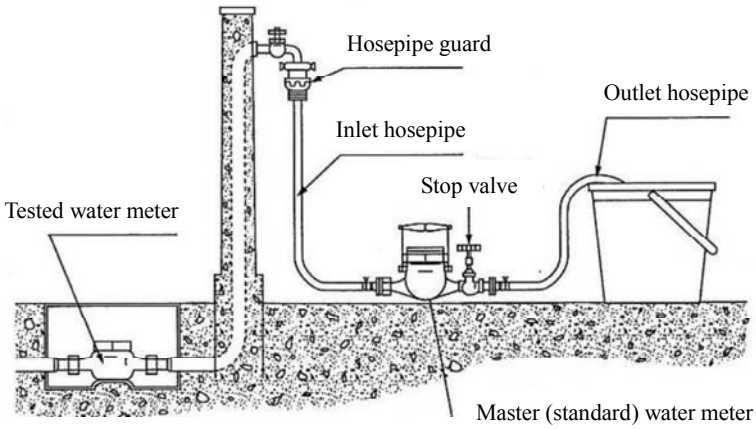


Figure 1.3 Example of Examination of Instrumental Error with Master (standard) water meter

[Example of Calculation]

Case 1

Type of water meter	Initial indicator	Final Indicator	Difference
Tested Meter (User's)	109.1067 m^3	109.1477 m^3	+0.0410 m^3 (I)
Master Meter	20.3782 m^3	20.4182 m^3	+0.0400 m^3 (Q)

E (%) = (I-Q)/Q x 100

= (0.0410-0.0400) / 0.0400 x 100

= **2.5 % <± 10%** It is OK!

Case 2

Type of water meter	Initial indicator	Final Indicator	Difference
Tested Meter (User's)	109.1067 m^3	109.1417 m^3	+0.0350 m^3 (I)
Master Meter	20.3782 m^3	20.4182 m^3	+0.0400 m^3 (Q)

E (%) = (I-Q)/Q x 100

= (0.0350-0.0400) / 0.0400 x 100

= **-12.5 % >± 10% It is above tolerance error!**

The Tested (User's) Meter should be replaced.

Draft Check Sheet
on
Water Distribution Facilities

CHECK SHEET (AIR VALVE)

Zone: 1, 2, 3, 4, North, Western **Inspection** Date (dd/mm/yyyy)_____

Inspector Name _____

SL. No. Sub-block [ ] Grid No. [ ] Road No. / Name [ ]

Facility ID: [ ] Road Type: [Pavement / Unpaved / Concrete / Others]

Air Valve and Valve Chamber

Air Valve Type: [Double Orifice / Rapid] Manhole Cover: [Existence / Nonexistence]

*Double Orifice Type: Main pipe dia. 75 – 500 mm, Rapid type: more than 600mm

Condition (Appearance): [Rusty / Dirty / Trash-filled (Garbage) / Submerged]

Valve Functioning: [Function / Not Function]

Water Leakage: [No Leakage / Leakage / Burst] Sound: [Yes / No / Vibration]

Main pipe and Valve dia.

Main Pipe Diameter (mm): [mm] Valve Dia. (70, 80, 100, 150 mm)

Pipe Material: [Ductile Iron (DI) / Cast Iron (CI) / PVC / Mild Steel (MS) / HDPE / Other ( )]

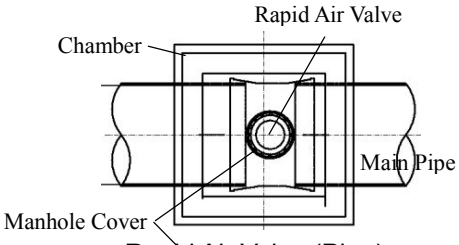
Repair Record

Activity on O&M Repair Record: [Clean / Leakage / Regular maintenance /

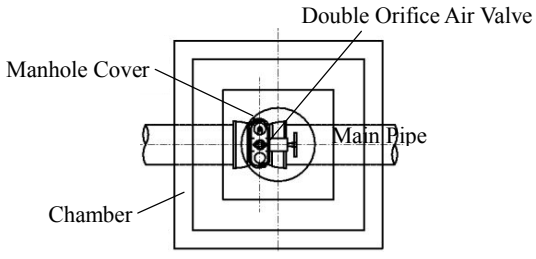
Repair ( ) / Replace ( ) / Other ( )]

Repair Date(dd/mm/yyyy): [ ] Ref. No. of Repair Report: [ ]

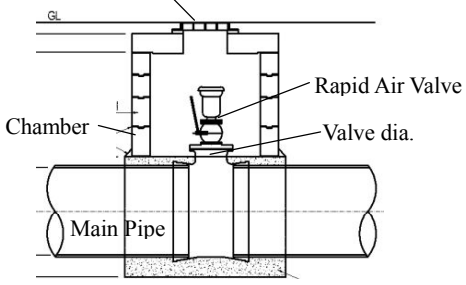
Drawdamaged / repaired / replaced partsbelow the picture (If any)



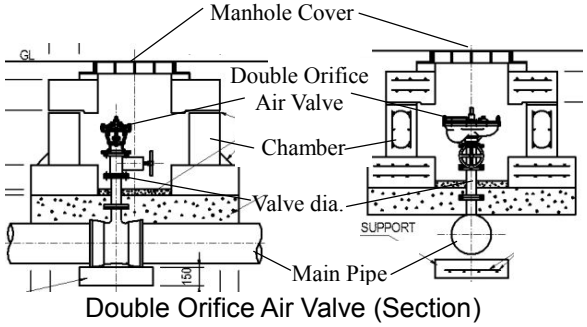
Rapid Air Valve (Plan)



Double Orifice Air Valve (Plan)



Rapid Air Valve (Section)



Double Orifice Air Valve (Section)

Ref.No. of Photo File (Photo File Name): _____

CHECK SHEET (OVER CROSSING PIPE)

Zone: 1, 2, 3, 4, North, Western Inspection Date (dd/mm/yyyy)_____

Inspector Name _____

SL. No. Sub-block Grid No.

Road No. / Name Facility ID:

Over CrossingPipe

Pipe Diameter (mm): mm Exposed Pipe Length: m

Crossing Type: Type A / Type B (refer to below figures)

Pipe Material: Ductile Iron (DI) / Cast Iron (CI) / PVC / Mild Steel (MS) / HDPE / Other ( )

Condition (Appearance): Rusty / Dirty / Trash-filled (Garbage) / Submerged / Other ( )

Air Valve Functioning: Function / Not Function/ No Valve

Water Leakage: No Leakage / Leakage / Burst Sound: Yes / No / Vibration

Existence of Air Release Valve: Yes / Not

Existence of Coating (Outside): Yes / Not Re-CoatingDate(dd/mm/yyyy):

*Under Ground: Polyethylene Coating, Exposed Pipe: Non-Breeding Type Epoxy Coating (Gray)

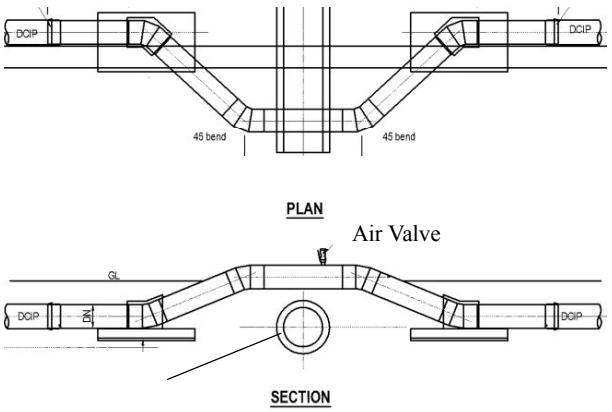
Repair Record

Activity on O&M Repair Record: Clean / Leakage / Regular maintenance /

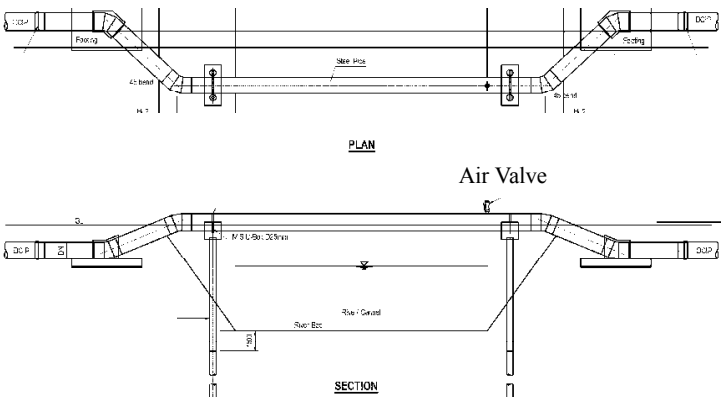
Repair ( ) / Replace ( ) / Other ( )

Repair Date (dd/mm/yyyy): Ref. No. of Repair Report:

Draw damaged / repaired / replaced parts or Leakage situation below the picture (If any)



Type A



Type B

Ref.No. of Photo File (Photo File Name): _____

CHECK SHEET (Butterfly VALVE)

Zone: 1, 2, 3, 4, North, Western Inspection Date(dd/mm/yyyy)_____

Inspector Name _____

SL. No. Sub-block Grid No. Road No. / Name

Facility ID: Road Type: Pavement / Unpaved / Concrete / Others

---

Butterfly Valve and Valve Chamber

Valve Chamber: Existence / Nonexistence Manhole Cover: Existence / Nonexistence

Valve Status (Under the normal operation): Opened / Partially opened / Partially closed / Closed

Degree of Opening (Butterfly Valve only):

Condition (Appearance): Rusty / Dirty / Trash-filled (Garbage) / Submerged / Other ( )

Valve Functioning: Function / Not Function

Water Leakage: No Leakage / Leakage / Burst Sound: Yes / No / Vibration

---

Main pipe

Pipe Diameter (mm): mm

Pipe Material: Ductile Iron (DI) / Cast Iron (CI) / PVC / Mild Steel (MS) / HDPE / Other ( )

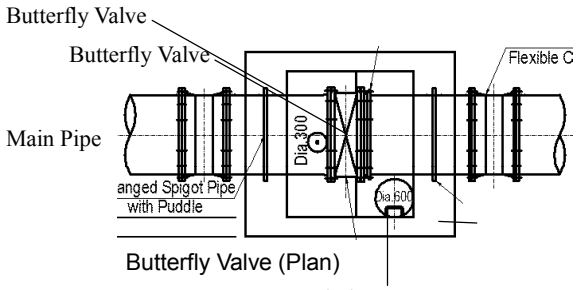
Repair Record

Activity on O&M Repair Record: Clean / Leakage / Regular maintenance /

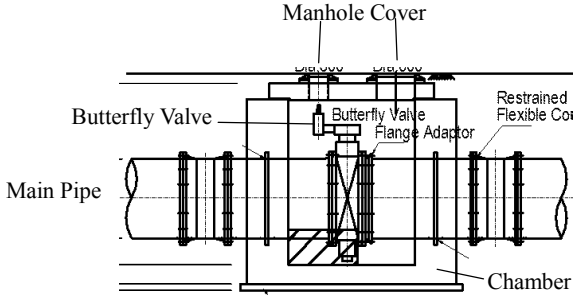
Repair ( ) / Replace ( ) / Other ( )

Repair Date(dd/mm/yyyy): Ref. No. of Repair Report:

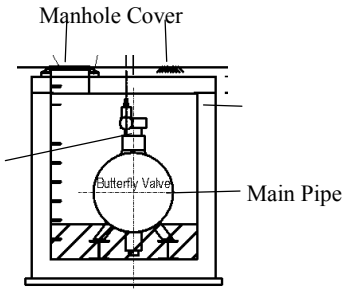
Drawdamaged / repaired / replaced parts below the picture (If any)



Butterfly Valve (Plan)



Butterfly Valve (Section)



Butterfly Valve (Section)

Ref.No. of Photo File (Photo File Name): _____

CHECK SHEET (DEEP TUBE WELLPUMP)

Zone: 1, 2, 3, 4, North, Western Inspection Date (dd/mm/yyyy)_____

Inspector Name _____

SL. No. Sub-block [ ] Grid No. [ ] Road No. / Name [ ]

Facility ID: [ ] Existence of Wall Fence: [Yes / Not]

Pump

Pump Category: [Submerged Pump / Dry Pit Type Pump]

Power: [kW] Head: [m] Pump Diameter: [mm]

No. of Pumps: [Unit] (Stand By: [Unit])

Submersible Pump: [Function / Not Function / No Pump]

Submersible Cable: [Function / Not Function / No Cable]

Condition(Appearance): [Rusty / Dirty / Trash-Filled(Garbage) / Other ( )]

Water Quality: [Not found abnormal / Turbidity / Unusual odor / Rusted color/ Other ( )]

Non-return valve: [Function / Not Function / No Valve]

Flow Meter: [Function / Not Function / No Flow Meter]

Pressure Gage: [Function / Not Function / No Pressure Gage]

Repair Record

Activity on O&M Repair Record: [Clean / Leakage / Regular maintenance /

Repair ( ) / Replace ( ) / Other ( )]

Repair Date (dd/mm/yyyy): [ ] Ref. No. of Repair Report: [ ]

Drawdamaged / repaired / replaced parts below the picture (If any)

Ref.No. of Photo File (Photo File Name): _____

CHECK SHEET (ELEVATED TANK)

Zone: 1, 2, 3, 4, North, Western Inspection Date (dd/mm/yyyy)_____

Inspector Name _____

SL. No. Sub-block [ ] Grid No. [ ]

Road No. / Name [ ] Facility ID: [ ]

Existence of Wall Fence: [Yes / No]

Elevated Tank and Yard Pipe

ConcreteCrack: [Yes (No. of Clacks) / Not]

Condition(Appearance): [Rusty / Dirty / Trash-Filled (Garbage)]

