CHAPTER 15

WATER AUDIT AND LEAKAGE CONTROL

15.1 INTRODUCTION

WATER AUDIT

Water Audit of a water supply scheme can be defined as the assessment of the capacity of total water produced by the Water Supply Authority and the actual quantity of water distributed throughout the area of service of the Authority, thus leading to an estimation of the losses.

Otherwise known as non-revenue water, unaccounted-for water (UFW), is the expression used for the difference between the quantity of water produced and the quantity of water which is billed or accounted for (Table-15.1).

TABLE 15.1

UNACCOUNTED-FOR WATER

<table>
<tr><td rowspan="5">Water accounted for</td><td colspan="2">Residential</td><td rowspan="5">Billed water</td><td rowspan="5">Revenue water</td></tr>
<tr><td colspan="2">Commercial</td></tr>
<tr><td colspan="2">Industrial</td></tr>
<tr><td colspan="2">Institutional</td></tr>
<tr><td colspan="2">Special Consumption
+
Operational Consumption</td></tr>
<tr><td rowspan="7">Water not accounted for</td><td colspan="2">Illegal Consumption</td><td rowspan="7">Losses</td><td rowspan="7">Non-Revenue water</td></tr>
<tr><td rowspan="3">Loss of water</td><td>Over flow</td></tr>
<tr><td>Leakage</td></tr>
<tr><td>Waste</td></tr>
<tr><td rowspan="3">Metering errors</td><td>Macro-metering errors</td></tr>
<tr><td>Micro-metering errors
(House connection meters)</td></tr>
<tr><td>Estimation errors</td></tr>
</table>

15.2 OBJECTIVE OF WATER AUDIT

The objective of water audit is to assess the following.

i) Water produced,

ii) Water used,

iii) Losses both physical and non-physical,

iv) To identify and priorities areas which need immediate attention for control.

15.3 PLANNING AND PREPARATION

Planning and preparation shall include the data collection element and the preparation of sketch plans for the distribution centres and other locations for the installation of the flow meters. Also included within this shall be the confirmation of flow rates for the bulk meter locations which has been carried out by the use of portable ultrasonic flow meters.

15.3.1 VERIFICATION AND UPDATING OF MAPS

Mapping and inventory of pipes and fittings in the water supply system: If the updated maps are available and bulk meters are in position network survey can be taken up as a first step. Otherwise maps have to be prepared and bulk meters fixed.

The agency should set up routine procedures for preparing and updating maps and inventory of pipes, valves and consumer connections. The maps shall be exchanged with other public utilities and also contain information on other utility services like electricity, communications etc. Refer to 8.4.2.1 and 8.4.2.3 in Chapter on "Operations and Maintenance of Distribution System".

15.3.2 INSTALLATION OF BULK METERS

The major activity during the overall water audit will be bulk meter installation at those points on the distribution network where water enters the system. It is expected that bulk meters will be required at the following locations:

- All major system supply points.
- All tubewells which supply the system directly.
- Major transfer mains which are expressly required for audit.

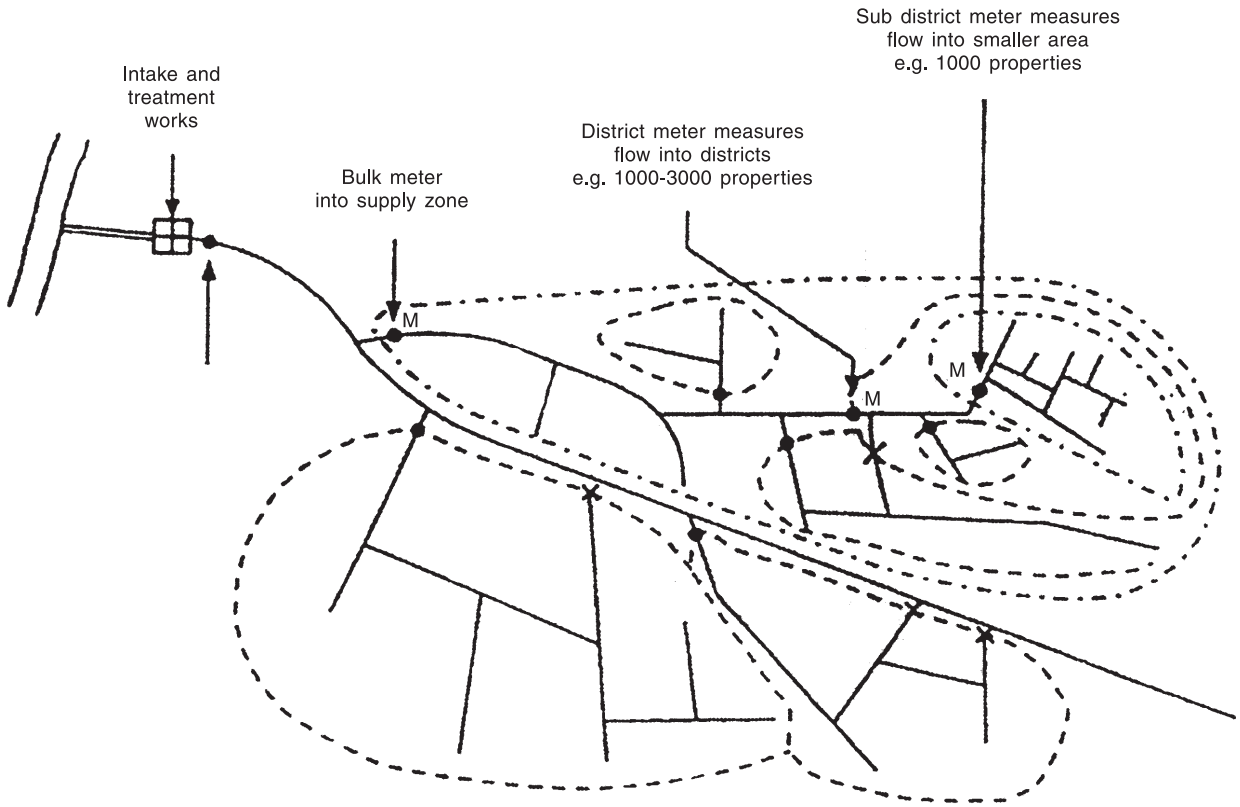
At distribution centres, the most appropriate meter position is on the outlet pipe from the service reservoir. Installation of a meter at this point will allow measurement of flows into the system not only if supplies are coming from the service reservoir but also if they are being pumped directly from the clear water reservoir (CWR). Refer Fig 15.1

The size of the meter can be determined by:

- Number of properties served.
- Per capita consumption (litres/person/day).
- Population density.
- Hours of supply.

Meter sizes must be sized according to current supply hours. Future changes to system operation may require the substitution of some bulk meters with those of a smaller size, due to reductions in flow over longer supply hours.

It is expected that bulk meters installed in locations where supply is rationed will tend to over-read. This is because when supplies are turned on, the air present in the pipes can cause the meter to spin. This problem may be overcome through the use of combined pressure and flow loggers. Flow through the meter will be recorded in the normal way. However, analysis of the pressure and flow plots together will enable the identification of those period of time when a flow is recorded at zero pressure. This time should correspond to the period when the meter is spinning, and the true flow through the meter over a period of time can therefore be calculated.



15.4 MONITORING OF THE PRODUCTION SYSTEM

The assessment of the leakage rates through the various features of the water supply system should be undertaken. These will include:

- Raw water transmission system.
- Reservoirs.
- Treatment Plant.
- Clear-water transmission system.
- Inter zonal transmission system.
- Tube wells.

15.4.1 TRANSMISSION SYSTEM

The methodology adopted to make an assessment of the level of losses in the transmission system is to install insertion probes/bulk meter at both ends of each section of main being monitored, thus monitoring both the inflow and outflow of the section. This monitoring should be done for a minimum period of 7 days. The difference of inflow and outflow will indicate the losses in the transmission main. The advantage of this method is that the trunk main need not be taken out of service.

Another way to measure leakage is to close two valves on the main. 25mm tapping are made on either side of the upstream valve and a small semi-positive displacement flow meter is connected between the two tappings. Flow through this meter will indicate the leakage in the main between the two closed valves. It must be ensured that the down stream valve is leak proof.

The approximate position of any leakage measured can be determined by the successive closing of sluice valves along the main in the manner of a step test.

15.4.2 RESERVOIRS

To reduce or avoid any leakage or consequent contamination in reservoirs, the reservoirs should be periodically tested for water tightness, drained, cleaned, washed down and visually inspected.

The losses in water storage structures can be monitored for a particular period noticing the change in the level gauges when the structure is out of use i.e. there is no inflow and outflow of water during this monitoring period.

The most reliable method for measurement of leakage from a service reservoir is to fill it to full level and isolate it from supply and to measure change in level over suitable time period. Suitable equipment to measure reservoir levels could be chosen like:

Sight gauges

Water level sensors (as per manufacturers instruction)

Float gauges

Submersible pressure & level transducers (as per manufacturers instruction).

15.4.3 TREATMENT PLANT

The losses in treatment plant can be monitored by measuring the inflow into the plant and outflow from the plant with the help of mechanical/electronic flow recorders. The difference of inflow and outflow for the monitoring period will indicate the water losses in the plant. In case the loss is more than the design limit, further investigation should be carried out for remedial measures.

15.4.4 TUBE WELLS

In conjunction with the programme of bulk meter installation is the operation to monitor the approximate yield from the tubewells This exercise can be carried out by the installation of semi-permanent meters to the tube wells on a bypass arrangement similar to that for the bulk meters. This can be effected utilising the smaller diameter bulk meters. Insertion probes or the

portable ultrasonic flow meters will be used for measurement of flows on the common feeder mains.

