WATER MANAGEMENT PROJECT

LEAK DETECTION IN A WATER DISTRIBUTION SYSTEM

A TRAINING/JOB MANUAL

BY

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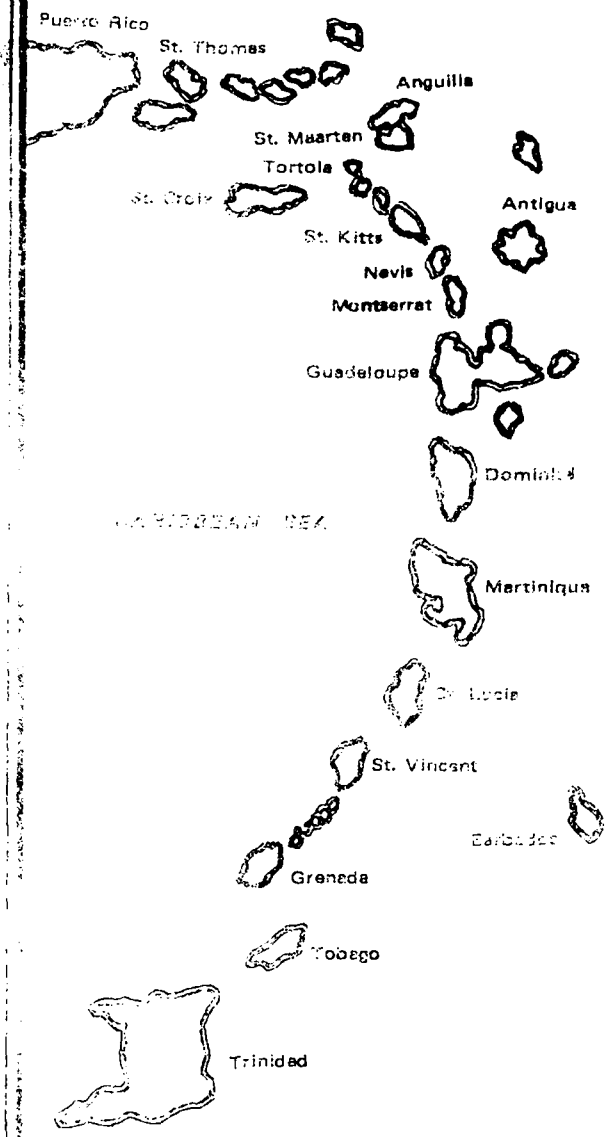
A JOINT-VENTURE PROJECT OF THE GOVERNMENTS OF

ANGUILLA, ANTIGUA, BRITISH VIRGIN ISLANDS, [illegible],
DOMINICA, GRENADA, MONTSERRAT, ST. KITTS/[illegible],
ST. LUCIA, ST. VINCENT, CANADA, UNITED KINGDOM,

AND

THE PAN AMERICAN HEALTH ORGANIZATION



JUNE 1979

CARIBBEAN BASIN WATER MANAGEMENT PROJECT

LEAK DETECTION IN A WATER DISTRIBUTION SYSTEM

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PREFACE

PURPOSE OF TRAINING/JOB MANUAL

MAINTAINING EFFECTIVE AND EFFICIENT ON-THE-JOB PERFORMANCE SHOULD BE THE AIM NOT ONLY OF EVERY SUPERVISOR AND FOREMAN BUT ALSO OF EVERY WORKER. FREQUENTLY SOME IMPROVEMENT IN PERFORMANCE IS NOTED AFTER TRAINING. OVER A PERIOD OF TIME, HOWEVER, PERFORMANCE OFTEN DECREASES TO, OR BELOW, THE ORIGINAL LEVEL. ONE WAY TO SET STANDARDS OF PERFORMANCE AND TO SUGGEST METHODS OF ATTAINING THAT PERFORMANCE IS TO PROVIDE A TRAINING/JOB (T/J) MANUAL WHICH CLEARLY STATES THE DESIRED PERFORMANCE AND SUGGESTS PROCEDURES FOR ATTAINING THIS LEVEL OF PERFORMANCE. THE FOLLOWING T/J MANUAL DOES JUST THIS.

HOW TO USE THE TRAINING/JOB MANUAL

THE MATERIALS THAT FOLLOW CAN BE USED IN A NUMBER OF WAYS, DEPENDING ON THE NATURE OF PERFORMANCE THAT NEEDS TO BE IMPROVED. IF THE TRAINEES ARE NEW TO THE SUBJECT MATTER, THE T/J MANUAL CAN BE USED IN A FORMAL TRAINING SYSTEM. THERE ARE DETAILED DESCRIPTIONS OF SUPPLIES AND MATERIALS AND TRAINING ACTIVITIES TO GUIDE THE TRAINER.

IN ANOTHER SITUATION, A SUPERVISOR, FOREMAN OR TRAINER REQUIRED TO DIAGNOSE PERFORMANCE DEFICIENCIES, CAN USE THE OPERATION BREAKDOWN SHEET AS A REFERENCE TO IDENTIFY THE AREA OF PERFORMANCE DEFICIENCY. HE CAN THEN CONCENTRATE TRAINING ON THIS PARTICULAR AREA BY USING THE APPROPRIATE SECTIONS OF THE T/J MANUAL AS A GUIDE.

WORKERS WHO ARE EAGER TO MOVE AHEAD IN ACQUIRING NEW KNOWLEDGE AND SKILLS COULD USE THE T/J MANUAL, ALONG WITH ASSISTANCE FROM FELLOW WORKERS WHO ARE KNOWLEDGEABLE IN THE SUBJECT AREA, TO STUDY THE MATERIAL ON THEIR OWN.

THE T/J MANUAL IS DESIGNED TO BE USED ON-THE-JOB AS A READY REFERENCE AS NEEDED. IN MANY CASES, JOB-AIDS CAN BE LIFTED FROM THE MANUAL AND POSTED DIRECTLY AT THE SITE WHERE THE PERFORMANCE IS TO TAKE PLACE. THEY WILL SERVE AS A CONSTANT REMINDER TO THE WORKER OF THE PROPER PROCEDURE FOR A TASK.

WHERE TO GET MORE INFORMATION

THIS T/J MANUAL IS ONE OF MANY BEING DEVELOPED BY THE CARIBBEAN BASIN WATER MANAGEMENT PROJECT TO IMPROVE THE PERFORMANCE OF PERSONNEL IN THE WATER UTILITIES OF THE EASTERN CARIBBEAN. MANUALS WILL BE DEVELOPED IN MANY ASPECTS OF WATER UTILITY OPERATION,MAINTENANCE, AND ADMINISTRATION. FOR MORE DETAILS ON MANUAL AVAILABILITY AND OTHER ASPECTS OF THIS PROJECT CONTACT:

ENG. NEIL. F. CAREFOOT, MANAGER
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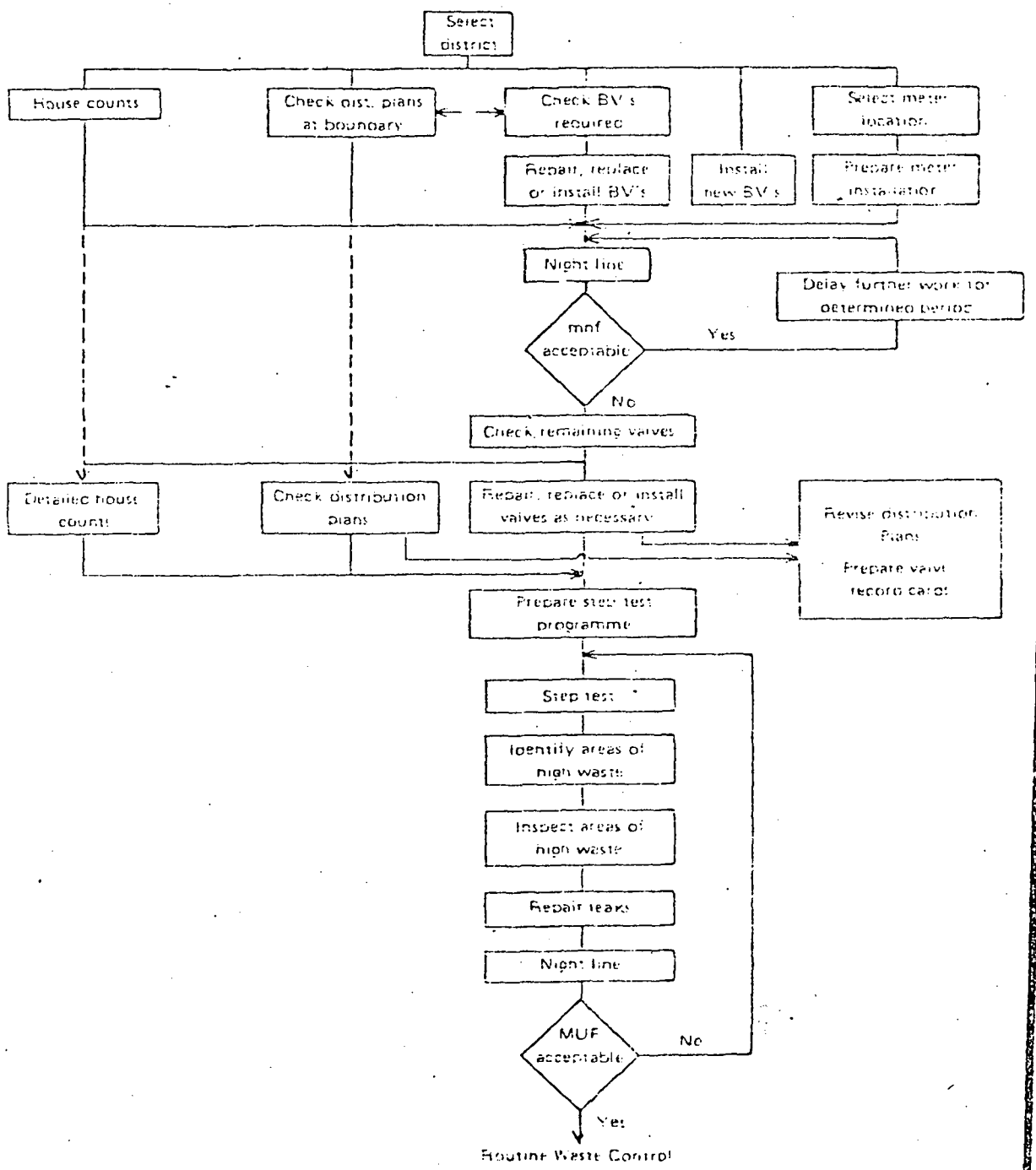


FLOW CHART FOR LEAK DETECTION IN A WATER DISTRIBUTION SYSTEM

INTRODUCTION

Every distribution system has leaks in it. These may be caused by a number of things: improper laying of system; poor workmanship when the pipes were connected; poor foundation on which pipe is laying; age; neglect, etc.

This waste or loss of potable water, can be as high as 50% of the total volume pumped. Such losses add to the cost of operating the system (.e.g. chemicals are lost, unnecessary energy is used for pumping, excess capacity is used) and possibly lead to an early and unnecessary expansion of pumping and treatment.