Water Leakage: [No Leakage / Leakage / Burst] Sound from pipe: [Yes / No / Vibration]

Water Quality: [Not found abnormal / Turbidity / Unusual odor / Rusted color]

Residual Chlorine: [mg/L] Valve: [Gate Valve / Butterfly Valve]

Repair Record

Activity on O&M Repair Record: [Clean / Leakage / Regular maintenance /

Repair ( ) / Replace ( ) /Other ( )]

Repair Date(dd/mm/yyyy): [ ] Ref. No. of Repair Report: [ ]

Drawdamaged / repaired / replaced parts below the picture (If any)

Ref.No. of Photo File (Photo File Name): _____

CHECK SHEET (FIRE HYDRANT)

Zone: 1, 2, 3, 4, North, Western Inspection Date (dd/mm/yyyy)_____

Inspector Name _____

SL. No. Sub-block [ ] Grid No. [ ] Road No. / Name [ ]

Facility ID: [ ] Road Type: [Pavement / Unpaved / Concrete / Others]

Fire Hydrant and Chamber

HydrantType: [Single Mouth / Dual Mouth] Manhole Cover: [Existence/ Nonexistence]

Condition (Appearance): [Rusty / Dirty / Trash-filled (Garbage) / Submerged]

Valve Functioning: [Function / Not Function] Water Leakage: [No Leakage / Leakage / Burst]

Sound: [Yes / No / Vibration]

Main pipe

Pipe Diameter (mm): [mm]

Pipe Material: [Ductile Iron (DI) / Cast Iron (CI) / PVC / Mild Steel (MS) / HDPE / Other ( )]

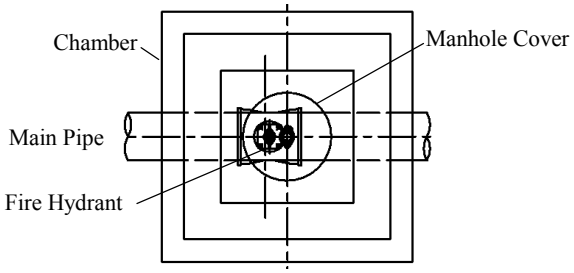
Repair Record

Activity on O&M Repair Record: [Clean / Leakage / Regular maintenance /]

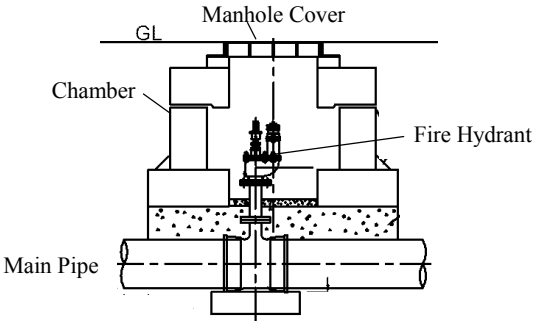
[Repair ( ) / Replace ( ) / Other ( )]

Repair Date(dd/mm/yyyy): [ ] Ref. No. of Repair Report: [ ]

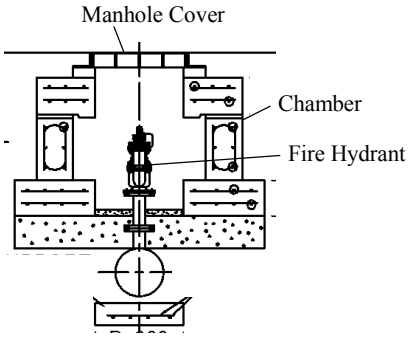
Drawdamaged /repaired / replaced parts below the picture (If any)



Fire Hydrant (Plan)



Fire Hydrant (Section)



Fire Hydrant (Section)

Ref.No. of Photo File (Photo File Name): _____

CHECK SHEET (GATE VALVE)

Zone: 1, 2, 3, 4, North, Western Inspection Date(dd/mm/yyyy)_____

Inspector Name _____

SL. No. Sub-block Grid No. Road No. / Name

Facility ID: Road Type: Pavement / Unpaved / Concrete / Others

---

Gate Valve and Valve Chamber

Valve Chamber: Existence / Nonexistence Manhole Cover: Existence / Nonexistence

Valve Status (Under the normal operation): Opened / Closed

Condition (Appearance): Rusty / Dirty / Trash-filled (Garbage) / Submerged / Other ( )

Valve Functioning: Function / Not Function

Water Leakage: No Leakage / Leakage / Burst Sound: Yes / No / Vibration

---

Main pipe

Pipe Diameter (mm): mm

Pipe Material: Ductile Iron (DI) / Cast Iron (CI) / PVC / Mild Steel (MS) / HDPE / Other ( )

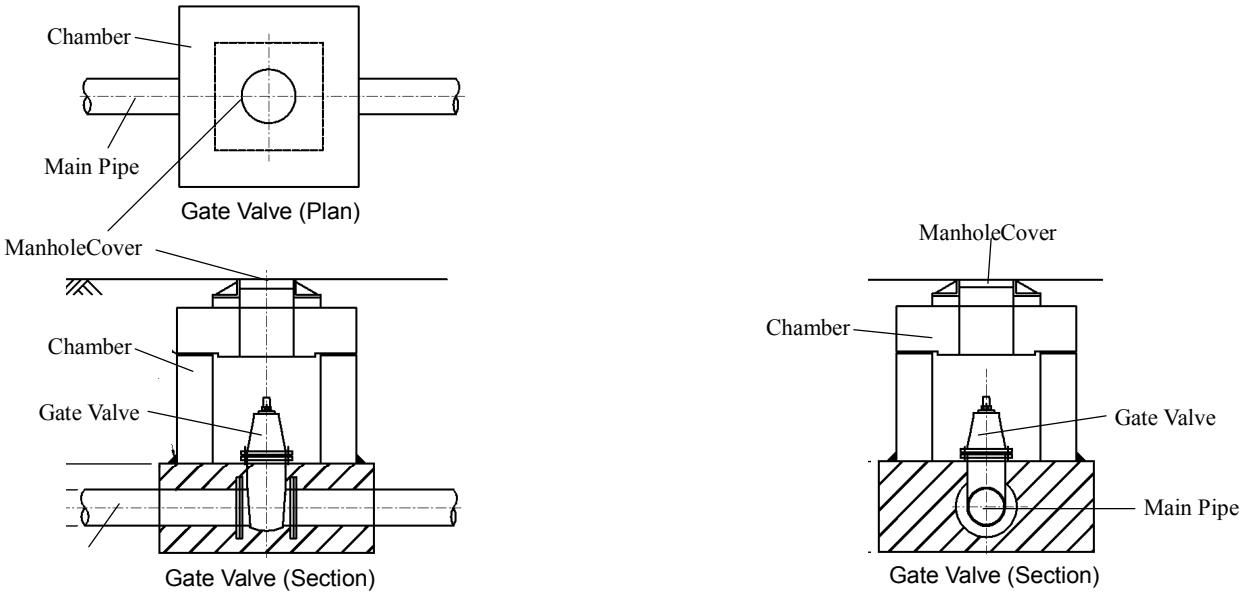
Repair Record

Activity on O&M Repair Record: Clean / Leakage / Regular maintenance /

Repair ( ) / Replace ( ) / Other ( )

Repair Date(dd/mm/yyyy): Ref. No. of Repair Report:

Drawdamaged / repaired / replaced parts below the picture (If any)



Ref.No. of Photo File (Photo File Name): _____

CHECK SHEET (INLET CHAMBER for DMA)

Zone: 1, 2, 3, 4, North, Western Inspection Date(dd/mm/yyyy)_____

Inspector Name _____

SL. No. Sub-block Grid No. Road No. / Name

Facility ID: Road Type: Pavement / Unpaved / Concrete / Others

---

Flow Meter, Valve and Valve Chamber

Manhole Cover: Existence / Nonexistence Valve Type: Gate Valve / Butterfly Valve

Valve Status (Under the normal operation): Opened / Closed

Condition (Appearance): Rusty / Dirty / Trash-filled (Garbage) / Submerged / Other ( )

Valve Functioning: Function / Not Function Water Leakage: No Leakage / Leakage / Burst

Sound: Yes / No / Vibration Flow Meter: Function / Not Function

---

Main pipe

Pipe Category: Primary / Secondary / Tertiary

Diameter (mm): mm

Pipe Material: Ductile Iron (DI) / Cast Iron (CI) / PVC / Mild Steel (MS) / HDPE / Other ( )

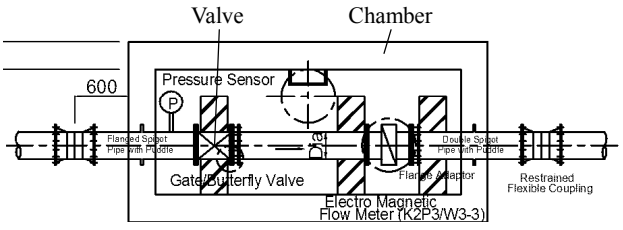
Repair Record

Activity on O&M Repair Record: Clean / Leakage / Regular maintenance /

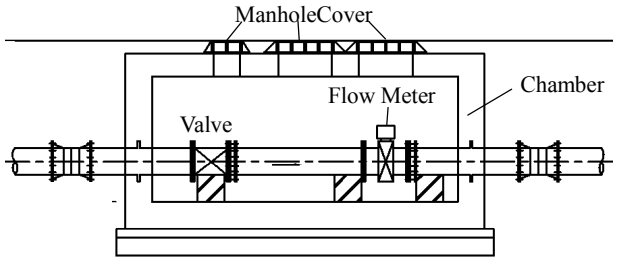
Repair ( ) / Replace ( ) / Other ( )

Repair Date(dd/mm/yyyy): Ref. No. of Repair Report:

Drawdamaged / repaired / replaced parts below the picture (If any)



Inlet Chamber (Plan)



Inlet Chamber (Section)

Ref.No. of Photo File (Photo File Name): _____

CHECK SHEET (PIPE)

Zone: 1, 2, 3, 4, North, Western Inspection Date (dd/mm/yyyy)_____

Inspector Name _____

SL. No. Sub-block [ ] Grid No. [ ] Road No. / Name [ ]

Facility ID: [ ] Road Type: [Pavement / Unpaved / Concrete / Others]

Main / Distribution Pipe

Pipe Diameter (mm): [mm]

Pipe Material: [Ductile Iron (DI) / Cast Iron (CI) / PVC / Mild Steel (MS) / HDPE / Other ( )]

Condition (Appearance): [Exposed / Other ( )]

Pipe Damaged: [Yes / No] Water Leakage: [No Leakage / Leakage / Burst] Sound: [Yes / No / Vibration]

Water Quality (Customer Complaint): [Not found abnormal / Turbidity / Unusual odor / Rusted color / Other]

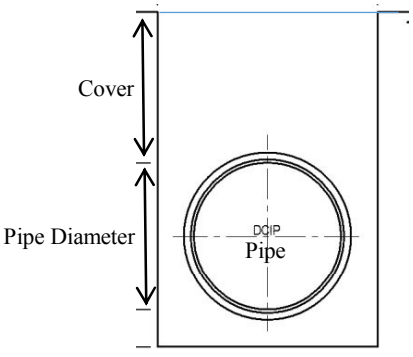
Repair Record

Activity on O&M Repair Record: [Clean / Leakage / Regular maintenance /

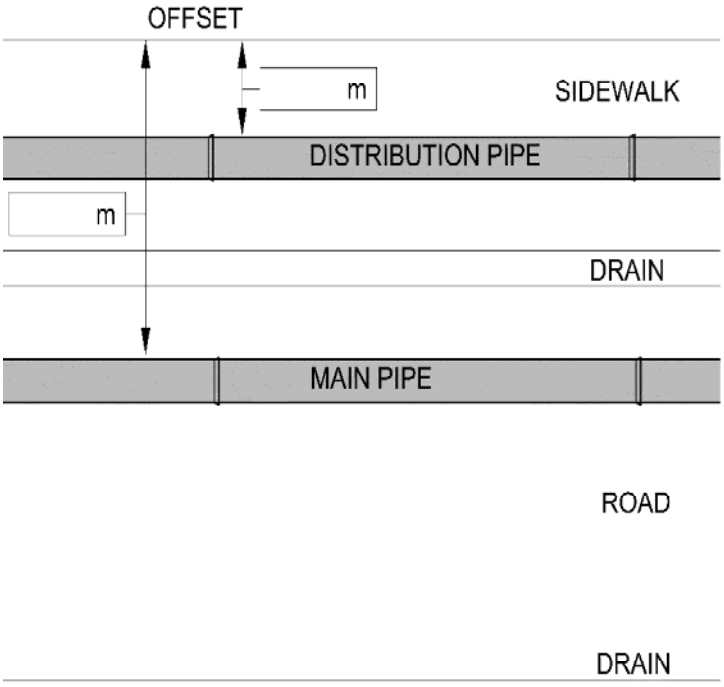
Repair ( ) / Replace ( ) / Other ( )]

Repair Date(dd/mm/yyyy): [ ] Ref. No. of Repair Report: [ ]

Drawdamaged / repair / replace parts or Leakage situation below the picture (If any)



Pipe (Section)



Pipe (Plan)

Ref.No. of Photo File (Photo File Name): _____

CHECK SHEET (SERVICE CONNECTION to Low Income Community)

Zone: 1, 2, 3, 4, North, Western Inspection Date (dd/mm/yyyy)_____

Inspector Name _____

SL. No. Sub-block Grid No.