15.5 MONITORING OF DISTRIBUTION SYSTEM

Distribution system comprises of service reservoirs, distribution mains & distribution lines including appurtenances, consumer service lines, connections viz. metered, unmetered (flat rate), public stand posts, hydrants, illegal connections. The area of the city is divided into Waste Metering Areas (WMA)/ Sample area zones. Since at one time it is not possible to carry out water audit in all WMAs, it is done for a part of the city at one time followed by other parts of the city in future. This has to be a continuous process managed by a water audit wing or a Leak Detection cell.

Water audit of the distribution system consists of:

i) Monitoring of flow of water from the distribution point into the distribution system (WMA).

ii) Consumer sampling.

iii) Estimating metered use by consumers.

iv) Estimating losses in the appurtenances and distribution pipe line network including consumer service lines.

15.5.1 MONITORING FLOW INTO THE DISTRIBUTION SYSTEM

A bulk meter of the appropriate type and size is installed at the outlet pipe of the service reservoir or at the point where the feeding line to the area branches off from the trunk main. If water from the WMA flows out into another zone a valve or meter is to be installed at this outlet point.

15.5.2 CUSTOMER METER SAMPLING

Water audit is a continuous process. However, consumers' meter sampling can be done on yearly basis by

- Review of all existing bulk and major consumers for revenue. A co-relation between the production/power consumed in the factory vis-a-vis water consumption can be studied.
- Sampling of 10% of all bulk and major consumers.
- Sampling of 10% of small or domestic consumers.
- Series meter testing of large meters suitably according to standard, calibrated meter
- Testing of 1% large and 1% domestic meters.
- Estimating consumption at a representative 5% sample of Public Stand Posts (PSP) and unmetered connections by carrying out site measurements.

All non-functioning and broken meters in the sample areas will be replaced and all meters may be read over a week. This information will be brought together with information derived from the workshop and series testing in order to estimate the average water delivered and

correction factors for consumer meters These factors can then be extrapolated to the rest of the customer meter database

15.5.3 CUSTOMER METERED USE

The average consumption per working meter is calculated by dividing the total consumption of all working meters in the WMA by the number of working meters. This average consumption is then multiplied by the meter correction factor derived from the customer meter sampling exercise in which the serial metering test and bench test of meters is done. Average slow or fast percentage of test recording of meters is known as correction factor. This average metered consumption multiplied by the correction factor is known as water used by consumer. Unmetered connections & illegal connections will also be treated to have same consumption as metered property.

Estimating customer metered use can also be carried out using the customer data obtained from the customer billing records. Consumption analysis will be carried out by:

- Consumer type.
- Revenue zone/sample area/WMA.
- Direct supply zone/sample area/WMA.
- Overall for the city/Water Supply Scheme.

During the analysis the correction factors derived in the sampling exercise will be applied for metered consumption. Default values will be applied to connections with estimated bill. Public Stand Posts (PSP), unmetered and illegal use will also be treated as metered consumption. Analysis of the billing data will enable the production of:

- A report on overall water delivered.
- An estimate of water delivered to wards/sample areas/WMA.
- UFW i.e., Physical losses and non-physical losses.
- Errors in assessment of water production. (in case of tube wells).

15.5.4 LOSSES IN CUSTOMER SERVICE LINES AND APPURTENANCES

Losses can be calculated by deducting from the total quantity, the following :

- Metered consumption.
- Unmetered consumption (assuming metered use).
- Illegal connection consumption (assuming metered use).
- PSP use.
- Free supply, fire-hydrants, use in public toilets, parks etc.

15.6 ANALYSIS

The information of the results of monitoring the distribution system together with the results of the bulk metering exercise will be consolidated and brought together to produce the water balance report and the overall water audit report. These results may be interpreted in financial terms.

Further exercise will be done to classify the water consumed/wasted/lost in financial terms with relation to the current and future level of water charges. This exercise will be carried out as a result of the field tests and the review of existing records forming part of the overall water audit.

This water audit will provide sufficiently, accurate areawise losses to prioritise the area into 3 categories viz.

1. Areas that need immediate leak detection and repair.
2. Areas that need levels of losses (UFW) to be closely monitored.
3. Areas that appear to need no further work at the current time.

It is recommended that cursory investigation should be carried out in the areas that appear to have the least levels of losses (UFW), locating any major leaks, followed by the leak repairs would reduce the losses (UFW) levels further.

After water audit of few cities it has been established that the components of UFW may generally be as follows:

i)	Leakage (physical losses)	75 to 80%
ii)	Meter under-registration	10 to 15%
iii)	Illegal/unmetered connections	3.5 to 6%
iv)	Public use	1.5 to 3.5%

15.7 PROBLEMS FACED IN WATER AUDIT

- Proper network details in the shape of maps are not available. If at all some maps are available, these are not updated with proper indication of appurtenances.
- Normally much attention is not paid by the Water authorities to the water audit of the water supply schemes.
- Barring a few major cities, separate Water audit units are not available with the Authority. Wherever these units are available the water audit staff is not motivated enough to carry out the work.
- By and large, water authorities are not equipped with the necessary equipment.
- Proper budgetary provision is not available for carrying out continuous and effective water audit.
- Lack of co-ordination between the Water Audit unit and operational and maintenance staff.
- No emphasis is given on Information Education and Communication (IEC) activities for conservation of water.

Water audit provides fairly accurate figures of both physical and non-physical losses in the different waste metering areas of city. Accordingly the areas with higher percentage of losses can be identified for carrying out the leakage control exercise for reduction of water losses. As explained earlier, the reduction in losses will result in saving in the form of:

i) Operational cost

ii) Capital cost

Apart from this, the saving in losses will result in consumer satisfaction, improved water quality and additional revenue to the Water Authority and postponed of augmentation schemes.

15.8 OBJECTIVE OF LEAKAGE CONTROL

The overall objective of leakage control is to diagnose how water loss is caused and to formulate and implement action to reduce it to technically and economically acceptable minimum. Specifically the objectives are :

- To reduce losses to an acceptable minimum.
- To meet additional demands with water made available from reduced losses thereby saving in cost of additional production and distribution.
- To give consumer satisfaction.
- To augment revenue from the sale of water saved.

15.9 WATER LOSSES

The water losses can be termed into two categories.

1. Physical losses (Technical losses)
2. Non-physical losses (Non-technical losses/Commercial losses)

15.9.1 PHYSICAL LOSSES (TECHNICAL LOSSES)

This is mainly due to leakage of water in the net work and comprises of physical losses from pipes, joints & fittings, reservoirs & overflows of reservoirs & sumps.

15.9.2 NON-PHYSICAL LOSSES (NON-TECHNICAL LOSSES)

Theft of water through illegal, already disconnected connections, under-billing either deliberately or through defective meters, water wasted by consumer through open or leaky taps, errors in estimating flat rate consumption, public stand posts and hydrants.

15.10 LEAKAGE DETECTION AND MONITORING

The major activities in the leak detection work in the distribution system:

- Preliminary data collection and planning.
- Pipe location and survey.
- Assessment of pressure and flows.
- Locating the leaks.
- Assessment of leakage.

15.10.1 Preliminary data collection and planning

The water distribution drawings are to be studied and updated. The number of service connections is to be obtained and in the drawings of the roads the exact locations of service connections marked. The district and sub-district boundaries are suitably fixed taking into

consideration the number of service connections, length of mains, pressure points in the main. The exact locations of valves, hydrants with their sizes should be noted on the drawings.

The above activities will help in planning the conduct of sounding of the system for leaks or for fixing locations for conduct of pressure testing in intermittent water supply system before commencement of leak detection work or for measuring pressure and leak flow in the continuous water supply system.

15.10.2 Pipe Location Survey

Electronic pipe locators can be used during survey. These instruments work on the principle of Electro magnetic signal propagation. It consists of a battery operated transmitter and a cordless receiver unit to pick up the signals of pre-set frequency. There are various models to choose from. Valve locators are metal detectors that are available which can be used to locate buried valves.

Assessment of pressure and flows

Data loggers are used to record the pressure and flows. It is an instrument which stores the raw data electronically so as to be able to transfer it to the computer with a data cable link. Two types of portable data loggers are used either with a single channel or dual channel.

Single channel loggers are of the analogue type with built in pressure transducers. A simple push fit connection with the street main enables direct recording of pressure for future retrieval.

Dual channel loggers consist of an analogue type sensor for pressure and a digital type sensor for recording flow reading. A pulse head for picking up a flow reading and its conversion into an electronic pulse is required with this logger. The data of pressure and flows are stored into the data loggers during the test. Subsequent transfer of the data is made electronically into the computers magnetic storage for further processing.

In the absence of electronic equipment, the pressures can be ascertained by tapping and providing a pressure gauge. Flows can be assessed by using meters on a bypass line.

15.10.3 Locating the Leaks

To zero in on the possible location of leakages, the following methods or combination of methods could be adopted.

(a) Walking
Walking over the main looking for telltale signs of presence of water.

(b) Sounding
Sounding is the cheapest and an effective method of detecting leaks in a medium - sized water supply system.

Sounding could be categorised into two types: Direct & Indirect

(a) Direct sounding is made either on the main or fittings on the main such as sluice or air valves, fire hydrants stop taps or any other suitable fittings.

(b) Indirect sounding consists of sounding made on the ground surface directly above the mains for locating point of maximum sound intensity. This method is a good supplement for confirming location of leak noise identified through direct sounding

Water escaping from a pressurised pipe emits a sound similar to the sound that can be heard when a sea shell is held upto the ear.

The range of frequency of the sound depends upon many factors such as nature of leak, size of hole through which water is escaping, the pipe material, nature of ground in which pipe is laid etc.

The equipment used is:

(a) Non-Electronic Equipment

These are also known as listening sticks. They are simple pieces of equipment consisting of a hollow rod of any material with an ear piece

(b) Electronic

These are electronic listening stick consisting of a metal rod that is screwed on to a combined microphone and amplifier unit. The sound can be amplified by using a volume knob and could be heard through earphones.