A leak detection programme is vital to the operation and maintenance of a distribution system. Such a programme, when properly utilized, will reduce losses and effectively minimize downtime and troubleshooting procedures.

This Manual will help achieve these objectives. Lessons include preparation of a district for detecting leakage; a "night line" programme which determines the amounts of water used, and a "step test" which determines how much water is lost in every individual street.

TRAINING/JOB MANUAL

Leak Detection in a Water Distribution System

UNIT

PREPARATION OF A DISTRICT FOR LEAK DETECTION

WHAT IS THIS UNIT ALL ABOUT?

This Unit deals with the preparation of a district or area, where it is intended to carry out a leak detection survey using either a leak detection meter on by-pass or a meter trailer.

WHY DOES THE TRAINEE NEED THIS?

In order to find leaks in a distribution system, the district or area must be defined and the district or area plans brought up to date. The record of the number and location of valves, hydrants and service connections must be complete and accurate before actual field work can begin.

The preparation process will update and complete the district plan. Preparation also includes all work which must be completed before the actual leak detection survey can be taken e.g., installing by-pass connections.

WHAT DOES THE TRAINEE NEED TO KNOW BEFORE BEGINNING?

The trainee should be able to:

1. Read a plan or drawing
2. Take field notes to update an area plan (e.g. completing list and location of valves, hydrants and (service connections) P.R.V's).
3. Excavate an area for the meter chamber, using jack hammers, shovels, picks,
4. Take accurate measurements in field using measuring tape.

WHAT EQUIPMENT AND SUPPLIES ARE NEEDED?

ITEMS	LESSONS						
	1	2	3	4	5	6	7
A plan of the District	x	x					
Note pad	x	x					x
Pencil	x	x					x
Chalk board	x		x				x
Valve tools		x			x		
Sounding Rods		x			x		
Valves - LH/RH		x		x	x	x	
Valve boxes LH/RH		x			x		
Measuring tape			x				
Working By-Pass Installation			x				
Compressor with pneumatic drill			x				
Shovels			x				
Pickaxes			x				
Drills			x				
Flange sockets				x		x	
Flange spigots				x		x	
Tees				x			
Bends				x			
Correct size pipe				x			
Meter				x			
Hydrants						x	
Tee (special)						x	
Collar						x	
Spanners					x	x	

WHAT SUPPLEMENTARY MATERIALS WILL HELP?

Technical Manual on Waste Detection Meter, Kent Meters Ltd., Mechanical Meter Division, Luton, Bedfordshire, England.

WHAT ARE THE OBJECTIVES?

The trainee will be able to?

1. Review a plan of a district.
2. (i) Determine and record the number of valves in the district - their location and operation.

   (ii) Count and record the number of services in the district.
3. Participate in the construction of a meter chamber.
4. Install by-pass connections on a main for leak detection meter.
5. Test by-pass joints for any leaks and return water flow to the district.
6. Install hydrants and valves to accommodate a meter trailer.
7. Develop a check list for the preparation of a district for leak detection.

NUMBER OF LESSONS AND TOTAL INSTRUCTIONAL TIME

Total Lessons: 7

Total time: 9 hours 30 minutes

TRAINING/JOB MANUAL	Leak Detection in a Water Distribution System
UNIT 1	Preparation of District for Leak Detection
LESSON 1	*REVIEWING A PLAN OF THE DISTRICT*
ESTIMATED TIME	30 minutes
PREREQUISITES	Recognize an engineering drawing or plan.

PERFORMANCE OBJECTIVES:

- The trainee will be able to:

  Review a plan of a district.

- Under the following condition:

  Given a sample form.

- To this standard:

  With total understanding and accuracy.

TRAINING RESOURCES

Equipment and Supplies:	Plan of a district, Chalk Board, Note-pads, Pencils.
Information Sheets:	U1:L1:IS:01, U1:L1:IS:02 U1:L1:IS:03

TRAINING ACTIVITIES

TRAINER ACTIVITY	TRAINEE ACTIVITY
1. Trainer questions trainees to find out if they know where the drawing office is located.	1. Trainees respond to questions.
2. Trainer and Trainee discuss "line" of person responsible for plans in the drawing office.	2. Discussion
3. Trainer distributes plan of district - See U1:L1:IS:02, and ask trainees to identify it as the district to be tested.	3. Trainees study plan and identify streets and other land-marks peculiar to the district.
4. Using U1:L1:IS:02 Trainer and Trainee discuss: (i) boundary of area to be tested for leaks. (ii) best location for leak detection meter. (iii) direction of water flow. (iv) location of valves; number and type of services.	4. Discussion
5. Trainer and trainee discuss final disposition of district plan, i.e., returning the plan and notes to the office.	5. Discussion with trainer.
6. Trainer reviews and discusses earlier activities using chalk board to list, write notes and illustrate.	6. Review and discuss.

OPERATION BREAKDOWN SHEET

POSITION: Plumber TASK: Preparation of District for Leak Detection

OPERATION: Reviewing Plan of the District

Important STEPS in the operation. STEP: a significant action which advances the operation towards completion.	KEY POINTS: the key to doing the steps correctly, efficiently or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
1. Get plan from Drawing Office or Superintendent. 2. Review plan.	1. Know where the drawing office is, and the person from whom he should get the plan. 2. See that plan is the one for the area to be checked, and that it is readable, showing all the lines, valves, names and numbers.

Selecting the area for the leak detection test is the first step in preparing a district. Selection is usually made by a distribution engineer. Besides size (which can vary from about 200 services to as large as 1000 services) there are several other factors which influence his decision.

One of these is the type of district - rural, urban, hotel or industrial. In a rural district for example, with perhaps 10 - 15 miles of mains feeding only a few houses, the size of the district may be limited by the time it would take a crew to travel to all the far-apart valves for their opening and closing.

Another consideration when selecting the area is the size of the leak detection meter to be used. The area should be small enough so that the night flow for that district should always register on the easily defined parts of the meter chart. It must never be allowed to run off the chart.

The choice of the boundaries of the district may also be influenced by:

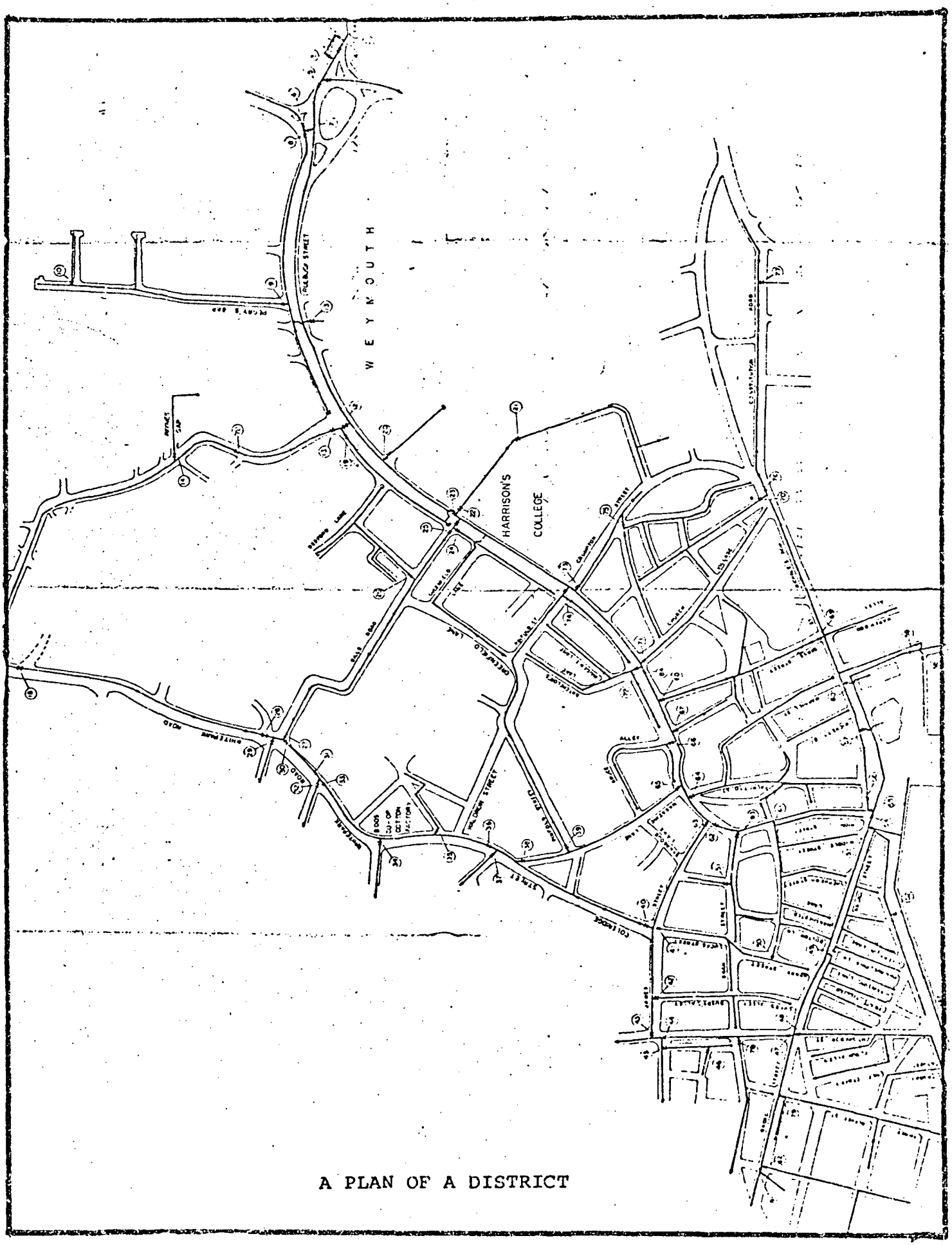
a) Service reservoirs contained within the area have to be valved off during the Test, resulting in loss of storage.

b) Pressure reducing valves.

c) The siting of meters such that several districts can be fed from the same meter.

d) Possible future development which may have to be included in the waste meter district.

e) Shape and size of the district.



A PLAN OF A DISTRICT

TRAINING/JOB MANUAL	Leak Detection in a Water Distribution System
UNIT 1	Preparation of District for Leak Detection.
LESSON 2 	*CHECKING THE NUMBER OF SERVICES AND VALVES IN DISTRICT, THEIR LOCATION AND OPERATION.*
ESTIMATED TIME	1 Hour
PREREQUISITES	Ability to read an area or district plan. Ability to recognize a service connection.

PERFORMANCE OBJECTIVE:

- The trainee will <u>be able to</u>:

  (*i*) *check and record the number of valves in the district and their location and operation.*

  (*ii*) *count and record the number of services in the district.*

- Under the following <u>condition</u>:

  Given standard procedures, required equipment and plan of the District/area.