Road No. / Name Facility ID:

Road Type: Pavement / Unpaved / Concrete / Others

ServiceConnection and Meter Box

Service Pipe Diameter (mm): mm

Service Pipe Material: Ductile Iron (DI) / Cast Iron (CI) / PVC / Mild Steel (MS) / HDPE / Other ( )

Meter Box Material: Brick / FRP / Concrete / Other( ) Box Location: Underground / Aboveground

Fiber Reinforced Plastic

Gate Valve Chamber: Brick / FRP / Concrete / Other ( )

Condition (Appearance): Rusty / Dirty / Trash-filled (Garbage) / Submerged / Other ( )

Gate Valve Work Functioning: Function / Not Function Water Leakage: No Leakage / Leakage / Burst

Sound: Yes / No / Vibration

Faucet: Number of Faucets: Faucet Condition: Normal / Abnormal ( )

Water Quality (Customer Complaint): Not found abnormal / Turbidity / Unusual odor / Rusted color/ Other ( )

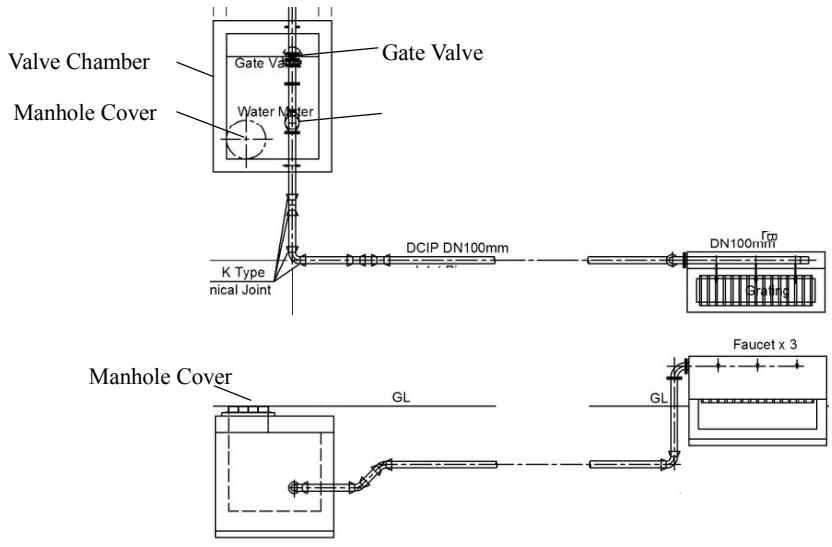
Repair Record

Activity on O&M Repair Record: Clean / Leakage / Regular maintenance /

Repair ( ) / Replace ( ) / Other ( )

Repair Date(dd/mm/yyyy): Ref. No. of Repair Report:

Draw damaged / repaired / replaced parts or Leakage situation below the picture (If any)



Service Connection (Section)

Ref.No. of Photo File (Photo File Na ___

CHECK SHEET (SERVICE CONNECTION to Customer)

Zone: 1, 2, 3, 4, North, Western Inspection Date (dd/mm/yyyy)_____

Inspector Name _____

SL. No. Sub-block [ ] Grid No. [ ]

Road No. / Name [ ] Facility ID: [ ]

Road Type: [Pavement / Unpaved / Concrete / Others]

ServiceConnection and Meter Box

Service Pipe Diameter (mm):[mm]

Service Pipe Material:[Ductile Iron (DI) / Cast Iron (CI) / PVC / Mild Steel (MS) / HDPE / Other ( )]

Meter Box Material: [Brick / FRP / Concrete / Other( )] Box Location: [Underground / Aboveground]

Fiber Reinforced Plastic

Condition (Appearance): [Rusty / Dirty / Trash-filled (Garbage) / Submerged / Other ( )]

Valve Work Functioning: [Function / Not Function] Water Leakage: [No Leakage / Leakage / Burst]

Sound: [Yes / No / Vibration]

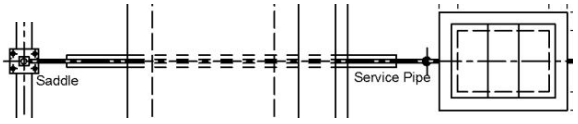
Water Quality (Customer Complaint): [Not found abnormal / Turbidity / Unusual odor / Rusted color/ Other ( )]

Repair Record

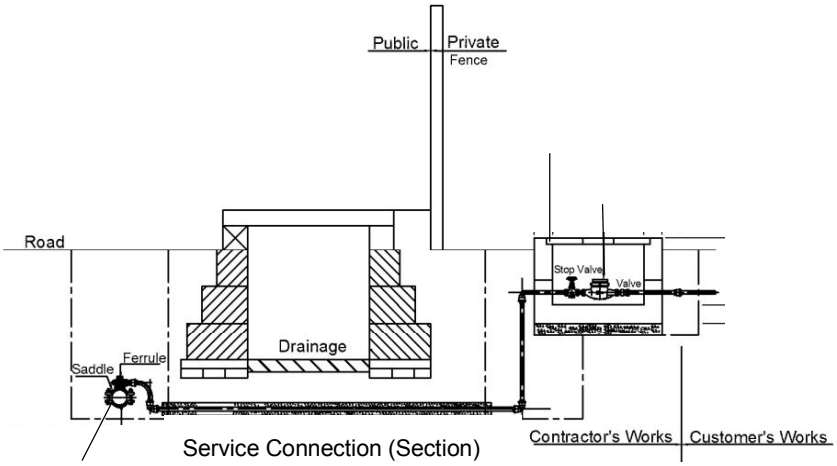
Activity on O&M Repair Record: [Clean / Leakage / Regular maintenance / Repair ( ) / Replace ( ) / Other ( )]

Repair Date(dd/mm/yyyy): [ ] Ref. No. of Repair Report: [ ]

Draw damaged / repaired / replaced parts or Leakage situation below the picture (If any)



Meter Box



Service Connection (Section)

CHECK SHEET (WASHOUT)

Zone: 1, 2, 3, 4, North, Western Inspection Date (dd/mm/yyyy)_____

Inspector Name _____

SL. No. Sub-block [ ] Grid No. [ ] Road No. / Name [ ]

Facility ID: [ ] Road Type: [Pavement / Unpaved / Concrete / Others]

Washout and Chamber

Manhole Cover: [Existence / Nonexistence]

Valve Status (Under the normal operation): [Closed / Not Closed]

Washing Date (dd/mm/yyyy): [ ]

Condition (Appearance): [Rusty / Dirty / Trash-filled (Garbage) / Submerged / Other ( )]

Valve Functioning: [Function / Not Function]

Water Leakage: [No Leakage / Leakage / Burst] Sound: [Yes / No / Vibration]

Main pipe

Main Diameter (mm): [mm] Drainage Pipe Diameter [mm]

Main Pipe Material: [Ductile Iron (DI) / Cast Iron (CI) / PVC / Mild Steel (MS) / HDPE / Other ( )]

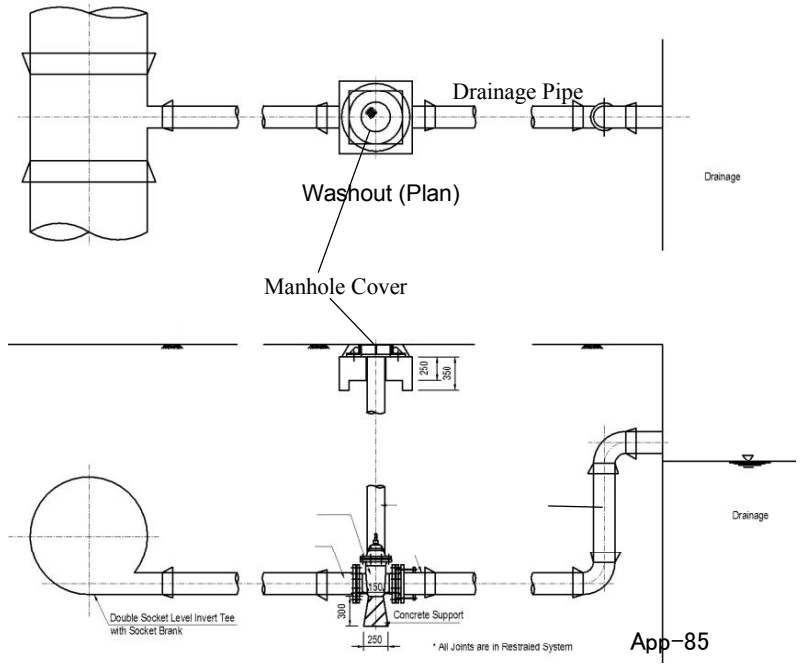
Drainage Pipe Material: [Ductile Iron (DI) / Cast Iron (CI) / PVC / Mild Steel (MS) / HDPE / Other ( )]

Repair Record (Main Pipe / Drainage Pipe)

Activity on O&M Repair Record: [Clean / Leakage / Regular maintenance / Repair ( ) / Replace ( ) / Other ( )]

Repair Date(dd/mm/yyyy): [ ] Ref. No. of Repair Report: [ ]

Draw damaged / repaired / replaced parts below the picture (If any)



Workshop Materials
(Presentation Slides)

The Draft Manual
on
O&M of Water Distribution Facilities

September, 2015

Contents of Workshop

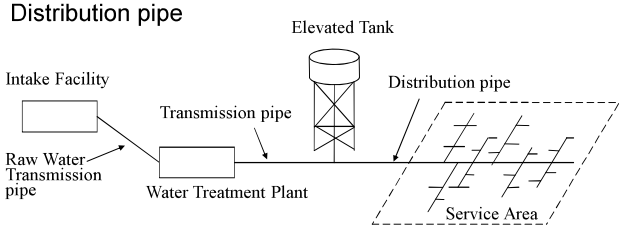
Objectives of Workshop

1. Basic knowledge of distribution facilities
2. How to operate a valve
3. Malfunction and Measures on a valve and water meter

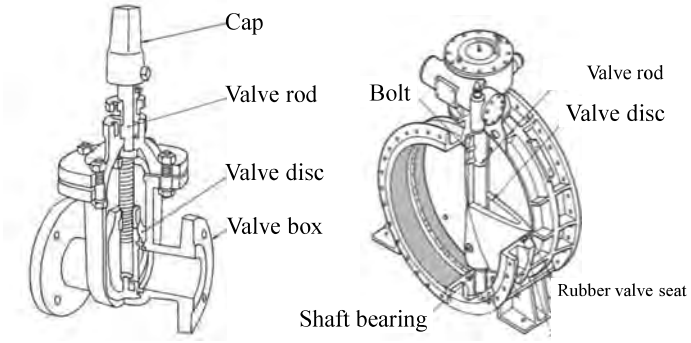
Water Distribution Facilities

Regular check of water distribution facilities

- Intake facility
- Raw water transmission pipe
- Transmission pipe
- Elevated tank
- Distribution pipe



Gate and Butterfly Valve



Gate Valve

Butterfly Valve

Precautions of Valve Operation 1

1) Do not turn a handle of a valve at excessive power when a gate position is either full open or full close.

2) Avoid opening and closing rapidly a valve because it cases a water hummer which damage a pipe and pump.

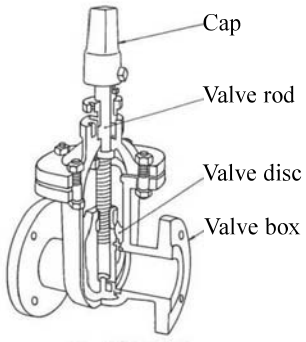
3) Confirm to stop flow completely by appearance, hearing and pressure after closing off fully.

Precautions of Valve Operation 2

4) Operate a handle after confirming an open-and-close direction of a valve. In case of a valve with an opening gauge, confirm whether the gauge and actual valve opening reconcile.

5) As an open-and-close of a valve, while around to the left is opening, around to the right is closing

Gate Valve

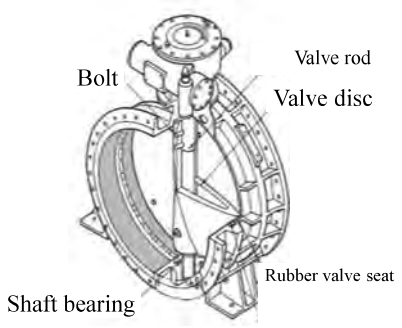


Gate Valve

Gate Valve

Gate valve functions are interception and discharge. Inside valve box, a valve disc which sets at right angle against flow direction moves to top and bottom and opens/closes. The valve disc position in the valve box is either full open or tight close. A middle position between open and close is undesirable.

Butterfly Valve



Butterfly Valve

Gate Valve

1) Adjustment of a gland packing in a valve box should not be strong tight and uneven clamping. Check a leakage from the gland packing part.

2) A gate valve seat is a metal. A valve disc should not be broken into the metal seat.

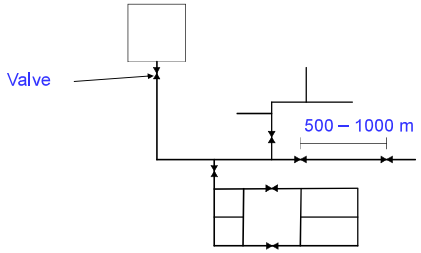
Butterfly Valve

Butterfly valve functions are control, interception and protection for pipes. Inside valve box, a valve disc rotates on a valve rod (vertical axis) and opens/closes.