There are also ground microphone consisting of a microphone unit and an amplifier unit, the microphone unit is attached to a handle that enables the unit to be placed on top of the ground, the signal received is amplified and passed on to the user through headphones. Some equipment have indicators.

(c) By the use of gas tracer

Sulphur hexafluoride gas tracer is injected into the main and will surface out along with water at point of leak. A detector is used to search for the substance that escapes. This is very suitable in rural areas where bore holes can be made easily at suspected points. The content of each bore hole is sampled in turn using a hand detector to ascertain the presence of gas.

(d) By using a Leak Noise Correlator

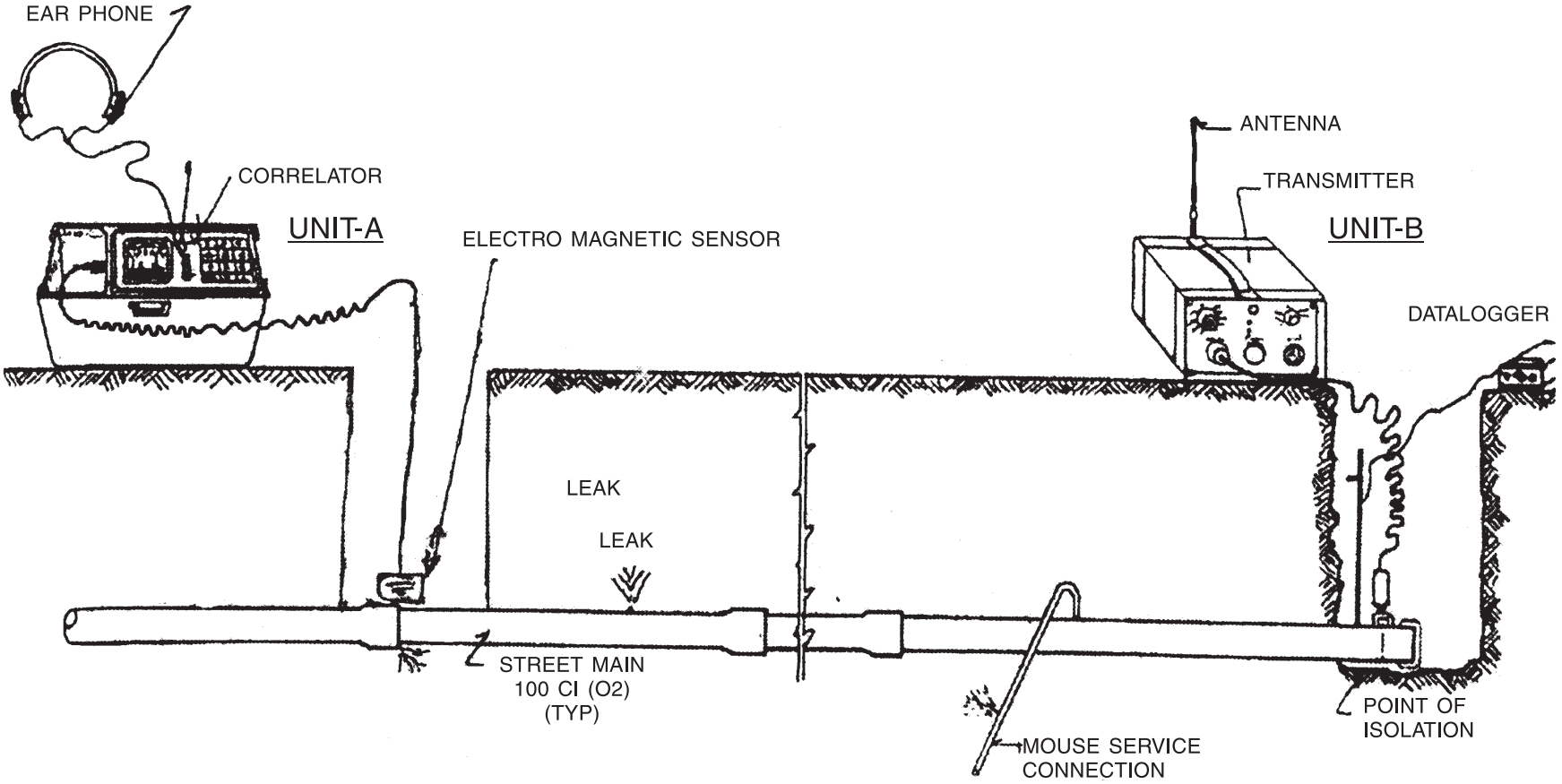
The leak noise correlator is an instrument consisting of a Radio transmitter unit and a correlator unit. (Fig. 15.2) Both the units are placed on the test mains at the two ends of the stretch under correlation by attaching their magnetic sensors to the mains. The correlator unit identifies the various frequencies of leak sounds and calculates automatically the distances of the leak points from the correlator unit

To minimize the possibility of human error, operator involvement in calculation is limited to merely operating the measurement "start key". This initiates the measurement procedure and automatically determines the leak position on the integral display, combined with the measurement curve and the operating conditions.

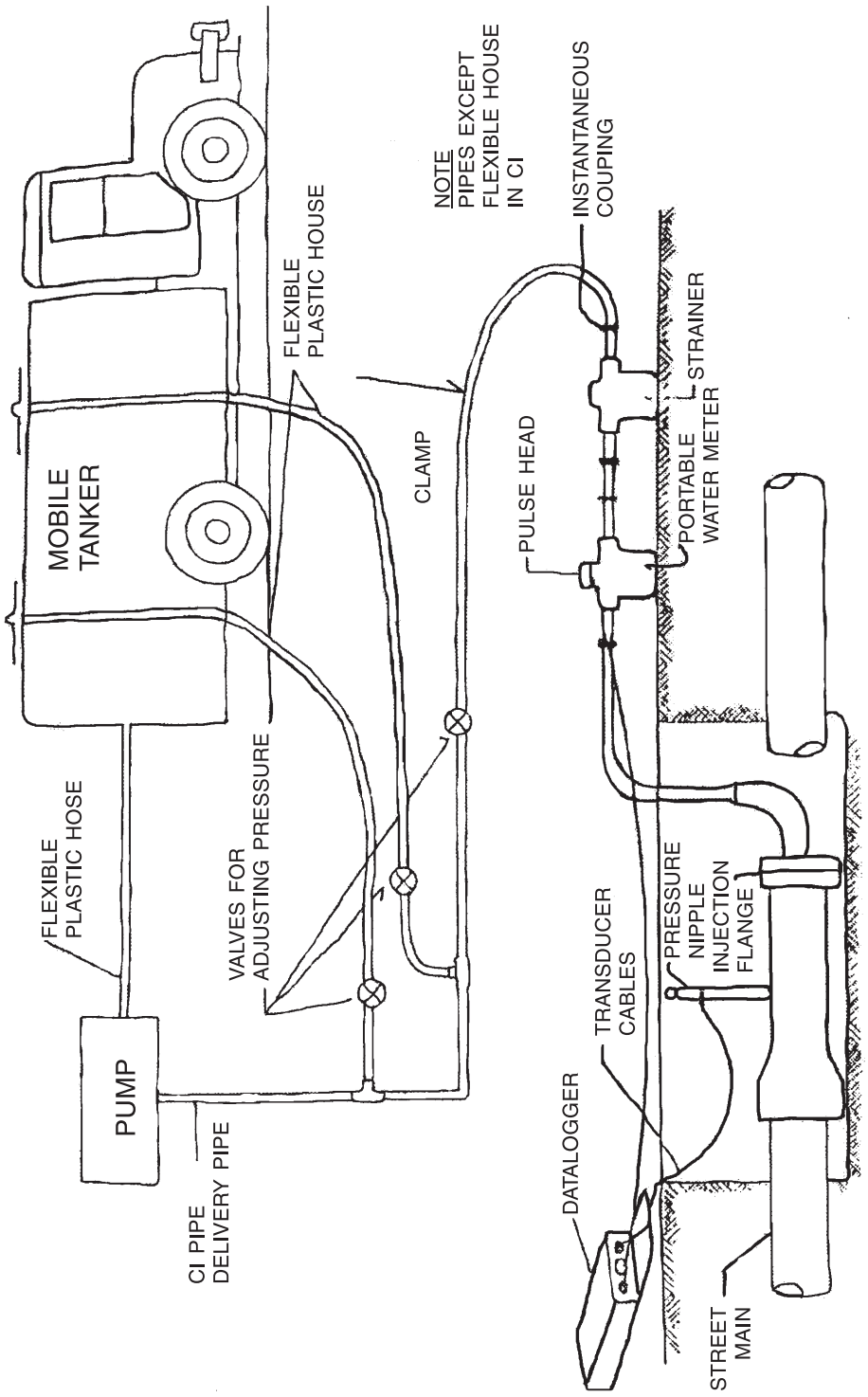
15.11 ASSESSMENT OF LEAKAGE

To conduct tests for assessment of leak the following equipment are needed:

- Road measurer.
- Pipe locator.
- Valve locator.
- Listening sticks or sounding rods.
- Electronic sounding rods.


EAR PHONE
CORRELATOR
UNIT-A
ELECTRO MAGNETIC SENSOR
ANTENNA
TRANSMITTER
UNIT-B
DATALOGGER
LEAK
LEAK
STREET MAIN
100 CI (O2)
(TYP)
MOUSE SERVICE
CONNECTION
POINT OF
ISOLATION

- Leak noise correlator.
- A street water tanker attached to a pump with ease to fabricate pipe assembly with valves to control pressure (Fig 15.3).
- Turbine water meters with pulse head, pressure point and data loggers.
- Leak Locator.