- To this <u>standard</u>:

  (*i*) *all services and valves must be located and recorded.*

  (*ii*) *the operation and maintenance of all valves must be recorded.*

TRAINING RESOURCES:

Equipment & Supplies:	Plan of district, note pads, pencils, valve tool, LH and RH valves, valve box, sounding rod.
Information Sheets:	U1:L2:IS:01, U1:L2:IS:02, U1:L2:IS:03, U1:L2:IS:04, U1:L2:IS:05.

TRAINING ACTIVITIES

TRAINER ACTIVITY	TRAINEE ACTIVITIES
1. Brief review of activity 4 in lesson 1. Discuss purpose of this lesson. Refer to U1:L2:IS:03.	1. Discussion
2. Distribute and discuss forms and method of recording information U1:L2:IS:02.	2. Read and discuss.
3. Using O.B sheet U1:L2:IS:01 discuss and explain all procedures for checking valves and services in the district.	3. Discussion
4. Trainer explains how to differentiate between a LH and RH operated valve, by observing the cover, and gives trainees practice in identifying and operating LH and RH valves. Refer to U1:L2:IS:01	4. Trainees listen, observe, participate and take notes.
5. Trainer explains, demonstrates and allows trainees to practice the sounding and throttling of valves. Refer to U1:L2:IS:02-05	5. Trainees listen, participate and take notes of the procedures.
6. Trainer and trainees review the lesson and discuss the update information that should be presented to the Drawing Office.	6. Discussion.

OPERATION BREAKDOWN SHEET

U1:L2:IS:01

POSITION Plumber TASK Preparation of District for Leak Detection

OPERATION Checking the number of valves in the district - their location and operation

Important STEPS in the operation. STEP: A significant action which advances the operation towards completion	KEY POINTS: The key to doing the steps correctly, efficiently and accurately.
HOW HE DOES IT (STEP)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
1. Get plan of district from drawing office.	1. Contact person in charge or person who will get drawing.
2. Proceed to district.	
3. Determine location of valve in field.	3.1 Check plan for location of valve and verify location in the district.
	3.2 Record location information on plans or in notebook. Give number to valve if it does not already have one.
	3.3 Check at intersections of streets if no valve is shown to ensure that there is actually no valve.
	3.4 Record any discrepancies between plan and actual field situation.
4.1 Determine operation of each val valve.	4.1 Use either valve box key or bar to valve key and lift valve cover.
4.2 Open valve box and insert valve key.	4.2. Key must fit valve stem to operate (open or close) valve.
4.3 Check if valve is right hand or left hand.	4.3 If valve cover is round, valve closes by turning spindle to the left. If valve cover is square, valve closes by turning spindle to the right. Record on plan or notebook. A round in a round - to the left. A round in a square - to the right.

OPERATION BREAKDOWN SHEET

POSITION Plumber TASK Preparation of District for Leak Detection

OPERATION Checking the number of valves in the district - their location and operation.

important STEPS in the Operation STEP: A significant action which advances the operation towards completion.	KEY POINTS: The key to doing the steps correctly, efficiently, or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
4.4 Check if valve is open or closed.	4.4 Use sounding rod, insert point of rod into hole for valve key. Place ear against other end of rod and listen. (i) If no sound, valve is closed (ii) If sound, valve is leaking through.
4.5 Check if valve is throttled.	4.5 If valve is open, correct number of turns required to close valve. Then reverse turning and fully open valve, counting number of turns again. If same number of turns are counted when opening valve as when closing valve, then valve was not throttled.
5. Check condition of valve chamber and valve.	5. (i) Does valve have correct cover? (ii) Is cover visible? Record. (iii) Is cover missing? Record. (iv) Is valve chamber clean? Free of rocks, pebbles, debris? Record. (v) Close valve again. Use sounding rod as in 4.4. If sound persists, valve needs repair. Record. See U1:L2:IS:02.

OPERATION BREAKDOWN SHEET

POSITION *Plumber* TASK *Preparation of District for Leak Detection*

OPERATION *Checking the number of services and valves in the district - their location and operation.*

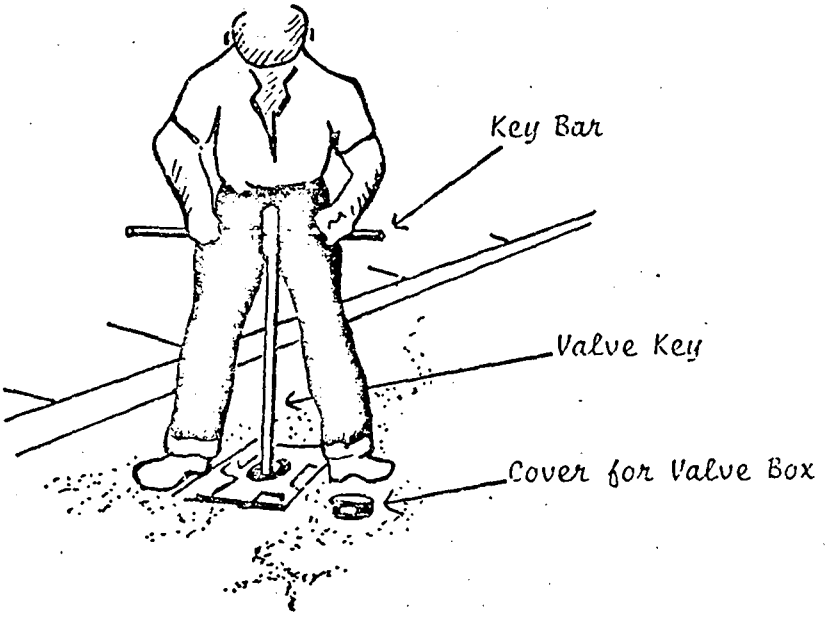
Important STEPS in the Operation STEP: A significant action which advances the operation towards completion.	KEY POINTS: The key to doing the steps correctly, efficiently, or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
6. *Count number of services in district.*	6.1 *Recognise a service connection and where the stopcocks are located.* 6.2 *Find the houses with service connections.* 6.3 *Record separately the domestic supplies, standposts, hotels, factories etc.* 6.4 *Record the number of services between valves.*
7. *Return plan and notes to Superintendent in charge of leak detection.*	7.1 *Discuss plan and notes with Supervisor. Tell him of changes to the master drawing of the district or request that such changes be made.* 7.2 *Transfer any changes to the master drawing of the district or request that such changes be made by Drawing office.*

The Waterworks Department
The Pine
St. Michael. Barbados

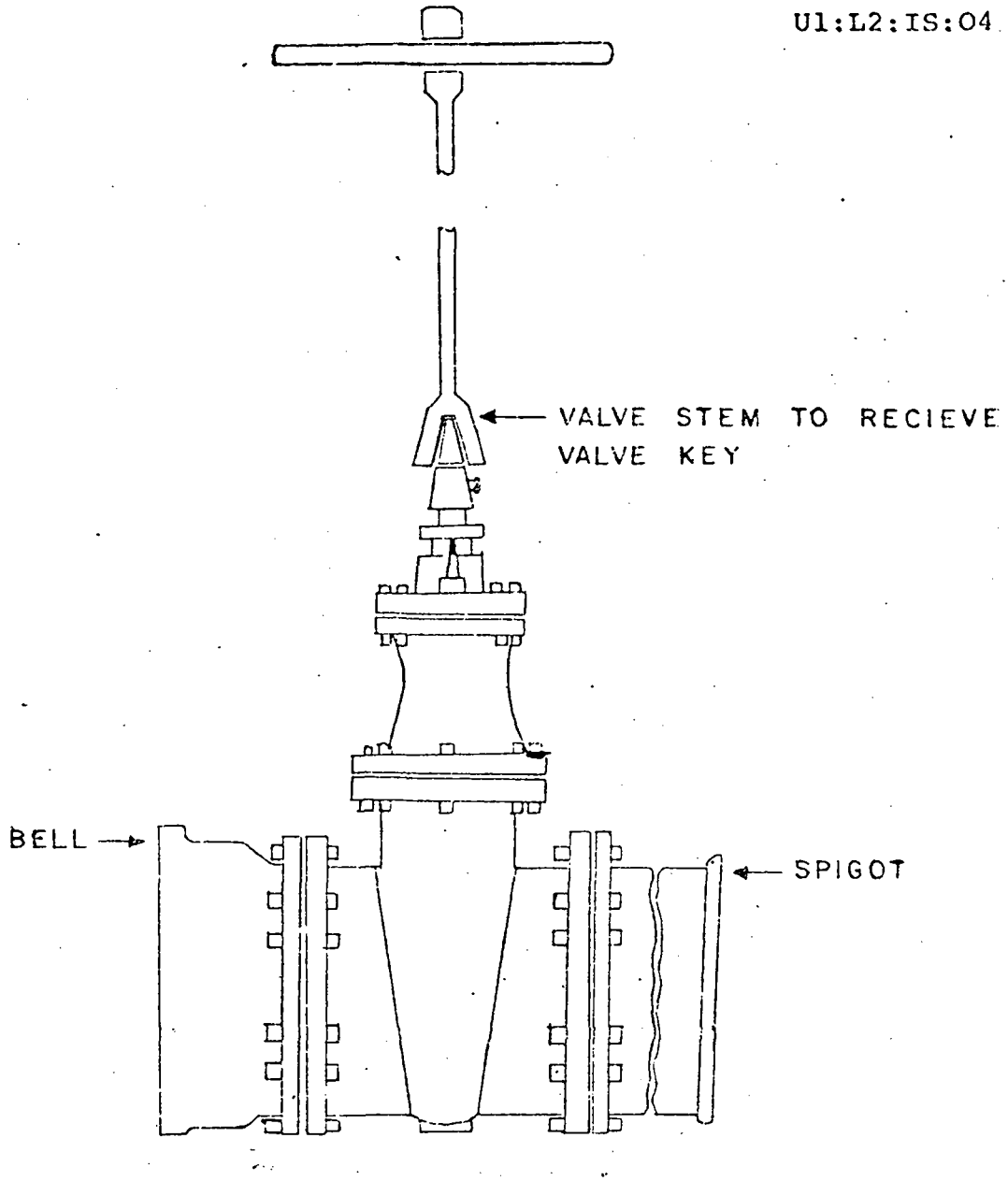
Waste Control Project
Valve Survey

District

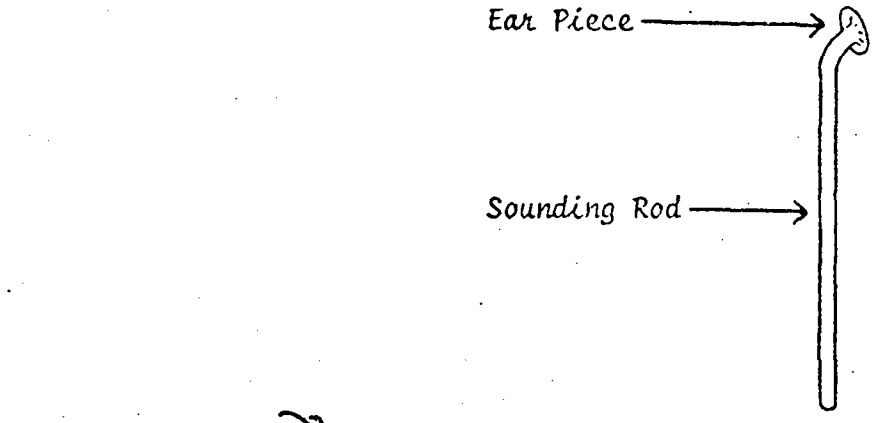
Valve Ref	Location	Size	LH/RH	Box LH/RH	Normally O/C	As on Plan	Box Visible	Box Lid Present	Chamber Clean	Valve Operable	Valve Leaking	Valve Drop Tight	Remarks