1) When a valve with a rubber valve seat is operated under dry condition of the valve seat, the rubber valve seat may be damaged by abnormal dry friction and/or torque limit switch working. In case of valve operation with an empty inside pipe (no water)

Roles of Valves and Locations

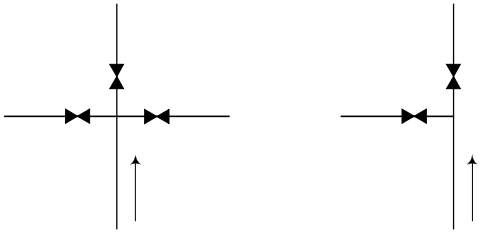
- To control flows and maintain pipelines
  → Leakage Repair and Pipe Replacement
- Gate Valve for 300 mm diameters below
- Butterfly Valve for 300 mm above
- To be installed at intervals of approx. 500 m – 1000 m



Location of Valves at Branches

(a) Maximum 3 valves will be provided at crosses

(b) Maximum 2 valves will be provided at tees



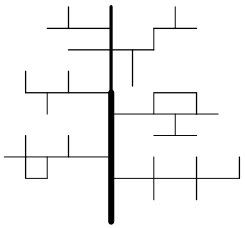
Precautions of Gate Valve Operation

No.	Item	Precaution
1	Cap	Caution of a rotation direction. The clockwise rotation makes close a valve, while counterclockwise rotation makes open a valve. A cap damaged and deformed by an excessive power. A key handle cannot be attached with corrosion
2	Gland packing	Caution against deformation of a gland packing and leakage
3	Valve rod	Caution against deformation in an attachment, garbage and rust at an exposed part
4	Valve disc	Caution against deformation, abrasion and thrusting a disc to a seat
5	Valve box	Possibility of damage to a valve box with an excessive power

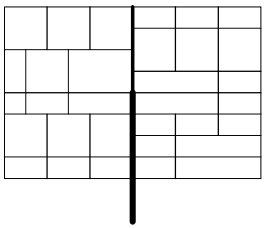
Precautions of Butterfly Valve Operation

No.	Item	Precaution
1	Opening gauge	Difference between an opening gauge and actual opening, damage of the gauge
2	Manual handle	Caution against rotation direction and not exert an excessive power
3	Valve rod	Confirmation of a faulty coupling and fastening to a valve disc
4	Valve disc	Caution against a strange sound and vibration by cavitation
5	Reamer bolt nut	Caution against looseness of a nut, nut falling off in case of a light load to manual handle
6	Rubber valve seat	Caution against jammed extraneous matters, broken into the metal seat and seat ablation
7	Rubber valve seat press	Damage by rubber sheet ablation

3.1 Distribution Network System

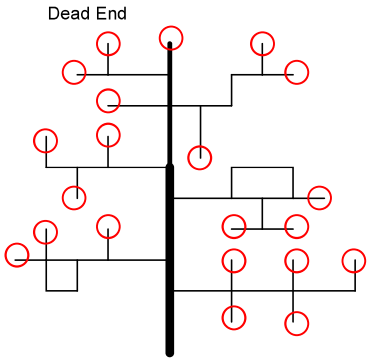


Tree Type Distribution System



Grid Type Distribution System

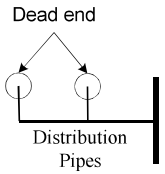
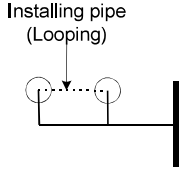
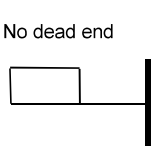
3.2 Tree Type Distribution System



Tree type system has dead ends which are the potential for stagnation and deterioration of water quality

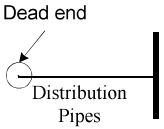
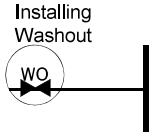
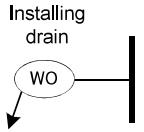
3.3 How to eliminate a dead end

a) To loop a pipe network

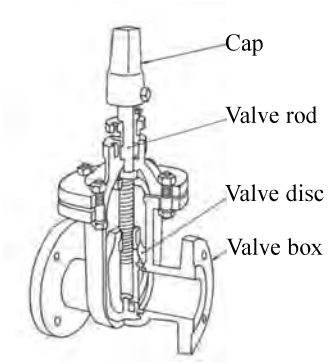
		
1) Current situation	2) Connecting between the dead ends	3) Loop Network

3.4 How to avoid generating rust-colored water at a dead end

b) To install a washout drain at a dead end

		
1) Current situation	2) Installing a washout at a dead end	3) Washed out through a drain periodically

Troubleshooting of Gate Valve



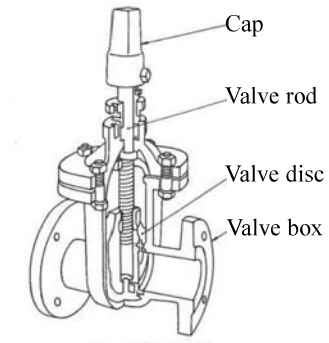
Gate Valve

Out of Order and Measures of Valve
Gate Valve - 1

Malfunction: It is Impossible to open and shut a valve

Causes	Measures
The valve seat is filled with alien substance such as garbage and sand	Removes alien substance
Abnormal abrasion of valve rod joint	Adjustment and repair of valve joint
Twist and distortion of valve rod	Replacement of valve rod
Abnormal abrasion of valve rod and valve box guide	Repair of valve box edge.
Malfunction of reduction gear	Decomposition and parts cleaning. Replacement of parts of reduction gears

Troubleshooting of Gate Valve



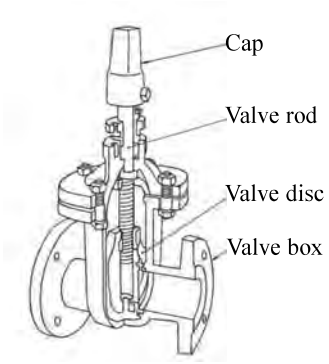
Gate Valve

Out of Order and Measures of Valve
Gate Valve - 2

Malfunction: Torque generates strongly in case of operation of the valve. Leakage of water from ground of valve

Causes	Measures
The valve seat and valve rod are filled with alien substance	Remove alien substance
Packing gland tighten up too much	Adjustment of packing gland nut.
Valve disc digs deep into valve seat	Adjustment of valve opening
Abnormal abrasion of packing, bad fastening of packing	Adjustment or replacement of packing
Dirt and so on adhere to a outcrop of valve rod, and surface of rod is a flaw.	Grinding or replacement of valve rod

Troubleshooting of Gate Valve



Gate Valve

Out of Order and Measures of Valve
Gate Valve - 3

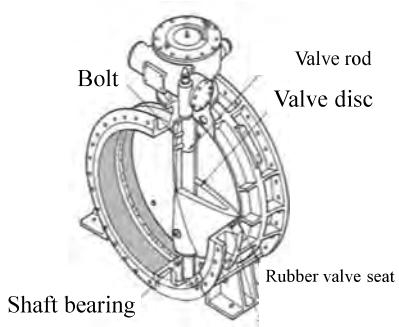
Malfunction: Leakage of water in spite of indicating close on opening gauge

Causes	Measures
Abnormal abrasion or damage of valve seat	Repair or replacement of valve seat
Bad opening gauge	Inspection, replacement of valve and gauge
Bad adjustment with valve	Readjustment with valve

Malfunction: Vibration and/or noise from a valve

Causes	Measures
Generation of cavitation in valve box	Set the valve opening with no generation of cavitation

Butterfly Valve



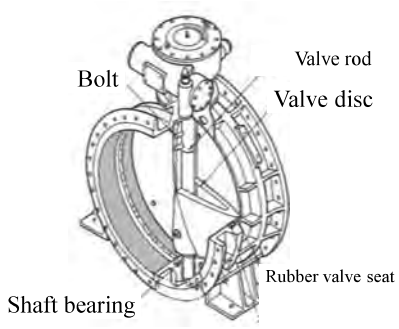
Butterfly Valve

Out of Order and Measures of Valve
Butterfly Valve - 1

Malfunction: It is impossible to open and shut a valve

Causes	Measures
The valve seat is filled with alien substance such as garbage and sand	Remove alien substance Repair rubber valve seat Repair a edge of valve disc
Malfunction of reduction gears	Decomposition and parts cleaning Replacement of parts of reduction gears.

Butterfly Valve



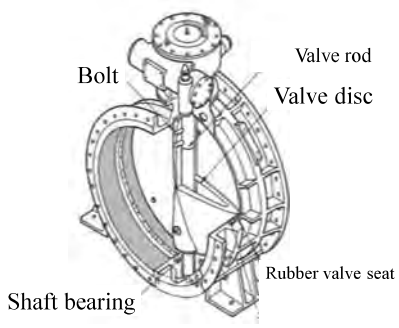
Butterfly Valve

Out of Order and Measures of Valve
Butterfly Valve - 2

Malfunction: Torque generates strongly in case of operation of the valve

Causes	Measures
Bad shaft bearing of valve disc	Replacement of shaft bearing
Valve disc moved down	Adjustment of valve disc position with adjusting-bolt
Valve disc digs deep into valve seat	Adjustment of valve opening

Butterfly Valve



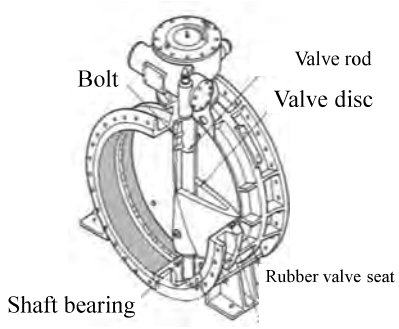
Butterfly Valve

Out of Order and Measures of Valve
Butterfly Valve - 3

Malfunction: Leakage of water from valve seat with abnormal torque when closing valve

Causes	Measures
Separation of rubber valve seat	Replacement of rubber valve seat
The valve seat and valve rod are filled with alien substance	Remove alien substance

Butterfly Valve



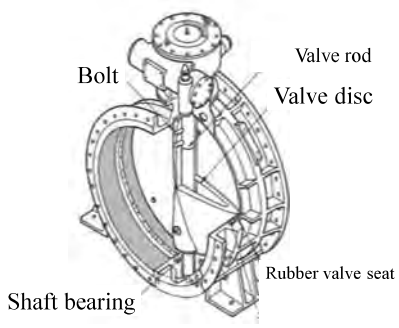
Butterfly Valve

Out of Order and Measures of Valve
Butterfly Valve - 4

Malfunction: Leakage of water in spite of indicating close on opening gauge

Causes	Measures
Damage of rubber valve seat	Replacement of rubber valve seat
Bad opening gauge	Conducting inspection of valve and gauge
Bad adjustment with valve	Readjustment with valve

Butterfly Valve



Butterfly Valve

Out of Order and Measures of Valve
Butterfly Valve - 5

Malfunction: Vibration and/or noise from a valve

Causes	Measures
Backlash of gear in second reduction gears	Adjustment and/or replacement of gear
Generation of cavitation in a valve box	Inspect a cause of cavitation, and remove it.

Discussion

(a) Questions

(b) Request for the Workshop

(c) Next Workshop

2. Service Pipe

2.1 Installation

3. Water Meter

3.1 Troubleshooting

(d) Planned Workshop

Inspection Method, Record of maintenance, etc.

Draft Standard Operation Procedure (SOP) on New Planning Formulation of Water Distribution Facilities

October, 2015

1.1 Planning of Distribution Facilities

Planning process

- Identification of water user's demand
- Determination of water quantities and pressure required for water demand
- Distribution system layout as optimization system including pipeline routes and pipe diameters

Initial Planning Tasks

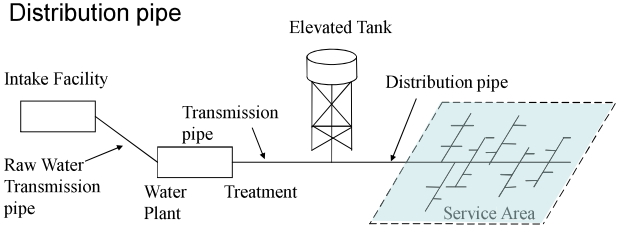
- To determine facility locations, water demand and water supply quantity.

1) The quantity of Water demand
2) The physical location and elevation of points of use within the service area
3) The required operation pressure at providing water points

Water Distribution Facilities

Regular check of water distribution facilities

- Intake facility
- Raw water transmission pipe
- Transmission pipe
- Elevated tank
- Distribution pipe



2. Required Quantities

1) Average daily design water flow:

Annual water flow divided by 365 days

→ Estimation of service charge and O&M costs

2) Maximum daily design water flow:

Water flow on the day of maximum water generation in a year

→ Design of WTP, Transmission Pipe and Transmission Pump

3) Hourly maximum design water flow:

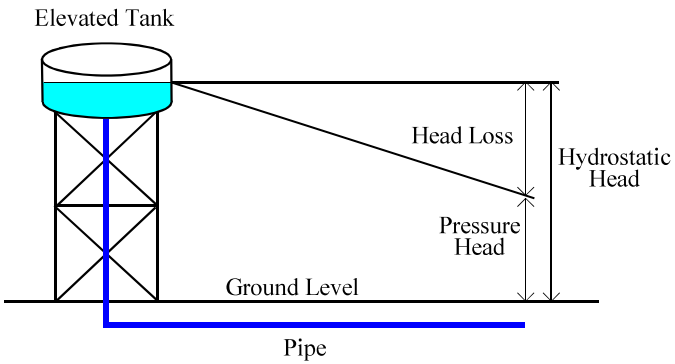
24 hours conversion of numerical value (m^3/day) of a peak water flow per hour on the day of maximum water generation

→ Design of distribution pipe and distribution pump

2.2 Pipe Size

- In design of water distribution system, pipe size must be balanced against the maximum velocity and total head loss across the distribution network.
- Pipe size too small → Head loss will be greater.
  → Pressures will be reduced.
- Pipe size too big → Head loss will be reduced.
- Appropriate velocities are 0.5 – 1.5 m/sec in a pipeline.
  → Economical construction.
  $Q\ (m^3/sec) = A\ (m^2) \times V\ (m/sec)$
  Q: Flow, A: Sectional area of a pipe, V: Velocity

2.3 Pressure Head



2.3 Pressure Head (2)

- Pressure head is a term that represents the internal energy of a fluid as a column of water.
  Pressure Head (m) = Hydrostatic Head (m) – Head Loss (m)
- Head loss: In any real moving fluid, energy is dissipated due to friction.
- Major losses associated with energy loss per length of pipe, and minor losses associated with bends, fittings and valves.