The methods for assessment of leaks and location of leaks in cases of water supply system on intermittent basis and on continuous basis are described below separately.

15.11.1 INTERMITTENT SUPPLY

Supply for short hours under low pressure is common in developing countries.

Leak detection equipments and meters do not function effectively under low pressure. Hence the necessity to increase pressure over a particular duration of time to measure leak flow. To achieve this end, the stop taps at consumers end are closed and the boundary valves of test areas are also closed for isolation of the water mains to be tested. The assessment can be done as under:

In the selected area to be tested, obtain all details of the water supply system such as location and size of mains valves, consumer connections. If they are not readily available utilise road measurers to measurer length; pipe locators to detect the alignment of pipes; valve locators to locate the valves. Study their working condition and restore them to operational level.

Decide the isolation points of test area, either by closing the existing valves or by cutting the main and capping it during test. The consumers connections may be isolated by closing the stop taps. If stop taps are not available they can be provided or connections can be temporarily plugged or capped.

Water is drawn from the tanker and injected into mains of test area by using a pump. A bypass pipeline returns the water partially to the tanker.

By manipulating the valves provided on the pump delivery and on the return lines, the desired pressure is maintained.

The water that is pumped in, is measured by a meter with pulse head and a data logger for recording the flow. A pressure transducer is also provided to log the pressure at the injection points. Since all exit points are closed, the amount of water recorded by the meter as flowing is obviously the amount of leakage in the system.

Down loading of loggers is done into a computer and graphs of flow and pressure with time are obtained. Consequent to tests and repairs to leaks the reduction in leak flow and the improvement in pressure can be obtained from typical computer graphs (Fig.15.4 and 15.5).

15.11.2 CONTINUOUS SUPPLY WITH ADEQUATE PRESSURE

(a) District Metering

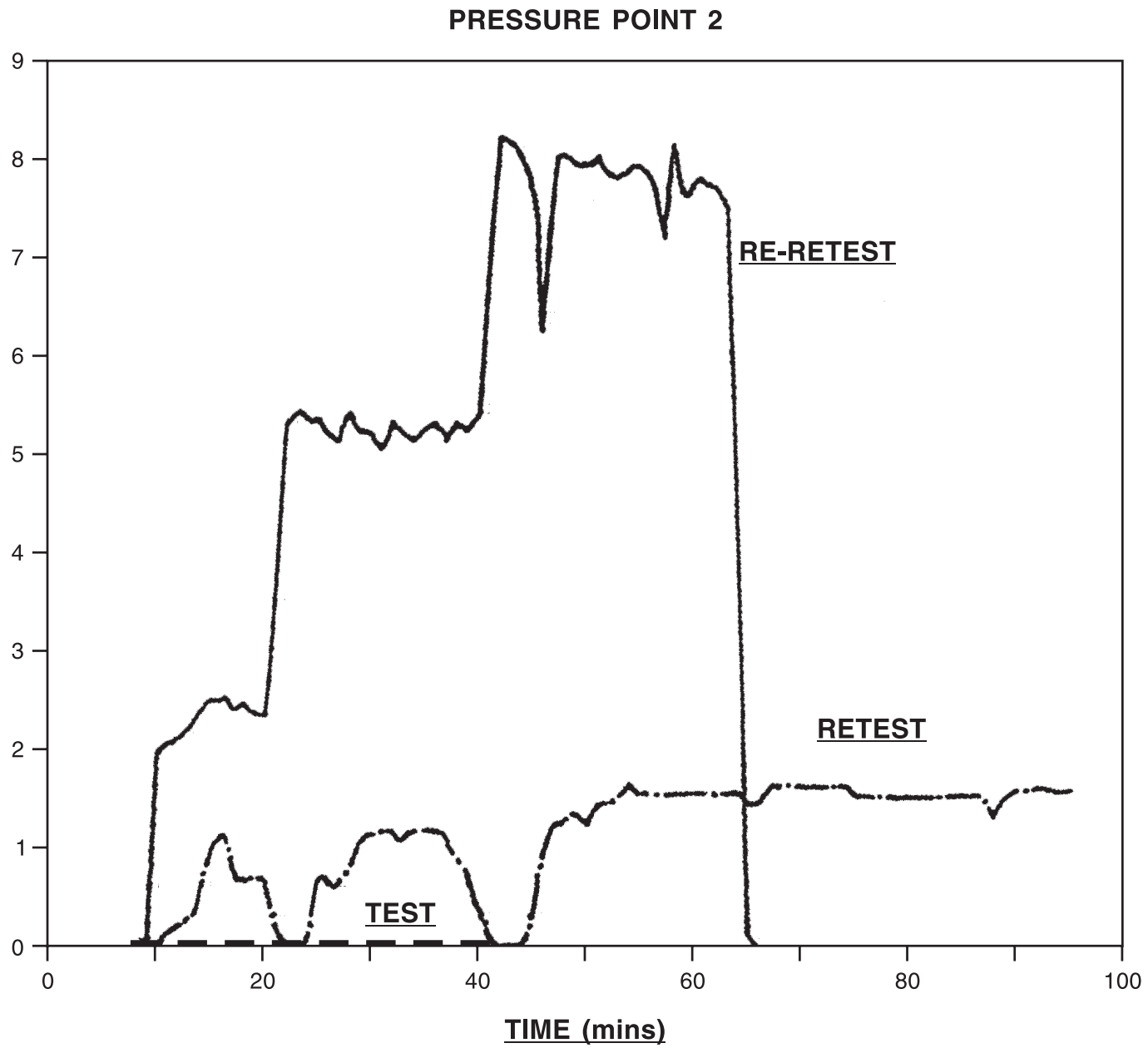
The term district metering is used to describe the method whereby flow meters are installed on all major supply lines and strategic points within the distribution system.

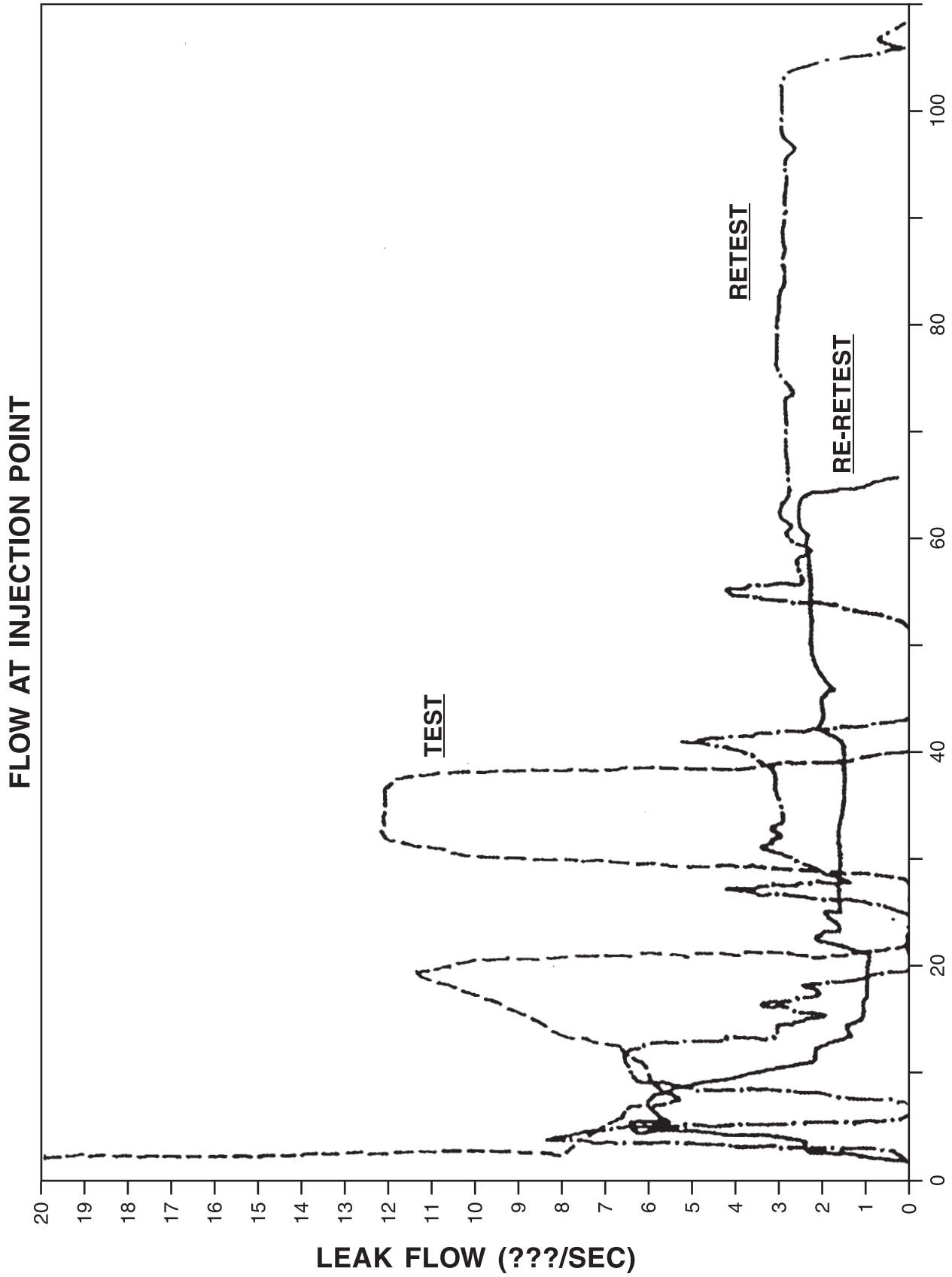
The meters are then used to monitor the overall performance of the system establishing average daily flows into various districts.

District meter areas ideally consists of 2000 to 5000 properties.

Size of the district meter should be such that it is capable of recording night flow without loss of accuracy and also must be capable of supplying peak flow without introducing serious head loss.