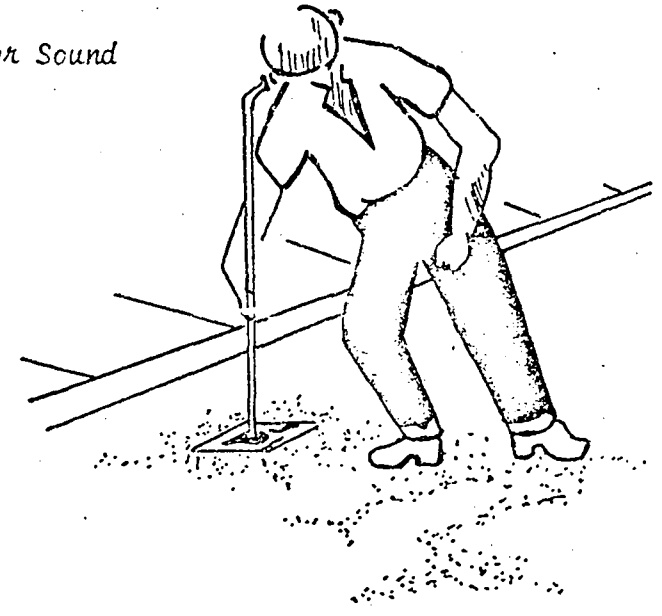
USING VALVE KEY TO OPEN OR CLOSE VALVE



TYPICAL DISTRIBUTION SYSTEM VALVE



Listening for Sound



USING SOUNDING ROD TO SOUND VALVE

TRAINING/JOB MANUAL	Leak Detection in a Water Distribution System
UNIT 1	Preparation of District for Leak Detection
LESSON 3	*INSTALLING BY-PASS CONNECTIONS ON MAIN FOR LEAK DETECTION METER*
ESTIMATED TIME	3 hours
PREREQUISITES	Ability to use measuring tape, to excavate, to install piping and make connections. Ability to construct a meter chamber.

PERFORMANCE OBJECTIVES:

- The trainee will be able to:

  install by-pass connections on main for leak detection meter.

- Under the following condition:

  given correct tools and size of pipe, three (3) valves, flange sockets and spigots, two (2) tees, two (2) bends and meter.

- To this standard:

  must be in keeping with standard procedures outlined. No leaks should occur at connections. Flanges should be correct distance apart to allow installation of meter between them, and allow bolting of meter flanges to pipe flanges. Meter chamber should be correct size to allow workmen enough room to make necessary adjustments for leak detection meter.

TRAINING RESOURCES

Equipment and Supplies:	Excavated are, correct tools and size of pipe, valves, flange sockets and spigots, too tees, two bends, and meter.
Information Sheets:	U1:L3:IS:01, U1:L3:IS:02, U1:L3:IS:03, U1:L3:IS:03, U1:L3:IS:05.

TRAINING ACTIVITIES

TRAINER ACTIVITY	TRAINEE ACTIVITY
1. Read and discuss with trainees all the steps on the operation Breakdown Sheet (U1:L3:IS:01).	1. Discuss procedures with trainer.
NOTE: Some of the steps involve activities that must be done prior to the actual installation of the By-pass connection. It is important that the trainees know the sequence of these events in relation to the installation of the By-pass connection.	
2. Demonstrate and have trainees practice those steps which need practice.	2. Practice operation steps under supervision of trainer.
NOTE: Some activities may possibly be practiced in the classroom if sample equipment is available. If all practice is to be done in the field, it may be necessary to have the prerequisite activities such as, excavating the area, done prior to the arrival of the trainees at the practice field site.	

OPERATION BREAKDOWN SHEET

U1:L3:IS:01

POSITION Plumber TASK Preparation of District for Leak Detection

OPERATION Installing by-pass connections on main for leak Detection Meter

Important STEPS in the operation. STEP: A significant action which advances the operation towards completion	KEY POINTS: The key to doing the steps correctly, efficiently and accurately.
HOW HE DOES IT (STEP)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
1. Select and measure area to be excavated.	1.1 Select location which does not seriously affect traffic flow. 1.2 Length to be measured includes: (i) Length of meter. (ii) Length of pipe between meter and bend. N B: The length of pipe between meter and bend should be ten times the diameter of pipe to be used. (iii) Length of valve and flanges. (iv) Plus an extra two feet on either side. Add to get total length. 1.3 Width to be measured includes: (i) Length of the bends. (ii) Length of pipe between valve and bend. (iii) The length of the valve, spigots and sockets. (iv) Plus an extra two feet on either side. Add to get the total width.

POSITION Plumber TASK Preparation of District for Leak Detection

OPERATION Installing by-pass connections on main for leak Detection Meter

Important STEPS in the operation. STEP: A significant action which advances the operation towards completion	KEY POINTS: The key to doing the steps correctly, efficiently and accurately.
HOW HE DOES IT (STEP)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
2. Excavate the area.	2.1 Use compressor with pneumatic drill and shovels, or pickaxes, drills and shovels. 2.2 The depth depends on the depth of the main pipe. Go below the depth of the pipe to facilitate the installation of meter connections. N.B: Do not puncture the water main during the excavation. Avoid electric and other cables in the vacinity. Where there are under ground cables/mains of other utility companies viz, - telephone, electric or gas - they should be notified before hand.
3. Inform sonsumers in the area to be shut off.	3.1 If the affected area is small personal notification can be made from house to house. 3.2 In large areas, it may be necessary to inform consumers by means of a radio bulletin or the press. 3.3 Radio notices should be given the day before the work is to be done as well as the morning of the work.

OPERATION BREAKDOWN SHEET U1:L3:IS:01 cont'd

POSITION Plumber TASK Preparation of District for Leak Detection

OPERATION Installing by-pass connections on main for leak Detection Meter

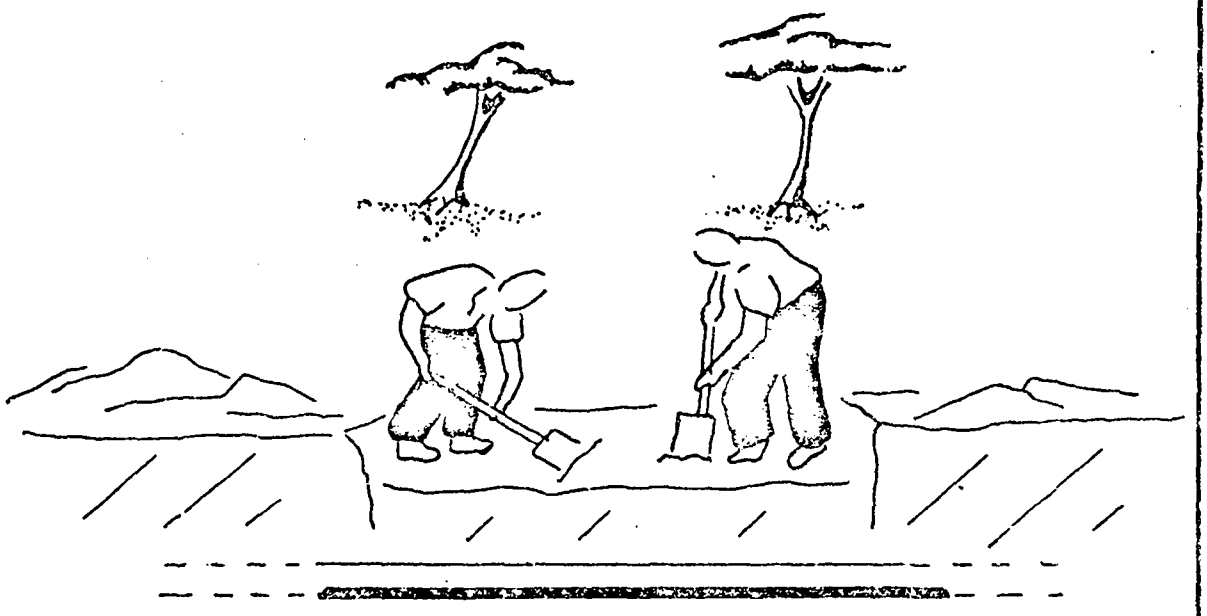
Important STEPS in the operation. STEP: A significant action which advances the operation towards completion	KEY POINTS: The key to doing the steps correctly, efficiently and accurately.
HOW HE DOES IT (STEP)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
4. Shut off water from main to be cut.	4.1 If cover is round in a round valve turn to left. If round in a square valve turn to right. 4.2 Open valve box, with lifting key or bar, and close valve. 4.3 Check whether valve is fully opened or trottled and make a note. 4.4 Sound valve to make sure it is fully closed.
5. Measure length of pipe to be cut.	5.1 Length includes: length of meter, length of pipe between meter and bend - this should be ten times the diameter of pipe to be used - and length of two flange spigots and bends.
6. Cut pipe vertically.	6.1 Use proper size pipe cutter. 6.2 Do not leave any burrs on pipe.
7. Install one valve and 2 branches or tees as required by size of meter to be installed. 8. Install the two valves one on each tee.	7.1 Tighten bolts diagnonally opposite each other. Refer to U1:L3:IS:03.