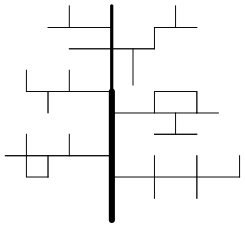
$$\text{Head Loss (m)} = \text{Hydraulic gradient (‰)} \times \text{Pipe Length (m)} = I \times L = 10.666\, C^{-1.85} D^{-4.87} Q^{1.85} \times L$$

- Hydrostatic head is the pressure rise caused by gravity acting on a column of water or fluid that is not in motion.

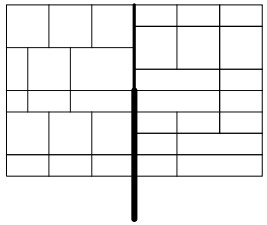
3. Planning of Distribution Network

1. Pipe Diameter:
   Investigation of main pipe and branch pipe diameters.
2. Pipe Routes:
   Confirmation of pipe route and pipe position with map of the existing pipe network.
3. The distribution network layout:
   Network will be formed by loops of pipelines to the extent practicable, thereby minimizing dead ends and providing flexibility in operation.
4. Pipe Connecting Node:
   Confirmation of position of pipe connecting node with map of the existing pipe network.
5. Determination of siphon culvert location:
   Method of installation of pipe at diversion points is decided after confirming other existing buried objects. Clearance between pipe and buried object should be more than 0.3 m.

3.1 Distribution Network System

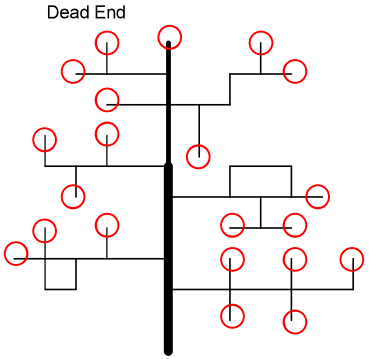


Tree Type Distribution System



Grid Type Distribution System

3.2 Tree Type Distribution System

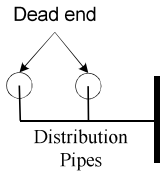
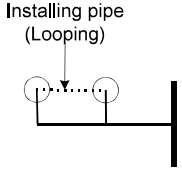
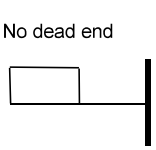


Tree type system has dead ends which are the potential for stagnation and deterioration of water quality

App–99

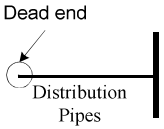
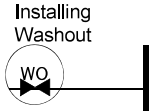
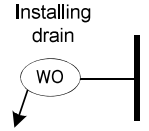
3.3 How to eliminate a dead end

a) To loop a pipe network

		
1) Current situation	2) Connecting between the dead ends	3) Loop Network

3.4 How to avoid generating rust-colored water at a dead end

b) To install a washout drain at a dead end

		
1) Current situation	2) Installing a washout at a dead end	3) Washed out through a drain periodically

3.5 Pipe Material

High Density Polyethylene (HDPE) pipe is adopted in CWASA.

- Light weight for ease of installation
- Flexible pipe
- Special corrosion protection is not required

- Available in welding joints
- Special joint restrains may not be required at changes in direction
- (HDPE pipe for a sewer is not affected by hydrogen sulphide.)

3.5 Pipe Material (Continued..)

Polyvinyl Chloride (PVC) Pipe

- Light weight for ease of installation
- Good Strength
- Easy handling
- Easy construction
- Low roughness coefficient
- Resistance to corrosion
- Periodical check needed
- Economical
- Vulnerable to UV under sunlight

App-100

3.5 Pipe Material (Continued..)

Cast Iron (CI) Pipe

- Heavy weight
- Durable for both of high internal and external pressures
- Resistant to corrosion
- To have applicable joints for vibration and infiltration
- Periodical check needed for joints
- Construction is not easy
- Resistant to UV under the sunlight
- Material cost is high

3.5 Pipe Material (Continued..)

Stainless Steel (SS) Pipe

- Durable for both of high internal and external pressures
- Long life time
- Resistant to corrosion
- Resistant to UV under the sunlight
- Periodical touch up and check needed
- Material cost is high

3.5 Pipe Material (Continued..)

Ductile Iron (DI) Pipe

- Heavy weight
- Long life time
- Durable for both of high internal and external pressures
- Resistant to corrosion
- Resistant to UV under the sunlight
- Construction is not easy
- Periodical touch up and check needed
- Material cost is high

3.5 Pipe Material (Continued..)

Mild Steel (MS) Pipe

- Heavy weight
- Durable for both of high internal and external pressures
- Resistant to UV under the sunlight
- Periodical touch up and check needed
- Construction is not easy
- Material cost is high

Service pipe Installation and Water Meter Reading

September 2015

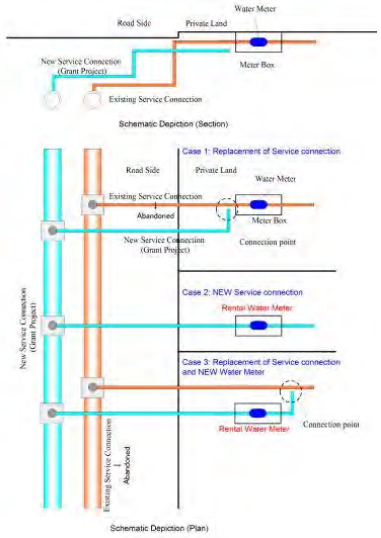
Customer Meter

Case 1: (existing pipe and meter)
Renewal construction from an existing service connection to new service pipe

Case 2: (to new building)
New construction of a service connection and water meter

Case 3: (no-meter or malfunctioning meter)
Renewal construction from an existing service connection to new service pipe, and installation of a water meter

2016/5/217 Jun. 2005



Location and Depth of Pipe Laying

- In case distribution mains are laid across or in the vicinity of other buried objects, more than 0.3 m of space shall be provided between them.

- Maintenance and repair work are difficult unless there is some space between the distribution main and other buried objects. The minimum space for laying is set at more than 0.3 m.

Location and Depth of Pipe Laying

- Although under the specifications and drawings of the KWSP-1, the earth cover is set at 1.2 m, it can be reduced to 0.6 m in case the prescribed earth cover cannot be realized with regard to the relationship with intersection with other buried objects.

Water Service Fittings

- The water service fittings in general consist of service pipe, water service apparatus and water meter.

Main pipe and Service pipe

Water Service Fittings

a. Connection point from distribution pipe should be surveyed sufficiently to avoid cross connections.
b. Service pipe diameter should be smaller in principle than distribution (main) pipe diameter.
c. Not to connect from joint and/or fitting point on main pipe.
d. Clean the surface of main pipe when service pipe is connected. During the installation of service saddle, fasten equally with bolts on the main pipe.

Location of Water Meter

a. Water meter is principally located inside the ground for easy inspection and/or replacement and where the probability of meter damage is low.

b. In case of installing a water meter under ground, use a meter box.

c. In case of installing water meter, inflow direction sign on meter should be confirmed and set in the horizontal position.

Branching of the service pipe from the distribution main

1) Tapping on the distribution main by drilling shall not cause adverse effects to the strength of the pipe and its inside coating.

For drilling tapping holes on the distribution main, the interval of the holes and their diameter shall carefully be chosen so that the strength of the main is not reduced.

A drill bit suitable for the coating on the inside wall of the main shall be used so that the coating is not peeled off.

Branching of the service pipe from the distribution main

3) In case taping is made using a corporation cock or a corporation cock with saddle, the interval of tapping shall be more than 30 cm.

In case making a branch from a distribution main by means of the corporation cock, it is prescribed under the Ordinance that more than 30cm of space between two cocks shall be maintained to prevent the impairment in pipe strength caused by drilling holes; avoid the adverse influence to the flow of one tap to be caused by that of another tap; and make maintenance easy.

Branching of the service pipe from the distribution main

2) For the purpose of branching of the service pipe from the distribution main, the corporation cock, the corporation cock with saddle, the plastic tee fitting (for hard PVC or polyethylene main), the tee fitting or the separate tee fitting for other pipe materials have roles to connect different pipe material and diameter of the distribution main and the service pipe.

•In case a branch is made from the distribution main for a service pipe, a corporation cock with saddle shall be used for a service pipe of a diameter of smaller than 50 mm.

•No corporation cock shall be tapped on special fittings. When tapping a corporation cock near a pipe joint, a space of more than 30 cm shall be provided from the joint in consideration of maintenance work.

Service Pipe Working Pipe Laying

1) When laying a water service pipe in a road, the location and the depth of exclusive occupation of the pipe shall not be mistaken. Besides, more than 30 cm of space shall be maintained between the pipe and other buried objects.

2) Backfilling shall be made with soil of good quality or sand; and the backfill shall properly be compacted to protect the pipe.

Pipe Laying

- 3) In case the pipe is laid in the premises of a house, the location of the valve box and the water meter shall be selected to facilitate their maintenance. The pipe shall be laid in a straight line as much as possible even in the premises.

- The curb cock and water meter shall be installed in locations, with which no trouble for maintenance is caused in future, and the water service pipe shall be laid in a straight line as much as possible. In case there is such an object as a drainage pipe in the halfway of the pipe, since there is a risk of contamination in an occasion of breakage of the pipe, the pipe shall be laid far enough from the object to avoid its influence.

Foundation of Service Pipe

1) The foundation of an underground service pipe shall be designed, sufficiently considering the conditions of the ground, loading conditions and the properties of the pipes used.

2) The backfilling earth shall be selected to allow proper compaction when the pipes are buried.

3) When a pipeline is laid in poor subsoil, the ground conditions and pipeline settlement shall be sufficiently examined, to use an execution method, pipes and joints suitable

Pipe Laying

- 4) In the occasion of crossing an open channel, the pipe shall be laid underneath the channel as much as possible.
- In the occasion of crossing a gutter or an open channel, the pipe shall be laid inside a sleeve of steel pipe placed underneath the channel etc. as much as possible. If such a measure is impossible, the pipe shall be laid above the high water level.

Foundation of Service Pipe

The quality of the nature of backfill soil affects the execution convenience of backfill and compaction, and also greatly affects the safety of the pipeline. Especially for steel pipes and PVC pipes, cobble stones and rock which threaten to damage the pipe should not be contained, and if excavated soil is not good enough to satisfy the design conditions, soil dressing is necessary.

Precaution of Pipe Working

1) Distance of service pipe and other embedded pipes should be kept at least 30 cm to avoid accidents such as cross connection and pipe damage.

2) Underground pipe works should be kept in a straight line as much as possible as it is easier to understand and locate the pipes later and such pipe laying is much economical.

3) Put a stopper at pipe end with plug to avoid filthy water from flowing into pipe when pipe stops working temporary or daily.

4) In drilling the distribution pipe, it shall not adversely affect the strength and inner coat.

Storage Tank for Building

- The storage tank is a type of tank that once receives water in a tank, and serves water from it; can, as a merit, maintain water service pressure and volume constant downstream of the tank; can feed a large quantity of water at a time; can secure water even at the times of suspension of water supply and a disaster and so forth. On the other hand, it needs such proper management as regular inspection and cleaning, and water temperature goes up in summer, which are the factors to give consumers anxiety about water quality.
- The elevated tank shall regularly be cleaned like the storage tank; otherwise there is a risk of water pollution.

Precaution of Pipe Working

5) A saddled corporations stop and T-pipes shall be used, when the service pipe is branched from the distribution pipe.

6) A stop valve and a water meter should be provided at position facilitating future maintenance, and service pipe should be laid as straight as possible.

7) Pipes are exposed along building/house columns and walls, where pipes are susceptible to damage due to deflection and vibrations by external forces, the pipes' own weight and water pressure, pipes should be fixed to the building/house using brackets at 1 – 2 m intervals.

8) When piping is completed, it is desirable that pipes are flushed and undergo flow before attaching meters.

O&M of Water Distribution Facilities Inspection

October, 2015

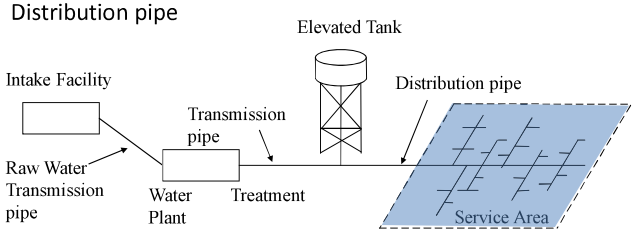
Purpose of Activities

- To confirm the current status of distribution facilities included in the existing facilities.
- To make inspection record, flow record and repair record of facilities

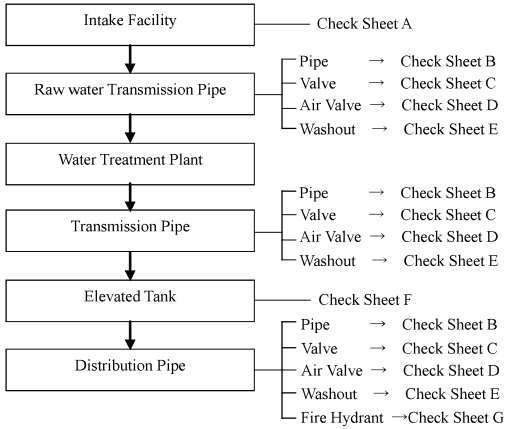
Water Distribution Facilities

Regular check of water distribution facilities

- Intake facility
- Raw water transmission pipe
- Transmission pipe
- Elevated tank
- Distribution pipe



Object Facilities of Inspection and Check Sheet



Accessory Equipment

The accessory equipment of distribution pipelines can be classified into:

- **Air valves**
- **Washout**
- **Fire hydrants**
- **Valves**
- **Flow meter and**
- **Manholes.**

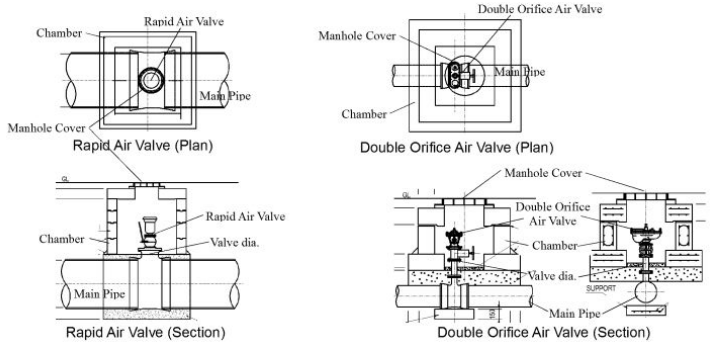
Accessory Equipment (Continued…)

- As the accessory equipment, the most appropriate devices must be arranged at proper places, considering the arrangement of distribution pipelines, the topographical and geographical conditions of the distribution area and water demand.
- The accessory equipment which have been used for long periods may be functionally degraded due to the wear at sliding portions and the deterioration of paint at wetted portions, to cause trouble in stable water supply. The accessory equipment must be rehabilitated and improved at opportune timing, to restore or improve the functions.