The District Meters should be read at weekly intervals at the same time of day as previous readings of the meter.


PRESSURE POINT 2
9
8
7
6
5
4
3
2
1
0
RE-RETEST
RETEST
TEST
0
20
40
60
80
100
TIME (mins)


FLOW AT INJECTION POINT
LEAK FLOW (???/SEC)
TEST
RETEST
RE-RETEST
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
0
20
40
60
80
100

Various types of flow meters such as venturi, pitot tube, insertion turbine meters, magnetic, ultrasonic flow meters etc. are available.

Once a district is established, repair of all known and ascertained leaks is undertaken. The measured flow into the district is then taken as the norms. Any significant variation in the measured flow indicates possible leakage and may be further investigated.

(b) Waste Metering

Within the distribution network, each metering district can be sub-divided into waste meter zones. The zone can be isolated by closing any interconnection with adjacent zones or 'boundary valves'. If the flow is then measured at times when there is virtually no normal usage, such as the early hours of 2.00 A.M.to 3.00 A.M. in the morning, then the recorded flow through the meter or 'Minimum Night Flow Method' gives an indication of the leakage level within the zone (Fig 15.6 &15.7).

(c) Step Testing

The method of closing valves within the district so as to successively reduce the size of the district supplied by the meter is known as step testing. This is done by closing intermediate valves or 'step valves', whilst simultaneously monitoring the effect of these alterations at the waste meter. A sudden reduction in night flow corresponding with the closure of a step-valve will indicate leakage on a particular section of main.

This section can be investigated in detail using sounding techniques, the leak noise correlator and the ground microphone. The detected leak points are repaired. The exercise is repeated and reduction in leakage is noted.

Starting furthest from the waste meter, valves are successively closed so that less and less of the district is supplied via. the meter. The sequence of closing valves is followed right up to the meter where upon the flow should drop to zero.

The success of both waste metering and step testing depends to a large extent upon the ability to isolate the waste meter district from rest of the system and this obviously depends upon valves shutting down tight.

Step testing is effective when the step size is approximately 100 properties. In smaller districts of up to 1000 properties the district should be divided into not less than 10 steps.

A detailed record of the inspection and leaks located and repaired should be maintained.

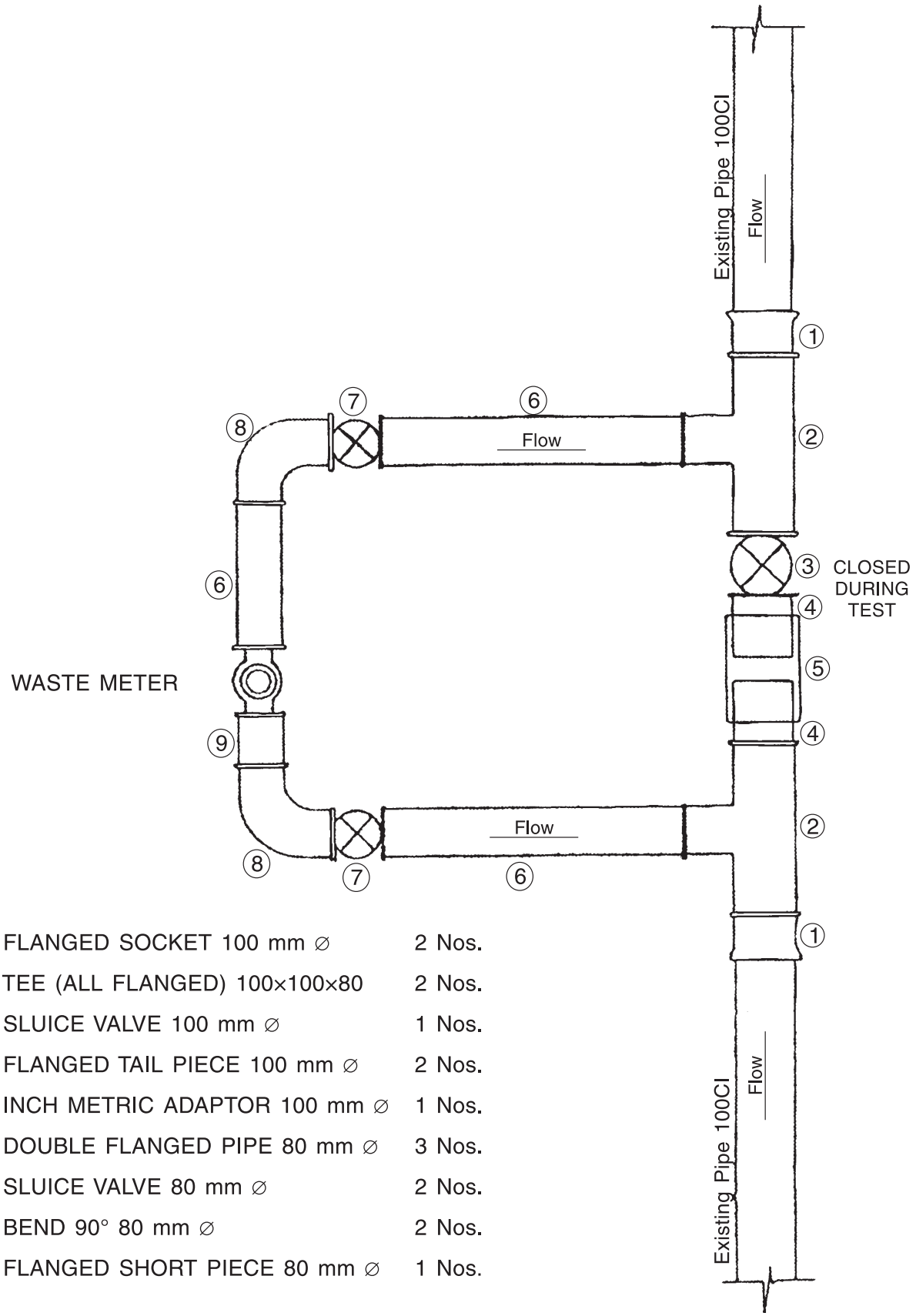
15.12 ACCEPTED NORMS FOR EXPRESSION OF LEAKAGE

Leakage within distribution mains be expressed in terms of night flow rate:

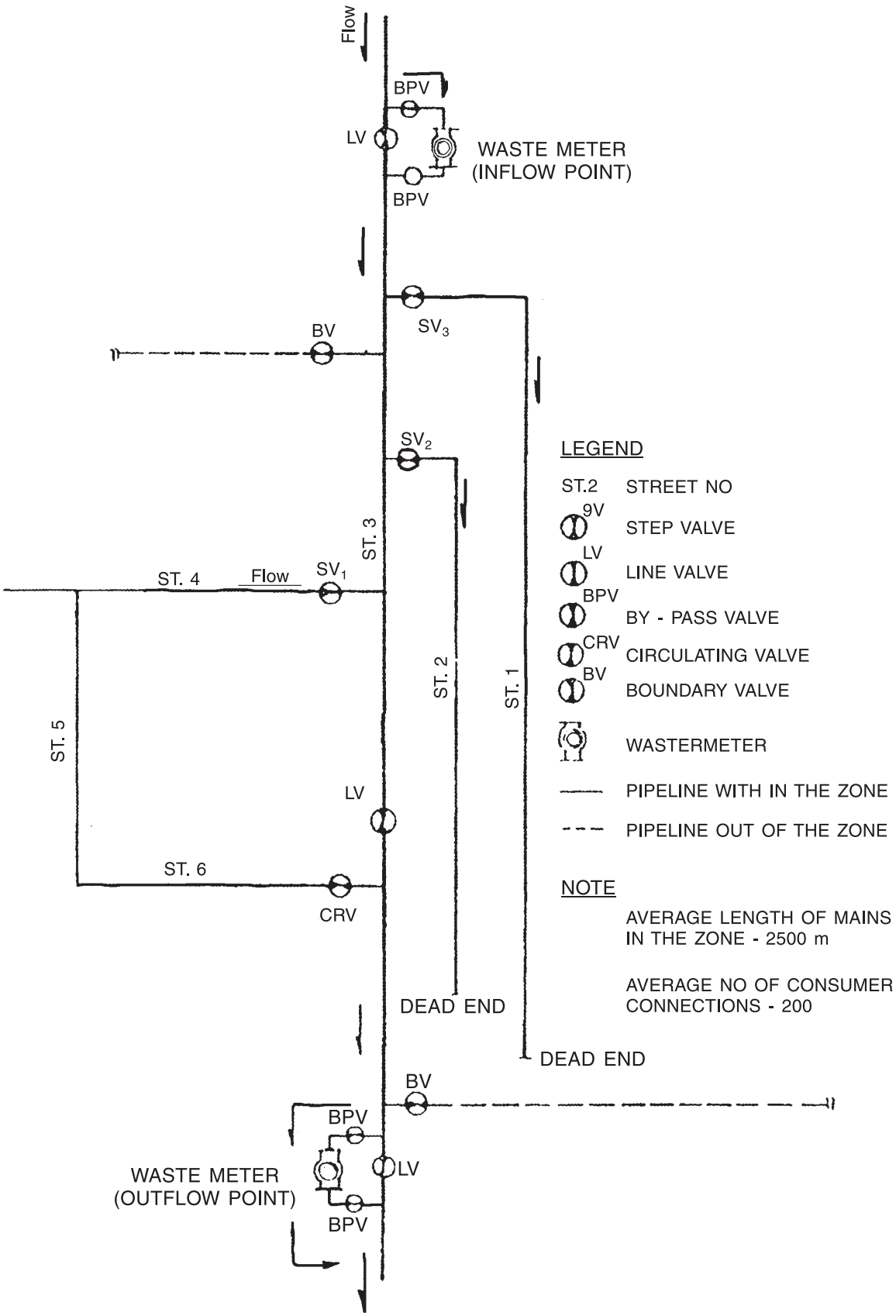
i) Litres/household/hour for urban areas and for whole systems.

ii) Litres/Kilo Meter of main/hour for rural areas.