OPERATION BREAKDOWN SHEET U1:L3:IS:01 cont'd

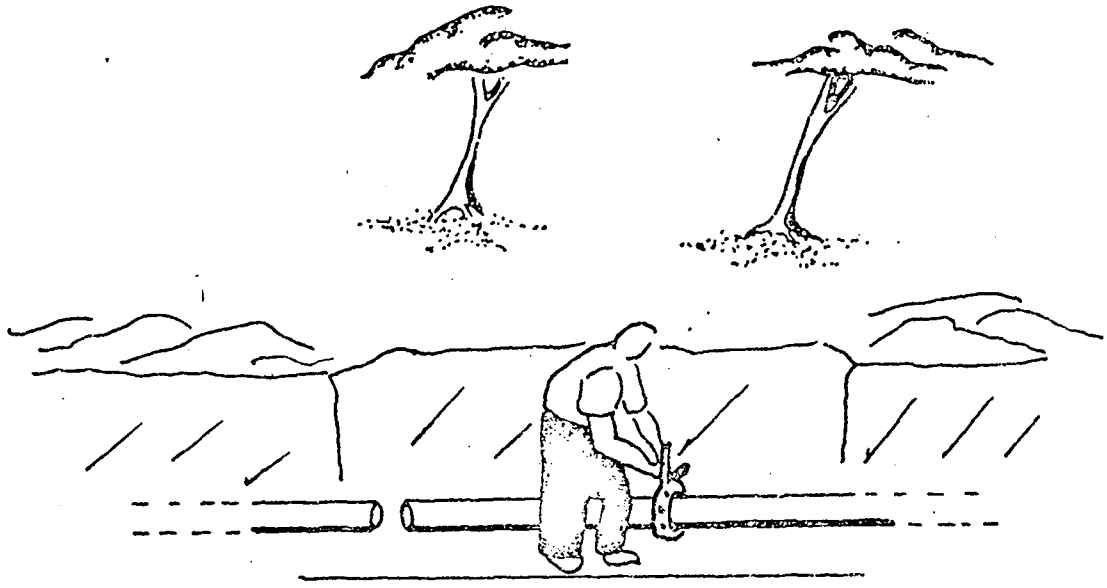
POSITION: Plumber TASK: Preparation of District for Leak Detection

OPERATION: Installing by-pass connections on main for Leak Detection Meter

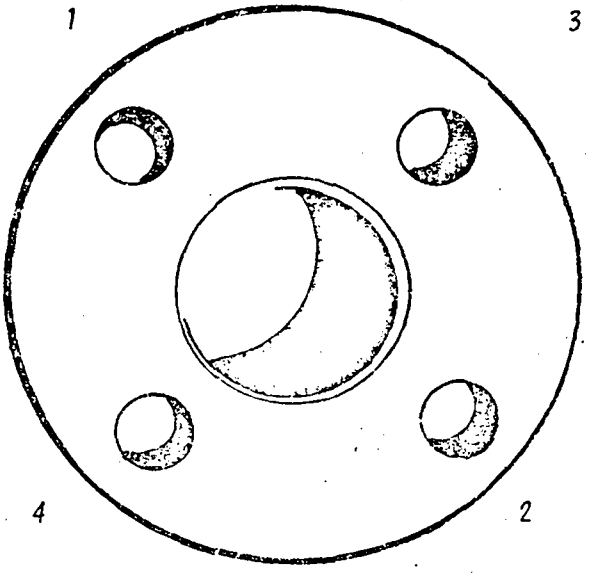
Important STEPS in the operation. STEP: a significant action which advances the operation towards completion.	KEY POINTS: the key to doing the steps correctly, efficiently or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
9. Cut two (2) pieces of pipe to required length to fit between bend and valve sockets on tee.	
10. Fit cut pieces of pipes into flange sockets of valves.	
11. Fit bends into pipe.	
12. Cut two pieces of pipe to fit between bend and meter, excluding the flange sockets.	12. The length of pipe should be ten (10) times the diameter of the pipe to be used.
13. Fit pipes into bends.	
14. Fit flange sockets onto pipes.	
15. Fits meter.	15. Tighten bolts in sequence.



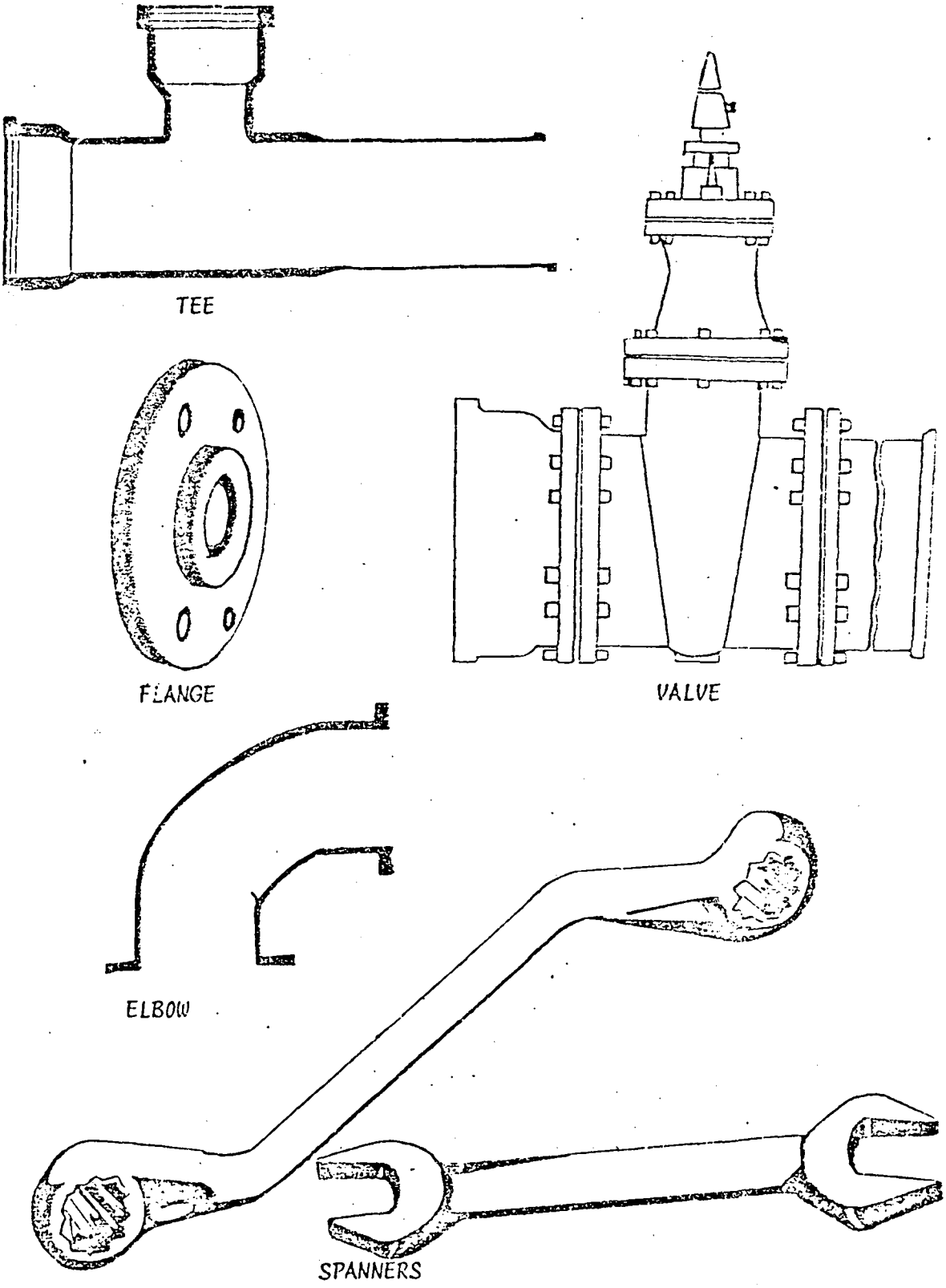
EXCAVATING AREA



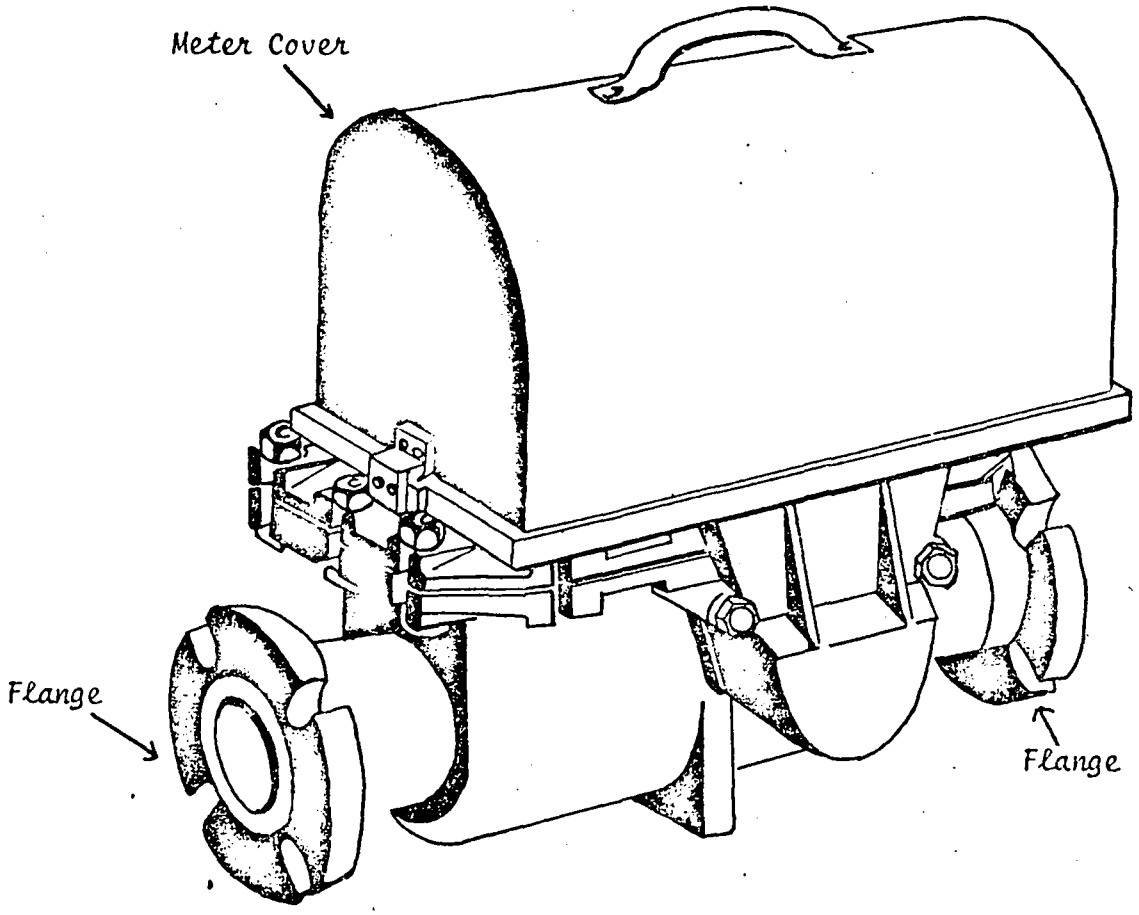
CUTTING PIPE TO INSTALL CONNECTIONS



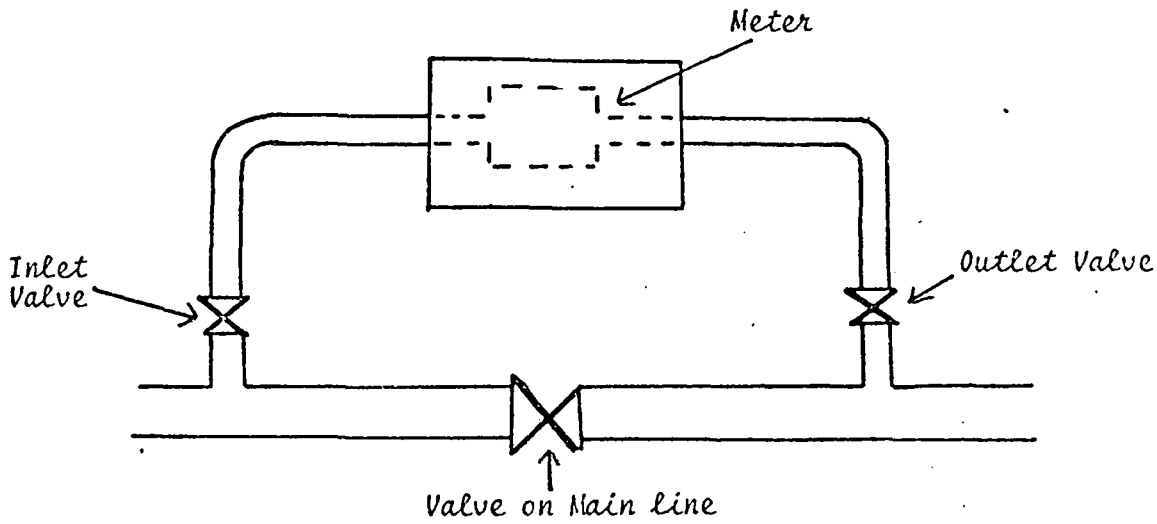
SEQUENCE FOR TIGHTENING BOLTS



FITTINGS AND TOOLS USED DURING INSTALLATION OF METER CONNECTIONS



LEAK DETECTION METER



BY-PASS INSTALLATION

TRAINING/JOB MANUAL — Leak Detection in a Water Distribution System

UNIT 1 — Preparation of District for Leak Detection

LESSON 4 — *TESTING BY-PASS INSTALLATION JOINTS FOR LEAKS AND RETURNING WATER TO THE ORIGINAL DISTRIBUTION LINE*

ESTIMATED TIME — 30 minutes

PREREQUISITES — Complete by-pass installation and connections to main feed line

PERFORMANCE OBJECTIVES:

- The trainee will be able to:

  test by-pass joints for any water leaks and return water flow to the original distribution line.