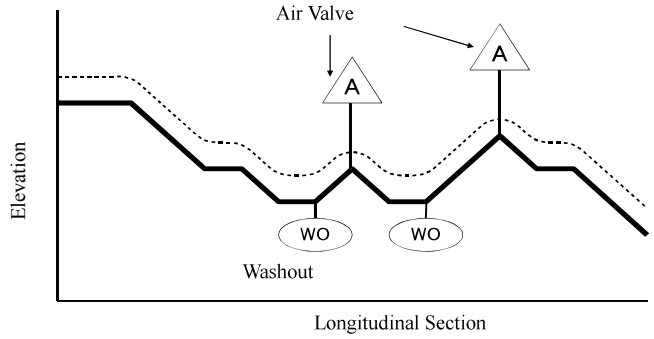
Air Valves

- Air valves are located on all high points in the distribution pipelines to allow trapped air to be release from pipelines without loss of water. Trapped air, if allowed to accumulate at a high point, carries out restrictions and reduces the capacity of the pipeline due to increasing headloss.

Air Valves



Schematic illustrating placement of air valves on distribution system



Locations of Air Valves and Washouts

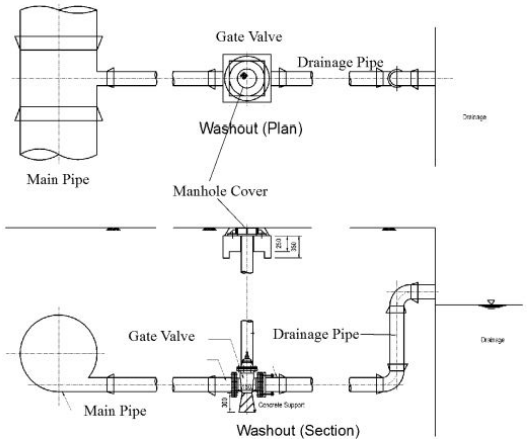
Air Valves (Continued…)

- When a pipeline is filled with water, the air in the pipeline must be properly eliminated, and when water in a pipeline must be eliminated for the necessity of construction or other work, proper air suction is necessary.

Washout

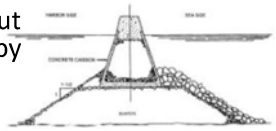
- Washouts are small pipe connections with valve located at dead ends and low spots in the distribution pipelines to allow accumulated sediment to be cleaned by flushing and the pipeline drained.

Washout



Washout (Continued…)

1) Location of washout drain: washout drain should be installed nearby drainage canal or river.



Rubble mound (image)

2) Drain pipe diameter is normally 1/2 – 1/4 size of main pipe diameter.

3) Washout drain should be built strongly at the spillway so as not to erode or to be destroyed by draining. If the place near a washout drain is likely to be eroded or damaged by discharge, protective work especially by concrete, rubble mound, etc. must be provided.

Rubble mound (reference)

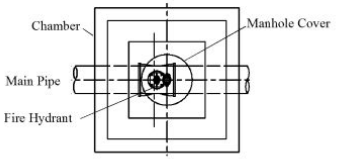
Washout (Continued…)

4) Washout drain is set at a position higher than the high water level of the water channel to prevent the backflow of sanitary wastewater from the water channel.

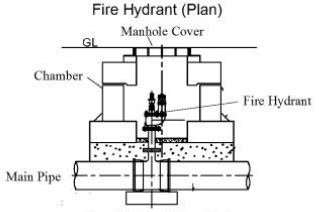
Fire Hydrant

- These fire hydrants can be used in case of fire. Fire hydrant will be located in the distribution network on all pipelines of at least 150 mm nominal diameter, otherwise, negative pressure may occur in small diameter such as less than 100 mm. Spacing will be at about 200 m and at street corners if practicable and at locations to avoid obstruction to property owners.

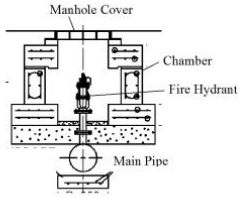
Fire Hydrant



Fire Hydrant (Plan)



Fire Hydrant (Section)



Fire Hydrant (Section)

Service Reservoirs and Elevated Tanks

- Service reservoir and elevated tank are a reservoir for receiving water from a water treatment plant and distributing in response to the demand of the distribution area,

Service Reservoirs and Elevated Tanks

- The service reservoir and the elevated tank must be water-tight, sanitary, and sufficiently durable in structure to avoid contamination from outside.

Service Reservoirs and Elevated Tanks

- Service reservoir and elevated tank must have function to respond to the hourly change of distributed amount and also a function to be able to maintain a predetermined amount and water pressure even when an accident occurs upstream of the service reservoir and/or the elevated tank.

Consideration of Facility Survey

- Items that CWASA staffs must always be aware of O&M for water supply facilities are shown below.

- As for the first target, CWASA confirms the current status of distribution facilities included in the existing facilities, and makes inspection, flow and repair records of facilities such as raw water transmission pipe, transmission pipe, valves and elevated tank. Main purpose of these activities is to inspect them regularly.

Consideration of Facility Survey

- As for the second target, water distribution maps that consist of pipe routes and locations of valves and washout drain and fire hydrant, pipe diameter and pipe material is to be created. This information map is necessary for maintenance and repair of facilities.
- The primary factors of distribution facilities include the location and required demand of the water users. The principal facilities needed for the delivery of treated water are an elevated tank for storage, transmission and distribution pipes.

Consideration of Conditions of Distribution Network

Confirmation of the following pipe conditions in pipe planning.

1) Pipe Diameter: Investigation of main pipe and branch pipe diameters.
2) Pipe Routes: Confirmation of pipe route and pipe position with map of the existing pipe network.
3) The distribution network layout for new areas to be served will be formed by loops of pipelines to the extent practicable, thereby minimizing dead ends and providing flexibility in operation.
4) Pipe Connecting Node: Confirmation of position of pipe connecting node with map of the existing pipe network.
5) Determination of diversion culvert location: method of installation of pipe at diversion points is decided after confirming other existing buried objects.

Object facilities of inspection and check sheet

Provision of Survey

- Required items in facilities inspection are listed below
  - Inspection Sheets
  - (Digital) Camera
  - Cover Opener (T Key)
  - Wrench, spanner, Screw driver, cotton work gloves and so on
  - Maps

Intake Facility/Deep Tube Well

1)Observational items are mainly Fence, Concrete degradation, Facility condition (Appearance), Water quality (turbidity, unusual odor), Screen (Rust, trash-filled), Sedimentation in canal, and so on.

2)CWASA staffs conduct the intake facility survey periodically. The inspectors contact the CWASA when discovering malfunction of the facility.

3)The Guard always supervises the fence to prevent trespassing.

4)CWASA displays Keep Off of general people in the bulletin board and signs at the intake site.

Table 5.1 Check Items of Water Facilities

Facilities	Check Items	Remarks
Intake	Date, Fence, Concrete degradation, Condition (appearance), Water quality, Screen, Sedimentation, etc.	Repair record, Sketch, Photograph
Pipe	Location, Diameter, pipe material, Condition (appearance), Water quality, Leakage, Sound, Customer complaints, etc.	Repair record, Sketch, Photograph
Valve, Air valve, Washout, Fire Hydrant	Type, Location, Main pipe dia., Condition (appearance), Working, Leakage, Sound, Valve status, etc.	Repair record, Sketch, Photograph
Elevated Tank	Location, Crack of concrete, Condition (appearance), Water quality, Leakage, Sound, Cleaning, etc.	Repair record, Sketch, Photograph

Procedures of investigation and report to CWASA

- At the time of the regular investigation of the water supply facilities, CWASA staffs make inspection record, and report to CWASA. When the abnormality and problem in the water facilities are discovered, staffs will repair it and inform CWASA of its result.

Emergency situations will be classified into:

1. Stop of water supply function (large scale power failure, damage of facilities, water contamination)

2. Natural disaster (earthquake, damages caused by floods, landslide, fire disaster, abnormal climate, infectious disease)

3. Terrorism (threat, destructive activities)

Emergency Situation Procedures

- In emergency, as the priority is given to protect life of residents and to secure safety. In order to inform quickly, CWASA staff need to identify emergent incidence properly and inform it to the CWASA as early as possible. CWASA must decide to inform to residents, collection proper information and grasping the proper situation of the incident. Liaison system in CWASA needs to establish, since residents may provide information to CWASA.

Contact Us

PANI-2 Office

Technical Cooperation of JICA

CWASA Bhaban 1st Floor

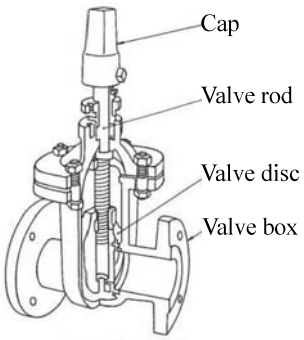
Engr. Md. Aourongojeb Mondal

Water Distribution Facilities
Inspection Training

October, 2015

App-115

Gate Valve



Gate Valve

Gate Valve

Gate valve functions are interception and discharge. Inside valve box, a valve disc which sets at right angle against flow direction moves to top and bottom and opens/closes. The valve disc position in the valve box is either full open or tight close. A middle position between open and close is undesirable.

Gate Valve

Inspection Item
of
Gate Valve

CHECK SHEET (GATE VALVE)

Zone: 1, 2, 3, 4, North, Western Inspection Date (dd/mm/yyyy) _____
Inspector Name _____

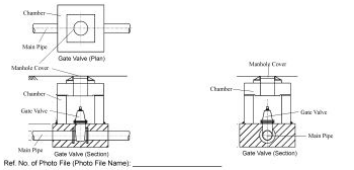
SL. No. [ ] Sub-block [ ] Grid No. [ ] Road No. / Name [ ]
Facility ID: [ ] Road Type: [Pavement / Unpaved / Concrete / Others]

Gate Valve and Valve Chamber
Manhole Cover: [Existence / Nonexistence]
Valve Status (Under the normal operation): [Opened / Closed]
Condition (Appearance): [Rusty / Dirty / Trash-filled (Garbage) / Submerged / Other ( )]
Valve Functioning: [Function / Not Function]
Water Leakage: [No Leakage / Leakage / Burst] Sound: [Yes / No / Vibration]

Main pipe
Pipe Category: [Primary / Secondary / Tertiary]
Diameter (mm): [ ] mm
Pipe Material: [Ductile Iron (DI) / Cast Iron (CI) / PVC / Mild Steel (MS) / HDPE / Other ( )]

Repair Record
Activity on O&M Repair Record: [Clean / Leakage / Regular maintenance /]
Repair ( ) / Replace ( ) / Other ( )
Repair Date (dd/mm/yyyy): [ ] Ref. No. of Repair Report: [ ]

Draw damaged / repaired / replaced parts below the picture (If any)



Ref. No. of Photo File (Photo File Name): _____

Over Crossing Pipe

Inspection Item
of
Over Crossing Pipe

CHECK SHEET (OVER CROSSING PIPE)

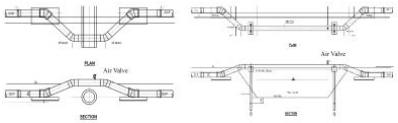
Zone: 1, 2, 3, 4, North, Western Inspection Date (dd/mm/yyyy) _____
Inspector Name _____

SL. No. [ ] Sub-block [ ] Grid No. [ ]
Road No. / Name [ ] Facility ID: [ ]

Over Crossing Pipe
Pipe Category: [Primary / Secondary / Tertiary] Pipe Diameter (mm): [ ] mm
Exposed Pipe Length: [ ] m
Model Type: [Pipe Beam / Stiffened] (In case of Stiffened Type: [Flange / Truss / Tie Road / Langer])
Pipe Material: [Ductile Iron (DI) / Cast Iron (CI) / PVC / Mild Steel (MS) / HDPE / Other ( )]
Condition (Appearance): [Rusty / Dirty / Trash-filled (Garbage) / Submerged / Other ( )]
Air Valve Functioning: [Function / Not Function / No Valve]
Water Leakage: [No Leakage / Leakage / Burst] Sound: [Yes / No / Vibration]
Water Quality: [Not found abnormal / Turbidity / Unusual odor / Rusted color / Other ( )]
Existence of Air Release Valve: [Yes / Not]
Existence of Coating (Outside): [Yes / Not] Re-Coating Date (dd/mm/yyyy): [ ]
*Under Ground: Polyethylene Coating, Exposed Pipe: Non-Breeding Type Epoxy Coating (Gray)

Repair Record
Activity on O&M Repair Record: [Clean / Leakage / Regular maintenance /]
Repair ( ) / Replace ( ) / Other ( )
Repair Date (dd/mm/yyyy): [ ] Ref. No. of Repair Report: [ ]

Draw damaged / repaired / replaced parts or Leakage situation below the picture (If any)



The Problem of Water Supply on Distribution Pipe

October 2015

Problem on Pipeline

It is possible to supply water normally from the elevated tank in service area.