Leakage from service reservoir may be usually expressed as a percentage of its capacity. Direct measurement of leakage from trunks mains are best expressed in litres/kilometer of main/hour.



①	FLANGED SOCKET 100 mm ∅	2 Nos.
②	TEE (ALL FLANGED) 100×100×80	2 Nos.
③	SLUICE VALVE 100 mm ∅	1 Nos.
④	FLANGED TAIL PIECE 100 mm ∅	2 Nos.
⑤	INCH METRIC ADAPTOR 100 mm ∅	1 Nos.
⑥	DOUBLE FLANGED PIPE 80 mm ∅	3 Nos.
⑦	SLUICE VALVE 80 mm ∅	2 Nos.
⑧	BEND 90° 80 mm ∅	2 Nos.
⑨	FLANGED SHORT PIECE 80 mm ∅	1 Nos.

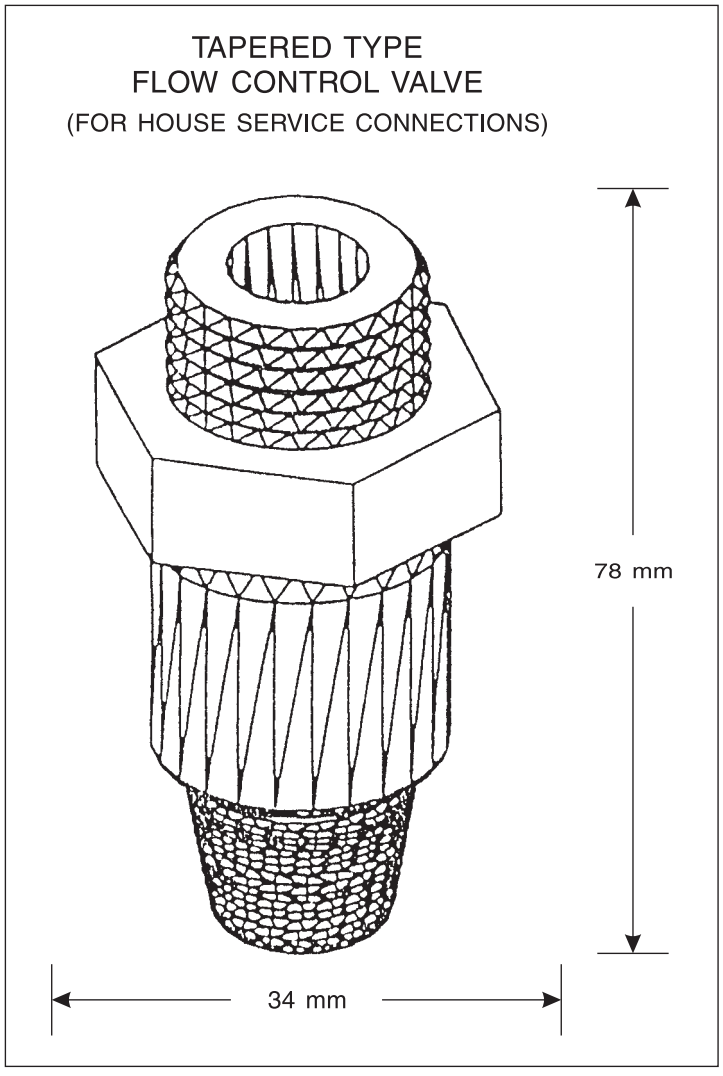

Flow
BPV
LV
WASTE METER
(INFLOW POINT)
BPV
SV3
BV
SV2
ST. 3
ST. 4
Flow
SV1
ST. 2
ST. 1
ST. 5
LV
ST. 6
CRV
DEAD END
DEAD END
BV
BPV
LV
WASTE METER
(OUTFLOW POINT)
BPV
LEGEND
ST.2 STREET NO
9V STEP VALVE
LV LINE VALVE
BPV BY - PASS VALVE
CRV CIRCULATING VALVE
BV BOUNDARY VALVE
WASTERMETER
PIPELINE WITH IN THE ZONE
PIPELINE OUT OF THE ZONE
NOTE
AVERAGE LENGTH OF MAINS IN THE ZONE - 2500 m
AVERAGE NO OF CONSUMER CONNECTIONS - 200

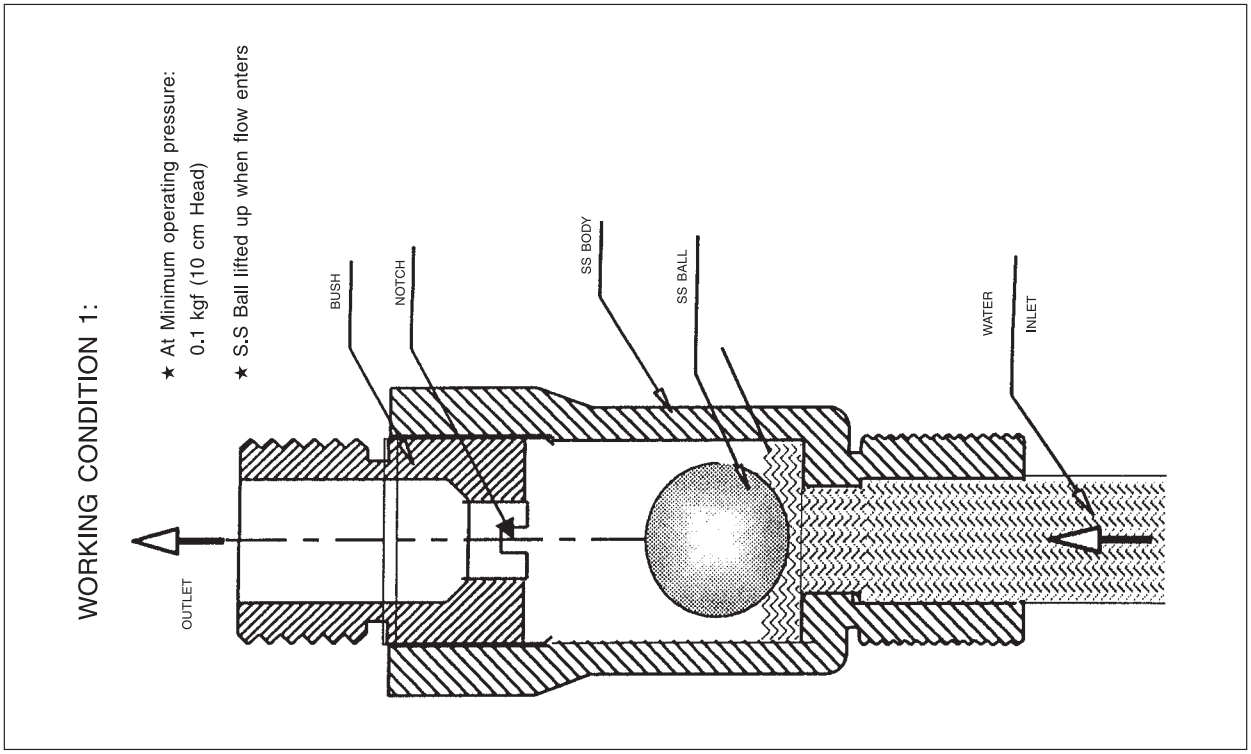
15.13 PREVENTION OF UFW IN CONSUMER CONNECTION

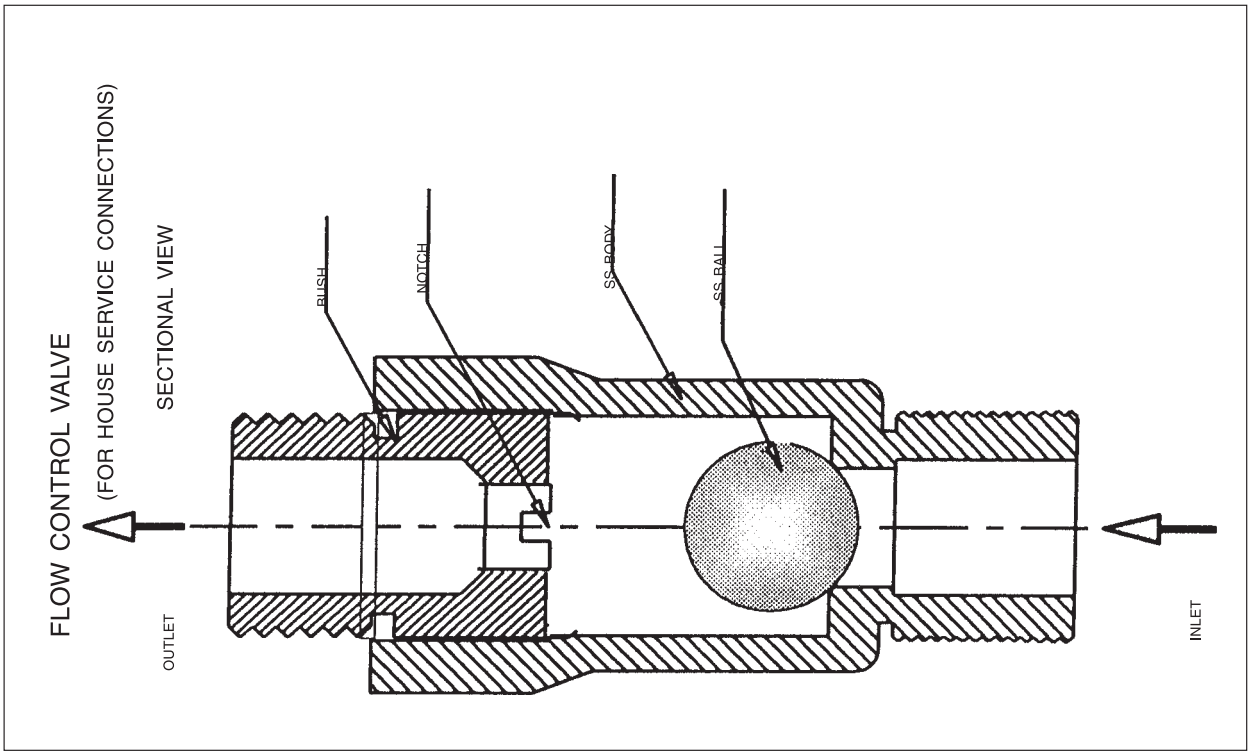
For domestic connection galvanized iron pipes are mainly used. After a period of time these pipes get choked due to corrosion/tuberculation. For house service connection, non-corrosive pipes can be used. The water supply drawing should have correct layout of the pipes, diameter, material, valves etc. This would facilitate proper maintenance. For arresting the illegal drawal of water from the distribution system by way of using small electrical driven motors in consumer connections, a mini Flow Control Valve in the form of a tapered ball drive system fixture, working on float principle, has been developed and found to be very successful in proper control & maintenance of service connection flows, even with supply hours ranging barely between 1-2 hours a day.