- Under the following conditions:

  open valve on main line to allow water into branches, and allow water to the original distribution line.

- To this standard:

  i) *that no water leaks from the joints of the all pipe connections.*

  ii) *that consumers are supplied again with pressure and flow as before.*

TRAINING RESOURCES

Equipment and Supplies: A working by-pass installation

Information Sheet: U1:L4:IS:01

TRAINING ACTIVITIES

TRAINER ACTIVITY	TRAINEE ACTIVITY
1. Trainer explains and demonstrates the sequence of steps for testing a by-pass installation. See U1:L4:IS:01 & U1:L3:IS:06.	1. Trainees listen, discuss and participate.
2. Trainer explains and demonstrates the opening and closing of the valve on the main line.	2. Trainees listen, discuss and participate.
3. Trainer explains and demonstrates the closing of the valves on the pipe branches, and the opening of the main line valve.	3. Trainees listen, discuss and participate.
4. Trainer invites individual trainees to explain and demonstrate the procedures.	4. Trainees explain and demonstrate the procedures under the guidance of the trainer.

OPERATION BREAKDOWN SHEET

POSITION: Plumber TASK: Preparation of District for Leak Detection

OPERATION: Testing By-Pass installation for leaks and returning water flow to original distribution line

Important STEPS in the operation. STEP: a significant action which advances the operation towards completion.	KEY POINTS: the key to doing the steps correctly, efficiently or accurately.
HOW HE DOES IT (Step)	**POINTERS TO BE OBSERVED IN PERFORMING THE STEP**
1. Open 2 valves on pipe branches.	1. Open valves using valve key. Turn key until valve is fully open. Water can now enter pipe branches as far as blank flanges.
2. Open valve on main line.	2. Remove valve cover. Use valve key and turn to open valve.
3. Check all joints from main line to blank flange, including tee, valves, elbows, pipe.	3. Joints should not leak. Allow water pressure in line for 20 - 30 minutes.
4. If no leaks, close main valve.	4. Use valve key and turn until valve is completely shut. Use sounding rod to verify that valve is shut. (See unit 1 lesson 2 for use of sounding rod.
5. Close valves on pipe branches for meter.	5. Closed valves will not allow water to flow into meter.
6. Open main line valve :	6. Remove valve cover, insert valve key and turn to right or left as required. NOTE: If valve was throttled, only open valve by same number of turns used when valve was closed. Otherwise, pressure and flow imbalance will result.

TRAINING/JOB MANUAL	Leak Detection in a Water Distribution System
UNIT 1	Preparation of A District for Leak Detection
LESSON 5	*CONSTRUCTION OF A METER CHAMBER*
ESTIMATED TIME	30 minutes
PREREQUISITES	Ability to use and operate the listed equipment

PERFORMANCE OBJECTIVES:

The trainee will be able to:

participate in the construction of a meter chamber

Under the following condition:

given the equipment listed in equipment and supplies

To this standard:

size of chamber must be convenient for installing by-pass meter and must be strong enough to support the weight of vehicular traffic.

TRAINING RESOURCES

Equipment and Supplies;	Measuring tape, compressor with pneumatic drills, shovels, pickaxes, drills, cement, concrete, wood, nails, hammer and masonary tools.
Information Sheet	U1:L5:IS:01, U1:L5:IS:02.

TRAINING ACTIVITIES

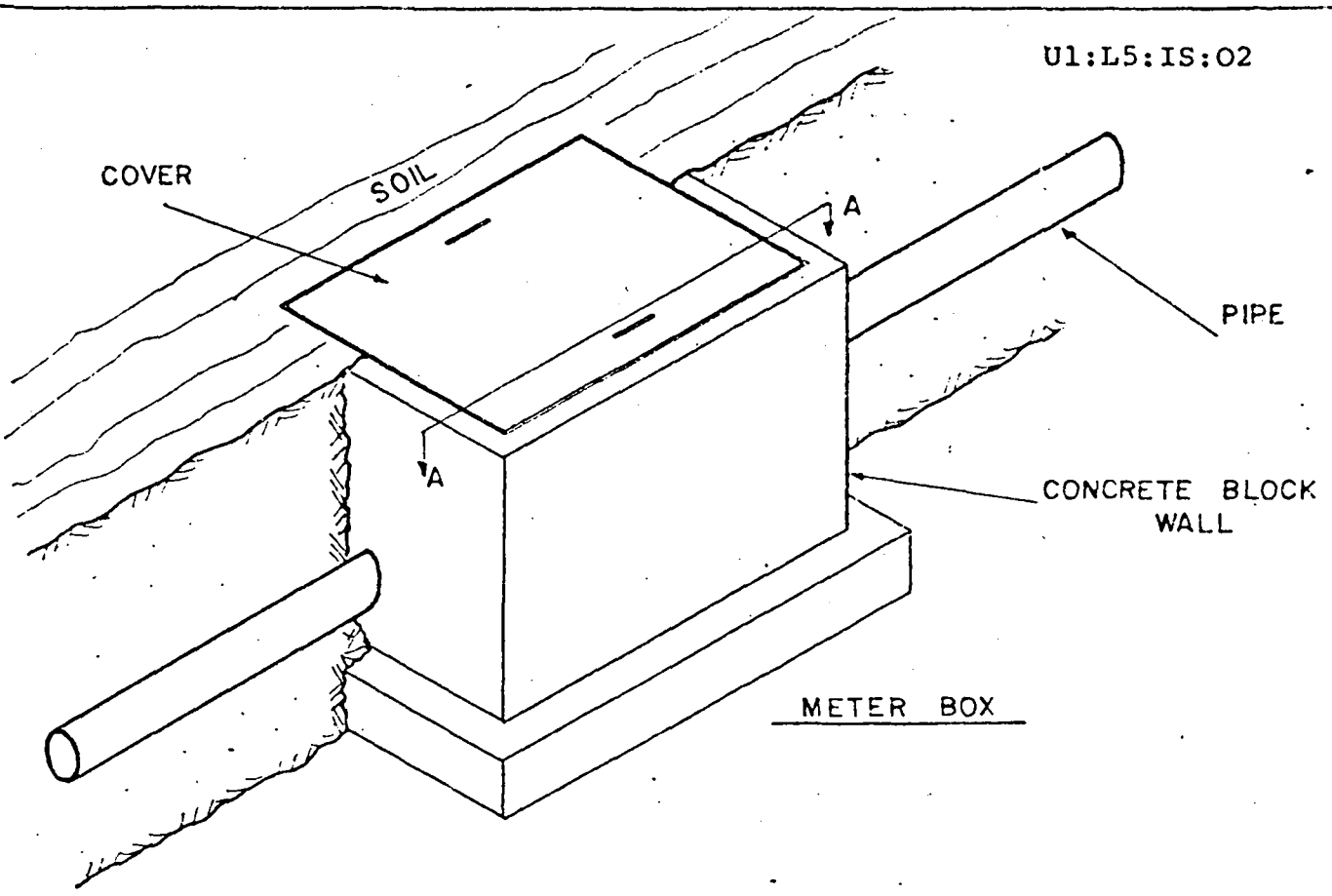
TRAINER ACTIVITY	TRAINEE ACTIVITY
1. Trainer/trainee discuss and list factors which determine selection of site - Refer to lesson 1, Activity 4.	1. Discussion.
2. Trainer explains, with the use of illustrations, the procedure for completing the chamber. Refer to U1:L5:IS:01.	2. Trainees discuss procedure with trainer.
3. Trainer distributes and discusses drawing of a completed chamber. Refer to U1:L5:IS:02.	3. Trainees study and discuss the drawing with the trainer.

OPERATION BREAKDOWN SHEET U1:L5:IS:01

POSITION Plumber TASK Preparation of District for Leak Detection

OPERATION Construction of a Meter chamber for By-pass Meter

Important STEPS in the operation. STEP: A significant action which advances the operation towards completion	KEY POINTS: The key to doing the steps correctly, efficiently and accurately.
HOW HE DOES IT (STEP)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
1. Construct chamber.	1.1 Build sides of the chamber with concrete and/or reinforced concrete. 1.2 Make sure that the foundation is reliable and the sides are "plumb". 1.3 Leave recess on the height to accommodate chamber cover. 1.4 Leave a manhole big enough to accommodate chamber cover.
2. Construct cover for meter chamber.	2.1 Use 2" x 8" boards. 2.2 Cut to width of cover. 2.3 Cover must be flush with ground surface.
3. Back-fill the excavated area outside of the chamber.	3.1 Must be flush with surrounding ground surface. 3.2 Ram filling if it is necessary.