Water supply sometimes stops due to temporal water supply.

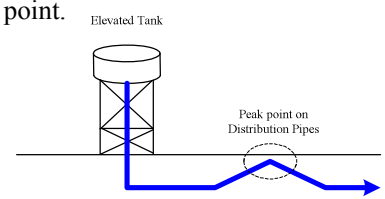
However, water can not be provided at a certain place in spite of resuming water supply.

1. Possible Cause

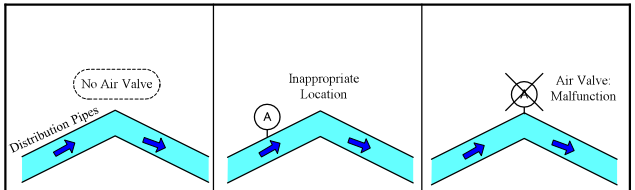
1) Since there may be entrapped air at a higher elevation on the pipeline, the entrapped air can hinder from conveying water through pipe.

2) Location of an air valve may be inappropriate.

3) An air valve may be malfunction but an air valve is installed at peak point.



2. Entrapped Air Occurrence Point

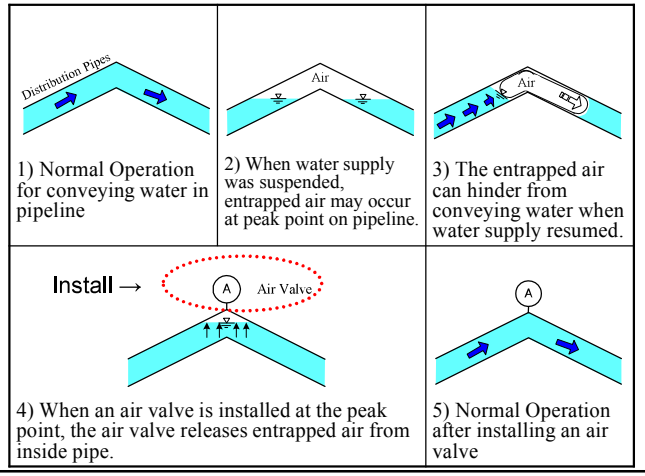


Nonexistence air valve at peak point on pipeline	In appropriate location of an air valve	An air valve is malfunction.

3. Measure

- To confirm the geographical higher elevations on the pipe route at first, then confirm an air valve existence or nonexistence.
- When necessity of an air valve is ascertained at some higher elevations, the air valve should be installed at the point.

4. Occurrence Procedure and Measure



1) Normal Operation for conveying water in pipeline

2) When water supply was suspended, entrapped air may occur at peak point on pipeline.

3) The entrapped air can hinder from conveying water when water supply resumed.

4) When an air valve is installed at the peak point, the air valve releases entrapped air from inside pipe.

5) Normal Operation after installing an air valve

Proper Treatment of a Water Meter

September 2015

Location of Water Meter

1) Water meter is principally located inside the ground for easy inspection and/or replacement and where the probability of meter damage is low.

2) In case of installing a water meter underground, use a meter box.

3) In case of installing water meter, inflow direction sign on a meter should be confirmed and set in the horizontal position.

Installation of Service pipe and Water Meter

- Water service installation should be given such that service pipes with adequate size and devices are reasonably combined so as to stably supply the water volume needed by users and supply a safe water.
- For the exact measurement of water consumption, proper selection, installation and control of water meters are essential.
- Even when service pipes are properly designed and executed, it is not possible to secure stable water supply and water quality if the method of use is not proper, improper devices are installed, or rebuilding is made upon users' discretion. Therefore, instruction and guidance should be given to users on the proper use and maintenance of water service pipe installation.

Required Water Meter Product

- Water meters are attached to water service equipment and used to integrate water volume consumed by users, and the measured water volume forms a basis of water to control water charges and revenue earning water rates.
- Additionally, conditions required for water meters are followings;
- a) Good measuring accuracy, b) Durability, c) Sufficient capacity, d) Good sensitivity, e) Wide measuring range, f) Ease in reading, g) Ease in handling, h) Relatively failure-free

Precaution for Safety (1)

- To pay attention while carrying heavy equipment and installing water meters since there are possibilities of injury.
- Not to touch directly a screw joint part on a meter case because there is a possibility of injury. To put on cotton work gloves to help prevent injury.

Precaution for Safety (2)

- To use appropriate tools such as wrenches for plumbing. Hindrance and accident may be caused by using inappropriate tools for plumbing.
- Not to pour hot or boiling water into the water meter. When hot water of more than 40 degrees flows in a water meter, there is a possibility to damage the inside plastic parts of the water meter.

Precaution for Water Meter Management during Meter Storage (1)

- Not to give water meter a strong shock.

  When a water meter falls, there is a possibility of meter damage and might be difficult to measure the amount of flow because the shaft bearing of the impeller will be damaged.
- Not to give water meter vibration.

  When a water meter receives vibration for many hours, it might be difficult to measure the amount of flow because the shaft bearing of the impeller will be damaged.

Precaution for Water Meter Management during Meter Storage (2)

- To cover gateway of water meter to prevent the wind blowing through the meter during water meter storage.

  When air blows through the water meter, it is possible that measured value can progress or revert because impeller rotates due to the wind. To put caps on the gateway of water meter to prevent this from happening.
- To cover gateway of water meter to prevent unwanted substances entering water meter during meter storage.

  When unwanted substances entered meter, it might be difficult to measure since the unwanted substance obstructs the rotation of the impeller.

Precaution for location of water meter installation (1)

- To install water meter in horizontal position.

  To set the meter horizontally with indicator upward according to the arrow shown on the meter.

- To select the place where installation and removal of a water meter are easy.

  Since it is necessary to replace water meter periodically (recommended in every 8 years), appropriate place for installing and removing a water meter is required.

Precaution for location of water meter installation (2)

- To select the place where meter reading is easy. Since it is necessary to conduct meter reading periodically, appropriate place, which is dry condition and not submerged, is required.
- To select the place where momentary pressure variation is low.

  It might be difficult to measure accurately because the rotation of the impeller will be increased by momentary pressure variation. The maximum working pressure, however, is 1 MPa.

Precaution for location of water meter installation (3)

- To select a place where there is no influence on vibration. It might be difficult to measure accurately because the rotation of the impeller is increased by vibration.
- Not to install water meter at a submerged location.

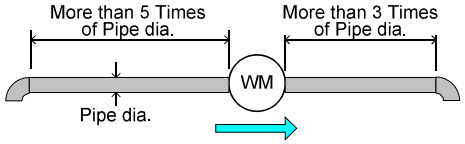
Precaution for water meter installation (1)

- A fitting length of water meter installation should be the total length of the meter. Otherwise, the meter can not be installed to pipes because the length may be short or long.
- When a welding junction is conducted at a pipe joint part, detach the water meter from the pipes.

  The plastic parts inside the water meter may be damaged by the high temperature of the welding.

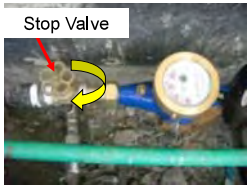
Precaution for water meter installation (2)

- Pipe length of more than 5 times of a pipe diameter in the upper stream of a water meter and the pipe length of more than 3 times in the downstream are required on a pipe arrangement. When the pipe length is shorter than above mentioned length, it might be difficult to measure accurately due to the influence of a valve or a bent pipe.
- To use proper packing to fit a pipe diameter during meter installation. Water leakage at joint parts and/or water measuring error may occur due to different dimensions of packing.



Precaution for water meter installation (3)

- The inside of the pipe should always be cleaned by flowing water before installing water meter. It might be difficult to measure accuracy because unwanted substances inside the pipe might obstruct the rotation of the impeller or even destroy the meter.
- To open a stop valve slowly when feeding water. When opening a stop valve hastily, the water meter might be damage due to water hammer.



Water Meter

Installed water meter

Water meter

Water Meter Inner Case

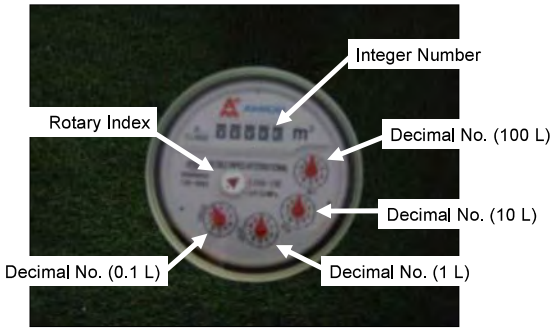
Meter indicator

Impeller and Gear wheel

Outline of Meter Reading

- Meter reading is the foundation of water tariff. It is necessary to keep conditions for easy reading and replacement, and effort should be made to improve accuracy of meter reading.

Meter Reading



Out of Order and Measures of Water Meter (1)

- No proceeding indicator:
  Indicators stop after installing or during use.
- Delay of indicator:
  Phenomenon that indiscrete value decreases temporary or continuously during use.
- Inverse rotation of indicator:
  Phenomenon of indiscrete value subtraction due to inverse rotation of indicator.
- Derangement of indicator:
  Phenomenon that indicator sometimes moves inversely, unstable due to damaged meter parts.

Out of Order and Measures of Water Meter (2)

- Leakage from meter: Phenomenon of leakage from meter or surroundings of meter.
- Unclearness of meter: It is not easy to read a meter due to unclearness of meter indicator and plate glass.
- Meter damage: Phenomenon that water meter is partially damaged due to external factors such as collision.

No indicator proceeding

Cause	Instance	Measure
Alien substance such as sands, rust and pipe material get into gear portion and stops meter	Indicator stops immediately after opening the valve.	Pipe cleaning is always conducted after pipe works.
Over flow causes abnormal abrasion of meter parts and damage them.	Abrasion is caused by heavy water flow.	Change meter to big rating one

No indicator proceeding

Cause	Instance	Measure
Damage by water hammer	When opening a valve forcefully after meter installation, there is a dash in the plumbing and the meter indicator will not work.	Open the stop valve slowly.
The transformation of the meter parts by hydrothermal, hot water	Plastic meter plastic parts are transformed and become immovable due to hydrothermal.	Replacement of meter parts

Delay of indicator

Cause	Instance	Measure
Alien substance such as sands, rust and pipe material get into impeller portion and stop meter temporally.	Alien substances are crowded at impeller makes it temporarily immovable, but due to pressure fluctuation the clog is recovered.	Pipe cleaning is always conducted after pipe working.
Over flow causes abnormal abrasion of meter parts and damage them.	Abnormal abrasion of rotation axes and gear wheel causes unstable condition.	Change meter to big rating one.

Delay of indicator

Cause	Instance	Measure
Delay of indicator by too little flow	In case the flow rate is below the minimum flow rate.	Change meter to suitable rating one.
Bad meter installation posture	The installed meter is leaning extremely.	Install meter on horizontal pipes
Accumulation of scale inside the meter	Smooth turn of impeller is obstructed due to the accumulation of alien substances such as sand.	Cleaning regularly

Inverse rotation of indicator

Cause	Instance	Measure
Reverse installation	-	Meter should be installed in the direction as indicated in the case.
Backflow in service pipe	Water flows backward by siphon when pump is stopped.	Check valve should be installed to prevent backflow
Influence of ventilation	Ventilation from exit side of meter backlashes and indicated value decreases under the transportation or storage.	Entrance and exit of meter should be covered by caps or a vinyl bag.

Derangement of indicator

Cause	Instance	Measure
Cause of water hummer	Indicator plate is damaged, and gear wheels are dislocated and make irregular turn.	Stop valve in a meter should be opened slowly.
Cause of over flow	Gear wheels were dislocated and make irregular turn due to abnormal abrasion of meter parts.	Change meter to big rating one.

Leakage from meter

Cause	Instance	Measure
Destruction by water hummer	When opening a valve forcefully, there is a dash in plumbing and the windowpane destroyed.	Stop valve in a meter should be opened slowly
Transformation and deterioration of gasket in meter	Fastening is too strong and causes crack.	Appropriate fastening.

Unclearness of meter

Cause	Instance	Measure
Accumulation of alien substance such as sands, rust inside the meter	Iron rust and other substances get accumulate inside the meter and meter reading becomes difficult.	Clean pipe regularly
Adhesion of water inside the meter	The register box of the dry-meter is cracked by water hammer, and moisture was trapped inside it.	The Stop valve in a the meter should be opened slowly to prevent impact of water hammer

Meter damage

Cause	Instance	Measure
Falling meter	Indicator plate and gear wheel are damaged.	Damaged meters should not be used.

Proper Treatment of a Water Meter

October 2015

App-127

1.1 Water Meter Accuracy Management Equipment

A master meter can be set in order to calibrate water meters.

- Purpose of establishment

  Improvement in performance of repair meter of CWASA.

- Principle of equipment

a) Typical size of the water meter to authorize is 20 mm (3/4 inch) and 25mm (1 inch).

b) Measurement of theoretical amount of water is calculated from a water gauge.

c) Accuracy management is evaluated from the difference of the measurement value of water amount and water meter.