It allows only the designated flows 5lpm (or) 10lpm (or) 15lpm (or) 20lpm (or) upto 25lpm in the house service line beyond it's location irrespective of the incoming quantity of flows in the line and can be protected from external tampering with a sealed box.

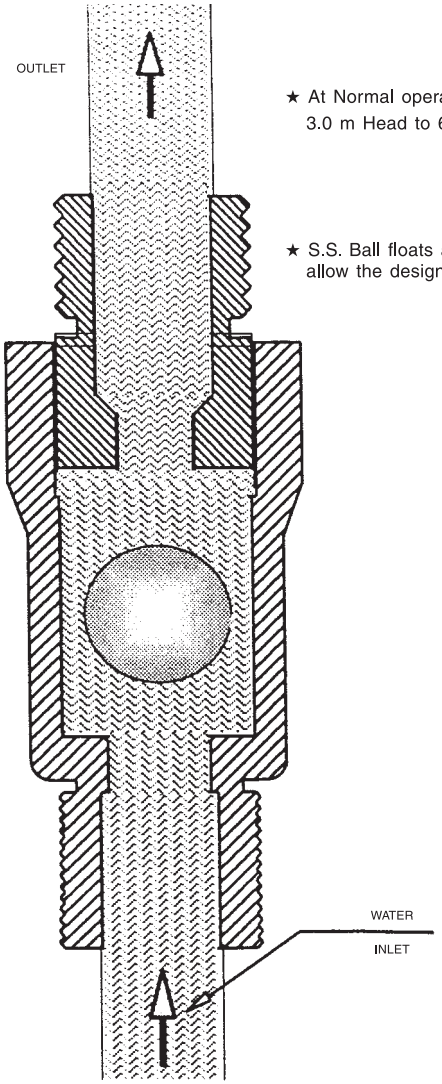
This arrangement is simple economical & free from tampering. As the insertion of this device may not be agreeable to the residents, the process of installation of this device needs to be accomplished tactfully.




WORKING CONDITION 1:
★ At Minimum operating pressure:
0.1 kgf (10 cm Head)
★ S.S Ball lifted up when flow enters
OUTLET
BUSH
NOTCH
SS BODY
SS BALL
WATER
INLET


FLOW CONTROL VALVE
(FOR HOUSE SERVICE CONNECTIONS)
SECTIONAL VIEW
OUTLET
BUSH
NOTCH
SS BODY
SS BALL
INLET

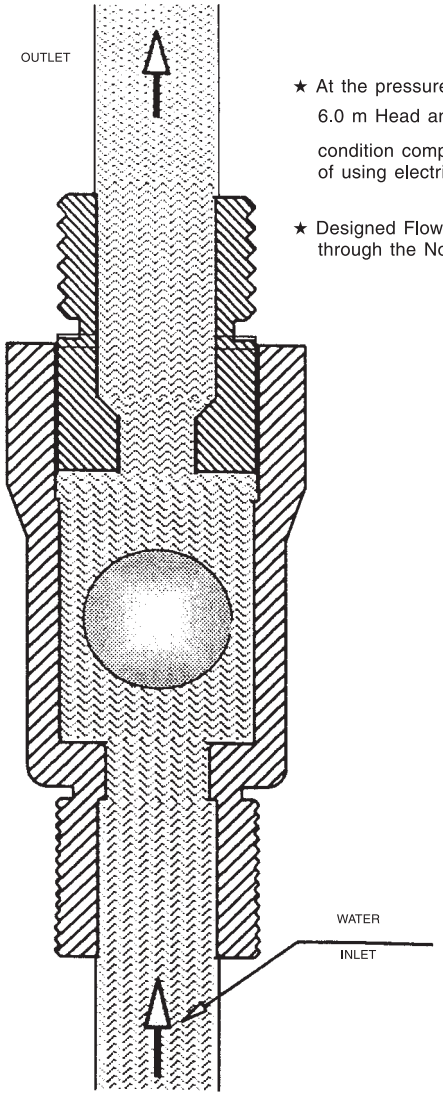
WORKING CONDITION 2:



★ At Normal operating pressure:
3.0 m Head to 6.0 Head

★ S.S. Ball floats at appropriate levels to allow the designed quantity of flow

WORKING CONDITION 3:

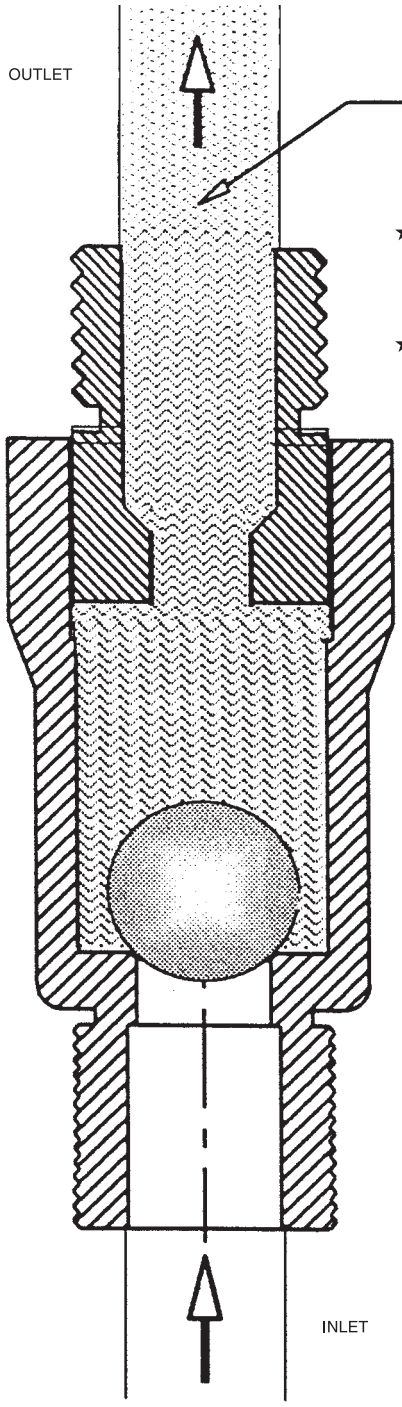


★ At the pressure Level:
6.0 m Head and above

condition comparable to situation of using electric suction motor

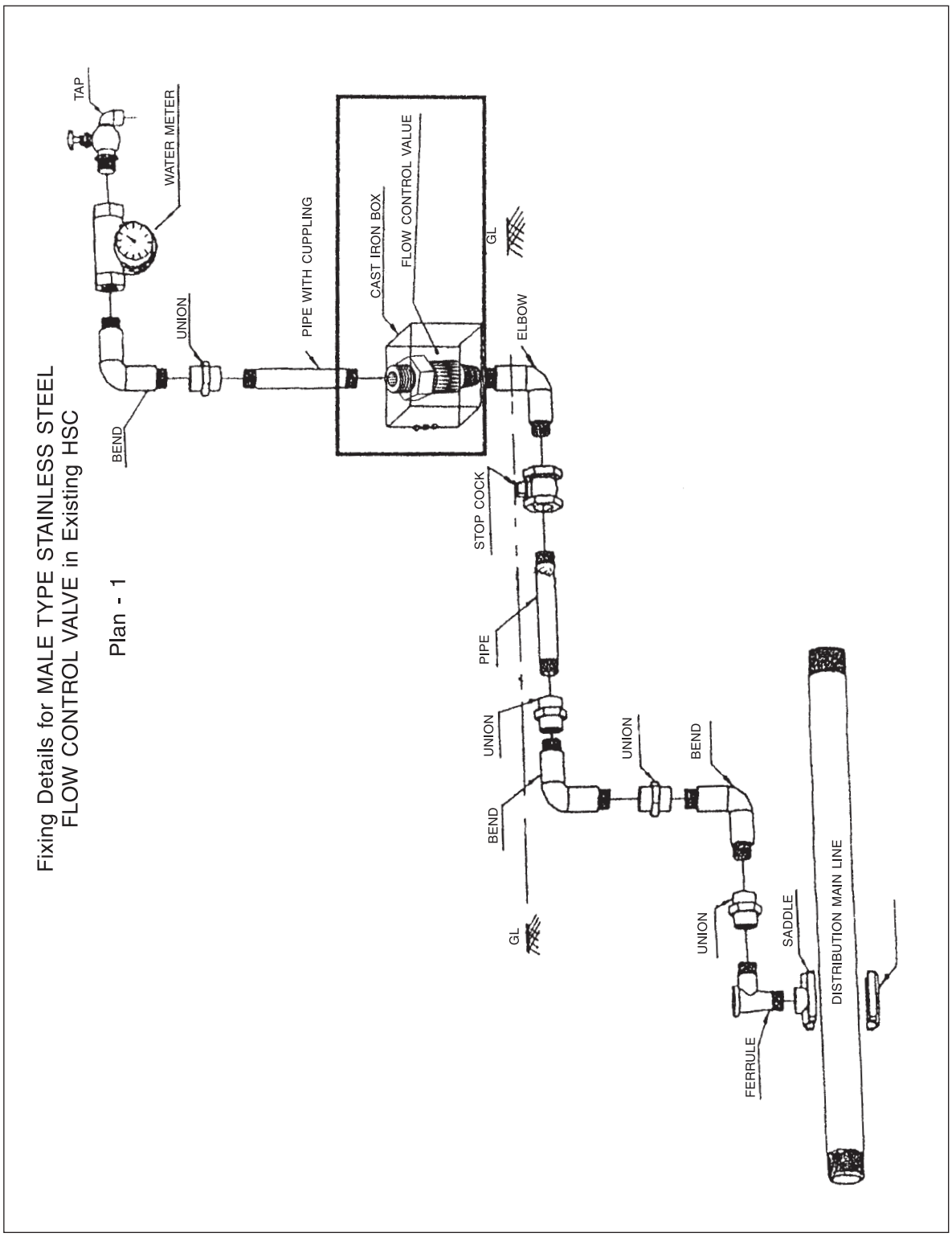
★ Designed Flow allowed only through the Notch