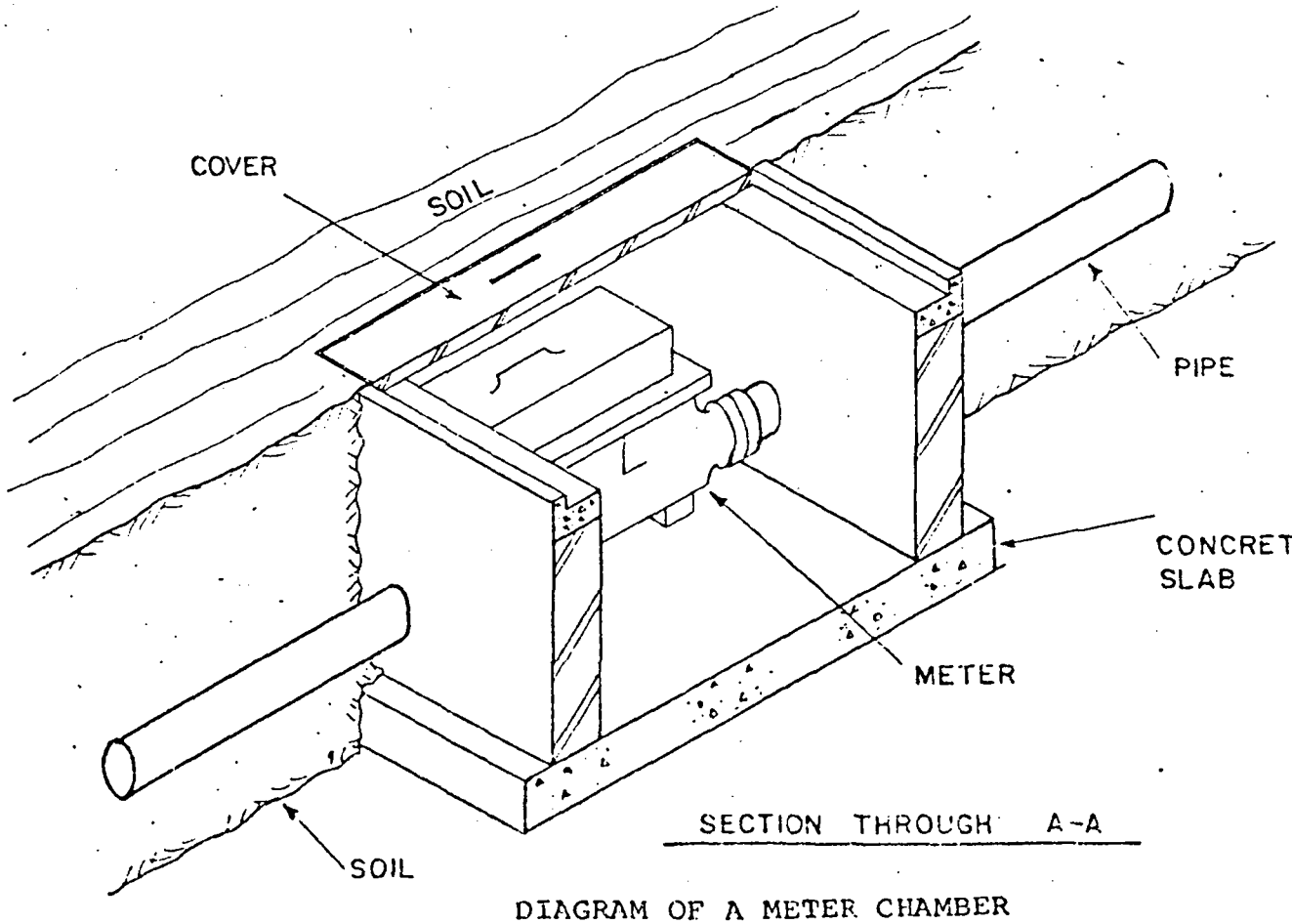


DIAGRAM OF A METER CHAMBER

TRAINING/JOB MANUAL	Leak Detection in a Water Distribution System
UNIT 1	Preparation of District for Leak Detection
LESSON 6	*INSTALLING TWO HYDRANTS AND VALVES TO ACCOMMODATE A METER TRAILER*
ESTIMATED TIME	3 Hours
PREREQUISITES	Senior Plumber or Plumber with 5 years experience

PERFORMANCE OBJECTIVE:

- The trainee will <u>be able to:</u>

  Install hydrants and valves to accommodate a meter trailer.

- Under the following <u>condition</u>:

  Given valves, two hydrants, two hydrant (tee specials) valve spigot, valve socket, collar, spanners.

- To this <u>standard</u>:

  In accordance with standard procedure.

TRAINING RESOURCES

Equipment and Supplies: Valves, Flange,spigot, Flange socket, Hydrants, Tees (special) Collar, Spanners.

Information Sheets: U1:L6:IS:01, U1:L6:IS:02, U1:L6:IS:03

<u>Note</u>: If this lesson is not taught in the field all equipment should be made available in the classroom.

TRAINING ACTIVITIES

TRAINER ACTIVITY	TRAINEE ACTIVITY
1. Read and discuss the sequence of events in the Operation Breakdown Sheet (U1:L6:IS:01) with the trainees. Also refer to installations U1:L6:IS:02 and 03.	1. Discuss sequence of operation steps with trainer.
NOTE: The first 7 steps in the operation have been dealt with in previous lessons. They are included here because they are prerequisites to the main section of this lesson (installing two hydrants and valves) which begins with Step 7.	
NOTE: Trainees should be made aware that this operation is suitable to accommodate a meter trailer.	
2. Demonstrate and have trainees practice those steps which need practice.	2. Practice operation steps under supervision of trainer.
NOTE: Some activities may be practiced in the classroom if sample equipment is available. If all practice is to be done in the field, it may be necessary to have the prerequisite activities such as, excavating the area, and notifying the consumers etc., done prior to the arrival of the trainees at the practice field site.	

U1:L6:IS:01

OPERATION BREAKDOWN SHEET

POSITION: Plumber TASK: Preparation of District for Leak Detection

OPERATION: Installing hydrant and valve to accommodate a meter trailer

Important STEPS in the operation. STEP: a significant action which advances the operation towards completion.	KEY POINTS: the key to doing the steps correctly, efficiently or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
1. Measure area to be excavated.	1.1 Must know the length of the hydrant specials, length of the valve, spigot and socket together.
	1.2 The depth of the excavations depends on the depth of the pipe.
	1.3 Add two feet on either side for working room.
2. Excavate area.	2.1 This is usually done with a compressor and the use of pneumatic cutting drills. An ordinary pickaxe drill and shovels could be used however.
	2.2 Care should be taken not to puncture the main during excavations.
3. Inform consumers in the area to be shut off.	3.1 If the affected area is small, a personal notification can be made from house to house.
	3.2 In a large area, it may be necessary to inform consumers by means of a radio bulletin or the press.
	3.3 Radio notices should be given the day before the work is to be done as well as the morning of the work.
	3.4 Other utility companies viz. telephone, electricity and gas should be informed before hand in case cables/pipes are under-ground.

OPERATION BREAKDOWN SHEET

POSITION: Plumber TASK: Preparation of District for Leak Detection

OPERATION: Installing hydrant and valve to accommodate a meter trailer

Important STEPS in the operation. STEP: a significant action which advances the operation towards completion.	KEY POINTS: the key to doing the steps correctly, efficiently or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
4. Shut off water from main to be cut.	4.1 Open valve box with lifting key or bar. 4.2 Insert valve key. 4.3 Proceed to close valve. The number of turns should be checked to find out whether valve is fully open or throttled, and if throttled by how many turns so that when job is completed and the water is to be turned back on, the distribution sould be the same as before. 4.4 Sound the valves to make sure they're closed and no water is passing.
5. Measure pipe to be cut.	5.1 Use tape or rule. 5.2 Measure length of hydrant tees, valve,, flange sockets plus an inch. This total will be the length of pipe to be cut out. The extra inch is to accommodate the gaskets.
6. Cut pipe.	6. Depending on size of pipe the correct size pipe cutter should be used.
7. Install hydrant and valves.	7.1 Mechanical joints are recommended for easier handling and fitting in case the valves are not shutting tight.

OPERATION BREAKDOWN SHEET

POSITION: Plumber TASK: Preparation of District for Leak Detection

OPERATION: Installing hydrant and valve to accommodate a meter trailer (cont'd)

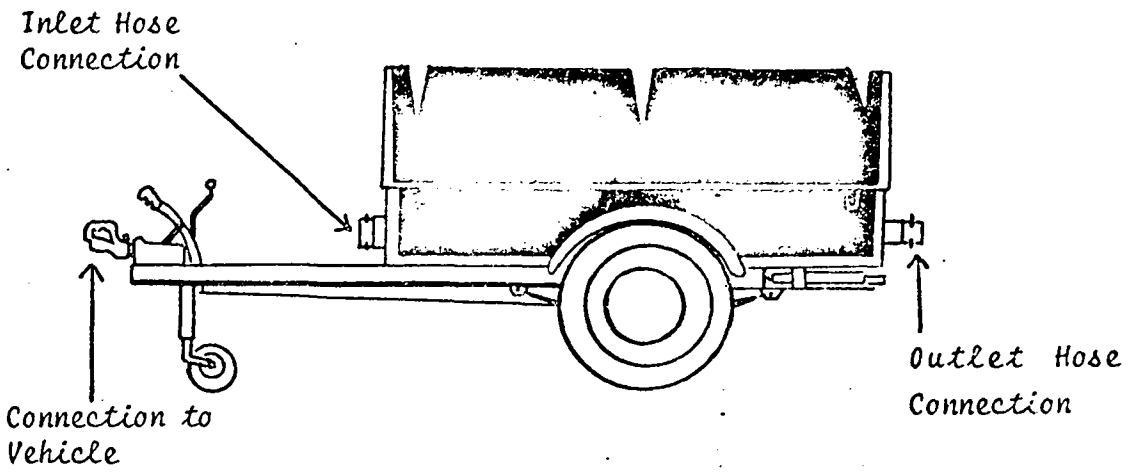
Important STEPS in the operation. STEP: a significant action which advances the operation towards completion.	KEY POINTS: the key to doing the steps correctly, efficiently or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
7. Install hydrant and valves.	7.2 The two hydrant tees can be fitted one on either end of the pipe, putting the socket ends to the pipe. Half tighten bolts to gland.
	7.3 The flange sockets can be fitted to the spigot ends of the hydrant tees, half tighten bolts to gland.
	7.4 Fit gaskets between flange sockets and valve.
	7.5 Fit or slide between flange sockets.
	7.6 Bolt up all joints, tightening the bolts in proper sequence.
	7.7 Place gaskets on hydrant tee to receive hydrant.
	7.8 Fit hydrant onto tee.
	7.9 Insert bolts and tighten nuts in proper sequence.
8. Put water back into the area.	8.1 Open valve box with lifting key or bar.
	8.2 Insert valve key.
	8.3 Open valve. Remember it was whether it was originally fully open or not. If not fully open, put back the correct number of turns on the valves.