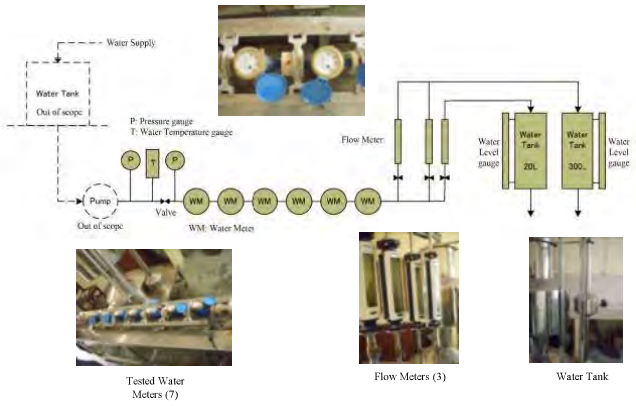
d) The range of an allowable error of measurement may be from ±5% to ±2%.

1. Water Meter Calibration Control

- The performance of water meters shall be such that they can accurately measure as wide a flow range as possible and are durable.

- Two methods of a water meter calibration are introduced herein. One is using the water meter calibration equipment at Chittagong WASA Central Store in Halishahar, the other is examination of instrumental error to an existing water meter.

Meter Calibration Equipment (Image)
(Chittagong WASA Central Store in Halishahar)



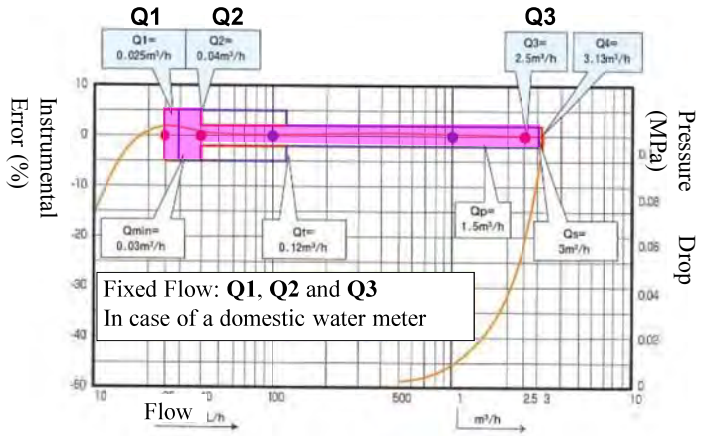


Figure1.2 Range of Verification Tolerance for Domestic Water Meter (15 mm)

In delivery inspection, there are 3 points to check the flow rate.

Q1:Minimum Flow Rate: The flow is a required minimum flow under meter movement conditions.

Q2:Transitional Flow Rate: The flow is a border value between small flow rang and big flow rang.

Q3:Permanent Flow Rate: The flow is a required maximum flow under meter movement conditions.

Q4:Overload Flow Rate: This is maximum flow to maintain a meter performance.

Table 1.1 Performance of Flow Rate

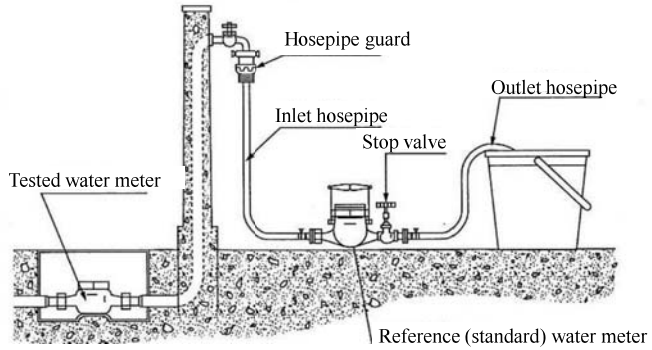
	Meter Size	
	20 mm	25 mm
Minimum Flow Rate : Q1	0.05 m^3/hr	0.08 m^3/hr
Transitional Flow Rate: Q2	0.08 m^3/hr	0.13 m^3/hr
Permanent Flow Rate : Q3	4 m^3/hr	6.3 m^3/hr
Overload Flow Rate : Q4	5 m^3/hr	7.8 m^3/hr

1.2 Examination of Instrumental error with Master (standard) water meter

Examination of Instrumental error (%) with master (standard) water meter is conducted by using equipment.

1. Engineer excludes air by running water through the meter and service pipe.
2. Fully open the stop valve of master (standard) water meter
3. Open the faucet slowly.
4. Fully close off the stop valve of master (standard) water meter, and read indiscrete values of 2 meters.
5. Fully open the stop valve of master (standard) water meter.
   Again fully close off the stop valve of master (standard) water meter after running water up to fixed test flow.
   Read indiscrete values of 2 meters.
6. The range of an allowable instrumental error of measurement may be ±10 % (i.e. in case of 100 L, the range of an allowable is ±10 L.)

1.2 Examination of Instrumental error with reference (standard) water meter



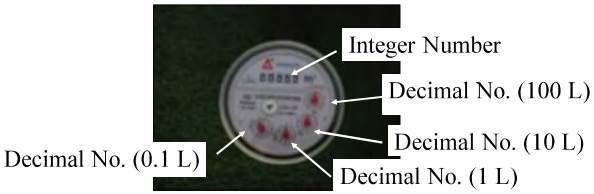
Calculation of Instrumental Error

$$E = \frac{I - Q}{Q} \times 100$$

E: Instrumental error (%)

I: Indiscrete value of tested water meter (L)

Q: Indiscrete value of master(standard) water meter (L)



Example of Calculation

Case 1

Type of water meter	Initial indicator	Final Indicator	Difference
Tested Meter(User's)	109.1067 m^3	109.1477 m^3	m^3 (I)
Master Meter	20.3782 m^3	20.4182 m^3	m^3 (Q)

Case 2

Type of water meter	Initial indicator	Final Indicator	Difference
Tested Meter (User's)	109.1067 m^3	109.1417 m^3	m^3 (I)
Master Meter	20.3782 m^3	20.4182 m^3	m^3 (Q)

Case 1

Tested Mater (I)

109.1477m^3 - 109.1067m^3= 0.0410 m^3

Master Meter (Q)

20.3782m^3 - 20.4182m^3= 0.0400 m^3

Checking

E=(I – Q)/Q x 100 = (0.0410 – 0.0400)/0.0400

= 0.0010 / 0.0400 x 100

= 0.025 x 100

= 2.5% <±10%

OK

Case 2

Tested Meter (I)

109.1067m^3 - 109.1417m^3= 0.0350 m^3

Master Meter (Q)

20.3782m^3 - 20.4182m^3= 0.0400 m^3

Checking

E=(I – Q)/Q x 100 = (0.0350 – 0.0400)/0.0400

= -0.0050 / 0.0400 x 100

= -12.5% <±10%

NO

Comparison of Flow

Attendant List of Workshop/OJT on Water Distribution Facility Maintenance

Attendant List of Workshop on Water Distribution Facility Mangement

	Date		Workshop	2015/9/6	2015/9/7	2015/10/6	2015/10/7	2015/10/18	2015/10/19	2015/11/16	2015/12/14	2016/3/2	2016/3/14	2016/3/21
No.	Name	Org.	Position	Distribution & Valve	Service pipe & Meter	Inspection Facilities 1	Inspection Facilities 2	Calibration, Distribution	Summary	Summary	Summary	Summary	Summary	Summary
-	Nasir Uddin Ahmed	PANI	TA	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
-	Md. Mostofa	PANI	TA	ok	ok	ok	ok	ok	ok	-	-	ok	ok	ok
1	Keya Chowdhury	CWASA	Assistant Engineer			ok	ok	-	-	-	-	-		-
2	Shahidul Islam	CWASA	Sub-Assistant Engineer	ok	ok	ok	ok	ok	ok	-	-	-	-	-
3	Richard Nelson Penheiro	CWASA	Sub-Assistant Engineer									ok	ok	ok
4	Nurul Islam	CWASA	Plumbing Mechanics	-	-	ok	ok	ok	ok	ok	ok	ok	ok	-
5	Sekander Meah	CWASA	Plumbing Mechanics	-	-	ok	ok	ok	ok	ok	ok	-	ok	-
6	Abul Khair	CWASA	Plumbing Mechanics	-	-	ok	ok	ok	ok	ok	ok	ok	ok	ok
7	Mohd Ullah	CWASA	Plumbing Mechanics	-	-	ok	ok	ok	ok	-	-	ok	ok	-
8	Md. Zakir Ahmed	CWASA	Plumbing Mechanics	-	-	ok	ok	ok	ok	ok	ok	-		-
9	Ratan Kumar Das Gupta	CWASA	Plumbing Mechanics									ok	ok	-
10	Md. Harunur Rashid	CWASA	Plumbing Mechanics									ok	-	ok
11	Md. Nurul Alam	CWASA	Plumbing Mechanics									ok	-	-
12	Md. Faruk	CWASA	Plumbing Mechanics									ok	ok	ok
13	Md. Mohi Uddin	CWASA	Plumbing Mechanics									ok	ok	ok
14	Surja Kumar	CWASA	Assistant Plumbing Mechanics	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok	ok
15	Md. Nurul Absar	CWASA	Assistant Plumbing Mechanics	ok	ok	-	-	ok	ok	-	-	ok	ok	ok
16	S. M. Abbas Hossain	CWASA	Assistant Plumbing Mechanics	-	-	ok	ok	ok	ok	ok	ok	ok	ok	ok
17	Ziaur Rahman	CWASA	Assistant Plumbing Mechanics	-	-	ok	ok	ok	-	ok	ok	-	-	ok
18	Sayed Shiful Islam	CWASA	Assistant Plumbing Mechanics	-	-	ok	ok	ok	ok	ok	ok	-	-	ok
19	Idrish Miah	CWASA	Assistant Plumbing Mechanics									ok	ok	-
20	Md. Nurul Amin	CWASA	Assistant Plumbing Mechanics									ok	ok	ok
21	Md. Anower Hossen	CWASA	Assistant Plumbing Mechanics									ok	-	ok
22	Md. Delower Hossen	CWASA	Assistant Plumbing Mechanics									ok	-	ok
23	Md. Jamal Uddin	CWASA	Assistant Plumbing Mechanics									ok	-	ok
24	Md. Rasel Mia	CWASA	Helper	ok	ok	ok	ok	ok	ok	-	-	ok	-	ok
25	Sonjoy Bosu	CWASA	Helper	ok	ok	ok	ok	ok	ok	-	-	ok	-	ok
26	Yousup Mirza	CWASA	Helper	ok	ok	ok	ok	ok	ok	-	-	ok	-	-
27	Md. Akhtar Hossain	CWASA	Helper	ok	ok	ok	ok	ok	ok	-	-	ok	-	ok
28	Shohel Rana	CWASA	Helper	ok	ok	ok	ok	-	ok	-	-	-	-	-
29	Md. Riazul Islam	CWASA	Helper	ok	ok	-	ok	ok	-	-	-	ok	-	ok
30	Md. Sarwar Uddin	CWASA	Meter Inspector											ok
31	Md. Jasim Uddin	CWASA	Meter Inspector											-
32	Abdur Rahim Khndkr	CWASA	Meter Inspector											ok
33	Md. Ali Sohail	CWASA	Meter Inspector											ok
34	Md. Abdul Majid	CWASA	Meter Inspector											ok
35	Md. Nurul Amin	CWASA	Meter Inspector											ok
36	Md. Enayetullah	CWASA	Meter Inspector											ok
37	ShamsulAlam	CWASA	Meter Inspector											-
38	Mohd. Sahjahan	CWASA	Meter Inspector											ok
39	Abu Jafar	CWASA	Meter Inspector											-
40	Mohd Abdul Momin	CWASA	Meter Inspector											ok
41	Mohd Hossain	CWASA	Meter Inspector											ok
42	Forhadur Rahman	CWASA	Meter Inspector											ok
43	Md. Kamal Khan	CWASA	Meter Inspector											ok
44	Nasir Uddin	CWASA	Meter Inspector											ok
45	Bahadur Kumar Singha	CWASA	Meter Inspector											ok
46	Md. SamsulKibria	CWASA	Meter Inspector											ok
47	Md. Nazrul Islam	CWASA	Meter Inspector											-
48	S. Kamrul Ahsan	CWASA	Meter Inspector											ok
49	Md. S. Maniruzzaman	CWASA	Meter Inspector											ok
50	Abul Hashem	CWASA	Meter Inspector											ok
51	Debabrata Das	CWASA	Meter Inspector											ok
52	Md. Reazur Rahman	CWASA	Meter Inspector											ok
53	Md. Atiqur Rahman	CWASA	Meter Inspector											ok
54	Mir MohdLokman	CWASA	Meter Inspector											ok
55	Md. OhidulAlam	CWASA	Meter Inspector											ok
56	Md. Jahangir Alam	CWASA	Meter Inspector											ok
57	Mosleh Uddin Meaji	CWASA	Meter Inspector											ok
58	Md. Mujibullah Khan	CWASA	Meter Inspector											-
59	Md. Harun MeahChy	CWASA	Meter Inspector											ok
60	Md. Jamal Uddin	CWASA	Meter Inspector											ok
61	RatanKanti Das	CWASA	Meter Inspector											ok
62	Md. Golam Sarwar	CWASA	Meter Inspector											ok
63	Md. Kutubul Hasan	CWASA	Meter Inspector											ok
64	Md. NurulAlam	CWASA	Meter Inspector											ok
65	Md. Abdul Mannan	CWASA	Meter Inspector											-
66	Mrs. NurNahar	CWASA	Meter Inspector											ok
67	Mrs. RabeyaBegum	CWASA	Meter Inspector											ok
68	Md. Mamunur Rashid	CWASA	Meter Inspector											ok
69	Md. Eskandar Ali	CWASA	Meter Inspector											ok
70	Md. Abul Bashar	CWASA	Meter Inspector											ok
71	Md. Anwar Hossain Chy	CWASA	Meter Inspector											ok

ok: attended, -: absent