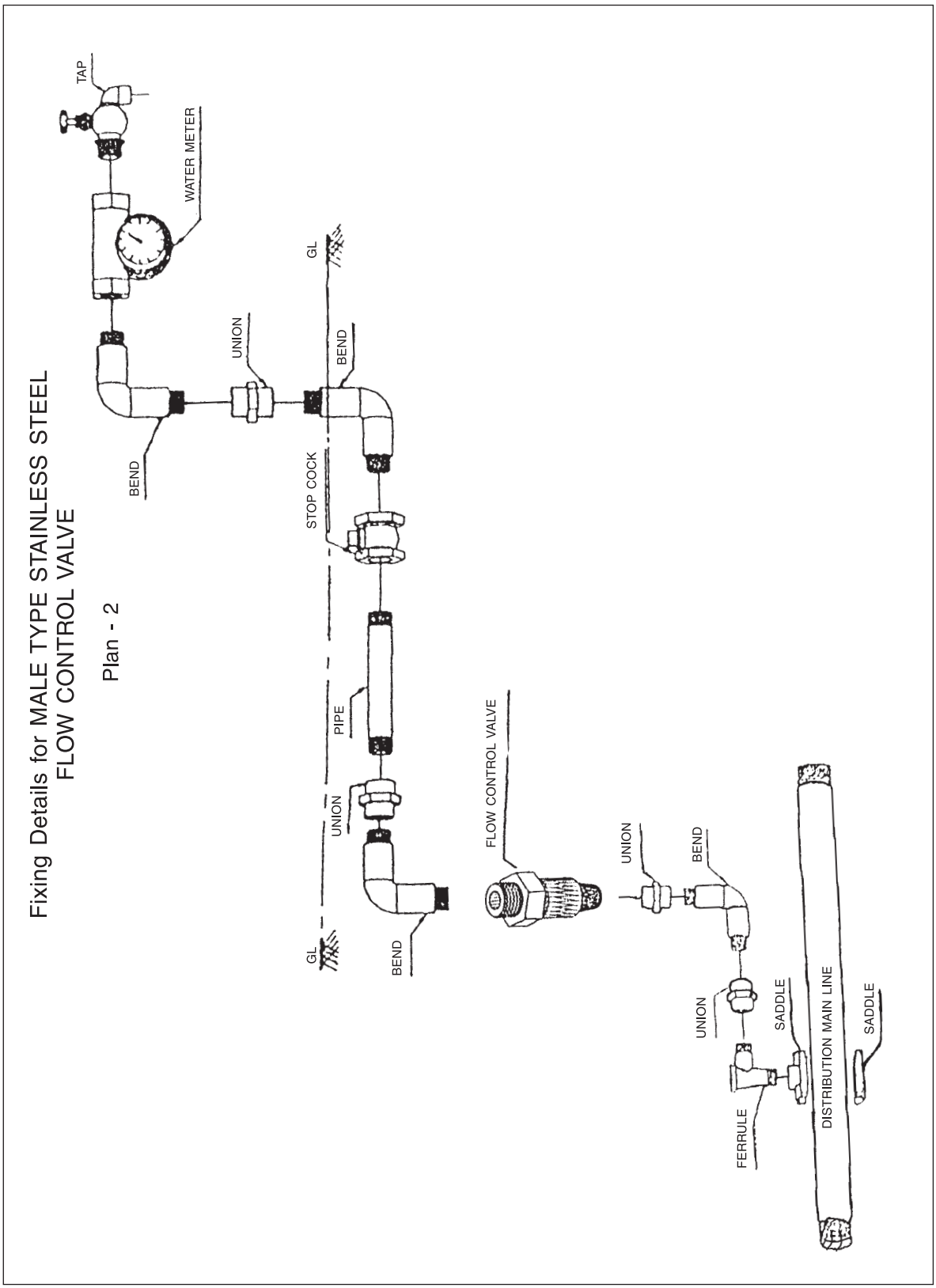
WORKING CONDITION 4:



★ Controls return flow from households with distribution closed

★ Functions as a non-return valve


Fixing Details for MALE TYPE STAINLESS STEEL
FLOW CONTROL VALVE in Existing HSC
Plan - 1
TAP
WATER METER
UNION
BEND
PIPE WITH CUPPLING
CAST IRON BOX
FLOW CONTROL VALUE
GL
ELBOW
STOP COCK
PIPE
UNION
BEND
GL
UNION
BEND
UNION
SADDLE
FERRULE
DISTRIBUTION MAIN LINE


Fixing Details for MALE TYPE STAINLESS STEEL
FLOW CONTROL VALVE
Plan - 2
TAP
WATER METER
BEND
UNION
GL
BEND
STOP COCK
PIPE
UNION
GL
BEND
FLOW CONTROL VALVE
UNION
BEND
UNION
SADDLE
FERRULE
DISTRIBUTION MAIN LINE
SADDLE

15.14 TRAINING

Training to the engineers should be conducted on the following aspects establishing new leakage district:

Monitoring leakage levels

Location of leakage using equipment such as leak noise correlator amplifiers and listening sticks.

Leak detection methods possible under the different condition.

15.15 ASSESSMENT OF UFW AFTER COMPLETION

After completion of all the improvements a review of the number and nature of complaints received before, during and after the project should be undertaken and may be tabulated (Table 15.2).

An independent survey is to be carried out on the consumers after completion of the UFW works and the consumers are to be surveyed to give their opinion on various categories of water supply, the duration of supply, the pressure available and the quality of water.

The over all assessment of these figures will give the impact of the UFW exercise.

15.16 BENEFITS OF WATER AUDIT AND LEAK DETECTION

Water audits and leak detection programmes can achieve substantial benefits, including the following :

(a) Reduced Water Losses

Water audit and leak detection are the necessary first steps in a leak repair programme. Repairing the leak will save money for the utility, including reduced power costs to deliver water and reduced chemical costs to treat water.

(b) Financial Improvement

A water audit and leak detection programme can increase revenues from customers who have been undercharged, lower the total cost of whole sale supplies and reduce treatment and pumping costs.

(c) Increased Knowledge of the Distribution System

During a water audit, distribution personnel become familiar with the distribution system, including the location of main and valves. This familiarity helps the utility to respond to emergencies such as main breaks.

(d) More Efficient Use of Existing Supplies

Reducing water losses helps in stretching existing supplies to meet increased needs. This could help defer the construction of new water facilities, such as new source, reservoir or treatment plants.

(e) Safeguarding Public Health and Property

Improved maintenance of a water distribution system helps to reduce the likelihood of property damage and safeguards public health and safety.

(f) Improved Public Relation

The public appreciates maintenance of the water supply system. Field teams doing the water audit and leak detection or repair and maintenance work provide visual assurance that the system is being maintained.

(g) Reduced Legal Liability

By protecting public property and health and providing detailed information about the distribution system, water audit and leaks detection help to protect the utility from expensive law suits.

15.17 LEAKAGE REPAIR TECHNIQUES

There are a number of different techniques for repairing pipes that leak. These techniques depend on the severity of leak, type of break in the pipe, the condition of the pipe and the pipe material.

A repair clamp to cover the defect.

A cut out of the defective section of pipe work/fittings & replacement with a short length of pipe.

Relay/Renewal of the whole or section of the pipe.

For more details, refer to Chapter 10 regarding Repairs of Pipelines.

15.17.1 LEAK REPAIR PROCEDURAL OVER VIEW

The first consideration will be site safety.

Notify the customer before the commencing the work.

Always locate other utilities before commencement of work.

Always allow a small flow of water to be maintained through the pipe line thus sustaining a positive pressure and reducing the risk of contamination.

Always ensure that the operatives excavate suitable sump hole below the pipe work to ensure no contamination enters the pipe.

TABLE 15.2

ANALYSIS OF COMPLAINTS RECEIVED IN THE DIVISION BEFORE AND AFTER THE UFW WORKS

		Nature of Complaint	
	Defective Water Supply	**Water Leak**	**Water pollution**
Division	2 months prior to work	2 months prior to work	2 months prior to work
Total No. of connections	Month prior to work	Month prior to work	Month prior to work
No. of connections tested	During work	During work	During work
Month/Year completed	Month after work	Month after work	Month after work
% of Division covered	2 months after work	2 months after work	2 months after work