OPERATION BREAKDOWN SHEET

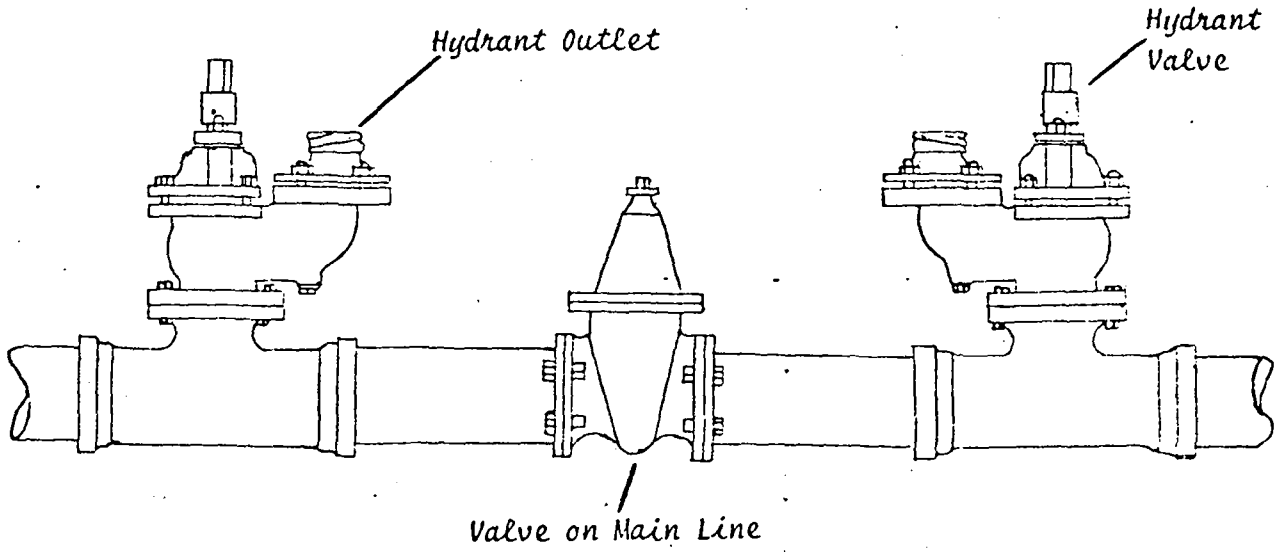
POSITION: Plumber TASK: Preparation of District for Leak Detection

OPERATION: Installing hydrant and valve to accommodate a meter trailer (cont'd)

Important STEPS in the operation. STEP: a significant action which advances the operation towards completion.	KEY POINTS: the key to doing the steps correctly, efficiently or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
9. Test joint to entire connection.	9. Inspect every joint. If one is leaking, fix it immediately.
10. Back fill excavation.	10.1 Back fill excavation up to a level where the valve box and hydrant boxes can be placed level with the road. 10.2 Back fill the remainder of the excavation and consolidate by ramming.
11. Check with consumers to make sure water has been restored.	



TRAILER METER



TRAILER METER CONNECTIONS

TRAINING/JOB MANUAL	Leak Detection in a Water Distribution System
UNIT 1	Preparation of District for Leak Detection
LESSON 7	*DEVELOPING A CHECK LIST FOR THE PREPARATION OF THE DISTRICT FOR LEAK DETECTION*
ESTIMATED TIME	1 hour
PREREQUISITES	Complete all previous lessons of Unit 1.

PERFORMANCE OBJECTIVE:

- The trainee will <u>be able to</u>:

  develop a check list for the preparation of a District for Leak Detection.

- Under the following <u>condition</u>:

  given operation break down sheets and training activities for Unit 1.

- To this <u>standard</u>:

  all important operations and steps must be included. the sequence of operations and steps must be correct.

TRAINING RESOURCES

Equipment and Supplies:	All previous Operation Breakdown Sheets and training activities. Notepads, pencils.
Information Sheet:	U1:L7:IS:01.

TRAINING ACTIVITIES

TRAINER ACTIVITY	TRAINEE ACTIVITY
1. Trainer instructs trainees to read Operation Breakdown Sheets and training activities, for previous lessons and list all important operations and steps.	1. Trainees read Operation Breakdown Sheet and training activities, and list important operations ans steps.
2. Trainer and Trainee discuss listing and develop check list.	2. Trainees and Trainer discuss listings and develop a check list.
3. Trainer distributes sample check list U1:L7:IS:01	3. Trainees read sample, discuss it and compare to their own.

Check List for The Preparation of a District For Leak Detection

1. Review plan of the district.	1.1 Know "line" of persons responsible for plans.
	1.2 Collect plan and make sure it is correct plan.
	1.3 Check to make sure that all lines, valves, names and numbers are legible.
2. Check number of services.	2.1 Record all services.
	2.2 Record separately the domestic supplies, stand post, hotels and factories.
	2.3 Record the number of services between valves.
3. Check number and operation of valves.	3.1 Locate all valves in the district.
	3.2 Cross check valves in the field with valves on the plan.
	3.3 Record any discrepancies between plan and actual field situation.
	3.4 Check if valve is (i) closed (ii) open (iii) throttled (iv) closed by turning left (LH) (v) closed by turning right (RH).
	3.5 Check if (LH) valve has correct cover - circle in a square and RH valve has correct cover - circle in a circle.
	3.6 Check for debris in valve box.
	3.7 Check if valve is shutting tightly.

Check List for the Preparation of a District For Leak Detection (cont'd)

4. Report to Superintendent and/or Senior Engineer's Assistant.	4.1 Discuss plan and field notes.
	4.2 Notify relevant officer(s) of improvements to be made to the plan or in the field.
5. Install connections for Meter on by-pass.	5.1 Identify site on the plan.
	5.2 Select all equipment and tools.
	5.3 Select location in the field.
	5.4 Measure and excavate area as outlined in the procedure.
	5.5 Inform consumers of "shut off." Recall procedure.
	5.6 Cut pipe and install connections - Recall procedure.
	5.7 Check for leaks - See procedure.
	5.8 Construct Meter chamber - Recall procedure.
	5.9 Back fill excavation.
6. Install connections for Trailer Meter.	6.1 Identify site on the plan.
	6.2 Select all equipment and tools.
	6.3 Select location in the field.
	6.4 Measure and excavate area - recall procedure.
	6.5 Inform consumers of "shut off." Recall procedure.

Check List for The Preparation of A District For Leak Detection (cont'd)

6. Install connections for Trailer Meter	6.6 Cut and install connections - recall procedure.
	6.7 Check for leaks.
	6.8 Put hydrant boxes in place and back fill excavation.

TRAINING/JOB MANUAL — Leak Detection in a Water Distribution System

UNIT 2 — *NIGHT LINE*

WHAT IS THIS UNIT ALL ABOUT?

This Unit deals with the part of Leak Detection called the Night Line. The Night Line shows the amount of water in gallons per hour that is being used in the district.

By knowing the number of service connections in the district, and knowing the average water consumption, it is possible to estimate the amount of water being lost through leakage in the system, and determine if the loss is insignificant.

WHY DOES THE TRAINEE NEED THIS?

The Night Line is needed to assess if there is significant leakage in the district.

WHAT DOES THE TRAINEE NEED TO KNOW BEFORE BEGINNING?

He should have completed Unit 1 of this manual: Leak Detection in a Water Distribution System.

WHAT EQUIPMENT AND SUPPLIES ARE NEEDED?

ITEMS	LESSONS					
	1	2	3	4	5	6
Leak Detection Meter	x		x			x
Nuts and Bolts	x					x
Flange gaskets	x					x
A plan of the district	x	x		x		x
Vehicle	x					x
Valve tool	x	x				x
Sounding Rod	x	x				x
Spanners	x					x
Trailer Meter		x				x
Hose		x				x
Hydrant stand post		x				x
Sterilizing material		x				x
24 hr Charts (3", 4", or 6")			x			x
Pencil					x	x
Note pad					x	x

WHAT SUPPLEMENTARY MATERIALS WILL HELP?

None.

WHAT ARE THE OBJECTIVES?

The trainee will be able to:

1. Install the leak detection meter on the by-pass and test the joints to the connections for leaks.

2. Transport and connect a Meter Trailer and divert water through it.

3. (i) Identify parts of a Leak Detection Meter.

   (ii) Fit and remove meter-charts.

4. List and explain the procedure for locating and closing boundary valves, and carrying out an Isolation Test.

5. Construct a check list for performing a Night Line.

6. Plan and carry out a Night Line.

NUMBER OF LESSONS AND TOTAL INSTRUCTIONAL TIME

Total Lessons: 6

Total Time: 9 hours 20 minutes

TRAINING/JOB MANUAL	Leak Detection in a Water Distribution System
UNIT 2	Night Line
LESSON 1	*INSTALLING AND TESTING JOINTS TO A LEAK DETECTION METER ON A BY-PASS*
ESTIMATED TIME	1 Hour
PREREQUISITES	Completion of Unit 1

PERFORMANCE OBJECTIVE:

- The trainee will <u>be able to:</u>

  Install the leak detection meter on the by-pass and test joints to connection for leaks

- Under the following <u>condition</u>:

  Meter chamber and by-pass completed and ready to receive meter. Preparation of district completed.

- To this <u>standard</u>:

  Meter will be installed and operated to record all flow entering district.
  No water leaks at connection

TRAINING RESOURCES

Equipment and Supplies:	Leak Detection Meter, Spanners, Nuts and Bolts, Flance gaskets, Vehicle. A plan of the district, Valve tool, Sounding Rod.
Information Sheets:	U2:L1:IS:01, U2:L1:IS:02, U2:L1:IS:03, U2:L1:IS:04.

TRAINING ACTIVITIES

TRAINER ACTIVITY	TRAINEE ACTIVITY
1. Trainer/Trainee discussion of correct meter size, correct number and type of nuts, bolts and gaskets, as well as tools and equipment. Refer to U2:L1:IS:01 - 04	1. Discussion
2. Trainer instructs trainee to select items listed in U2:L1:IS:01.	2. Trainees select items as instructed by the trainer.
3. Trainer explains and demonstrates, with the assistance of the trainees the procedure for installing the meter. U2:L1:IS:01	3. Trainees listen, observe and participate.
4. Individual groups of trainees disassemble and reassemble the installation under the guidance of the trainer.	4. Individual groups of trainees disassemble and reassemble the installation, under the guidance of the trainer.
5. Trainer explains and demonstrates the procedure for determining leaks at the connection. U2:L1:IS:01	5. Trainees listen, discuss and participate in the process.

OPERATION BREAKDOWN SHEET

POSITION: Plumber TASK: Night Line

OPERATION: Installing Meter on by-pass and testing joints to connection

Important STEPS in the operation. STEP: a significant action which advances the operation towards completion.	KEY POINTS: the key to doing the steps correctly, efficiently or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
1. Go to stores and select correct size meter (3", 4", or 6", gaskets, bolts and nuts, as required.)	1.1 Use vehicle. With help of 2 labourers carefully lift meter onto back of vehicle. 1.2 Check no. and size of bolt holes in meter flange, get paper size gaskets, bolts and nuts to connect to pipe flange. 1.3 Measure thickness of flanges and length of nuts plus 1/4" to ascertain length of bolts required.
2. Go to district where meter will be installed.	2. Use vehicle.
3. Open manhole to meter chamber.	3. Lift cover by using valve key bar or by hand.
4. Back truck as close as possible to meter chamber. This will minimize carrying distance of meter to chamber. Lift meter from truck and lower into meter chamber.	4.1 Use rope or chain around "neck" of meter, 2 trainees stand, one at each end of meter and lift meter off back of truck. Carefully walk over to chamber. Do not drop meter. 4.2 Refer to area plan for direction of water flow.

OPERATION BREAKDOWN SHEET

POSITION: Plumber TASK: Night Line

OPERATION: Installing Meter on by-pass and testing joints to connection

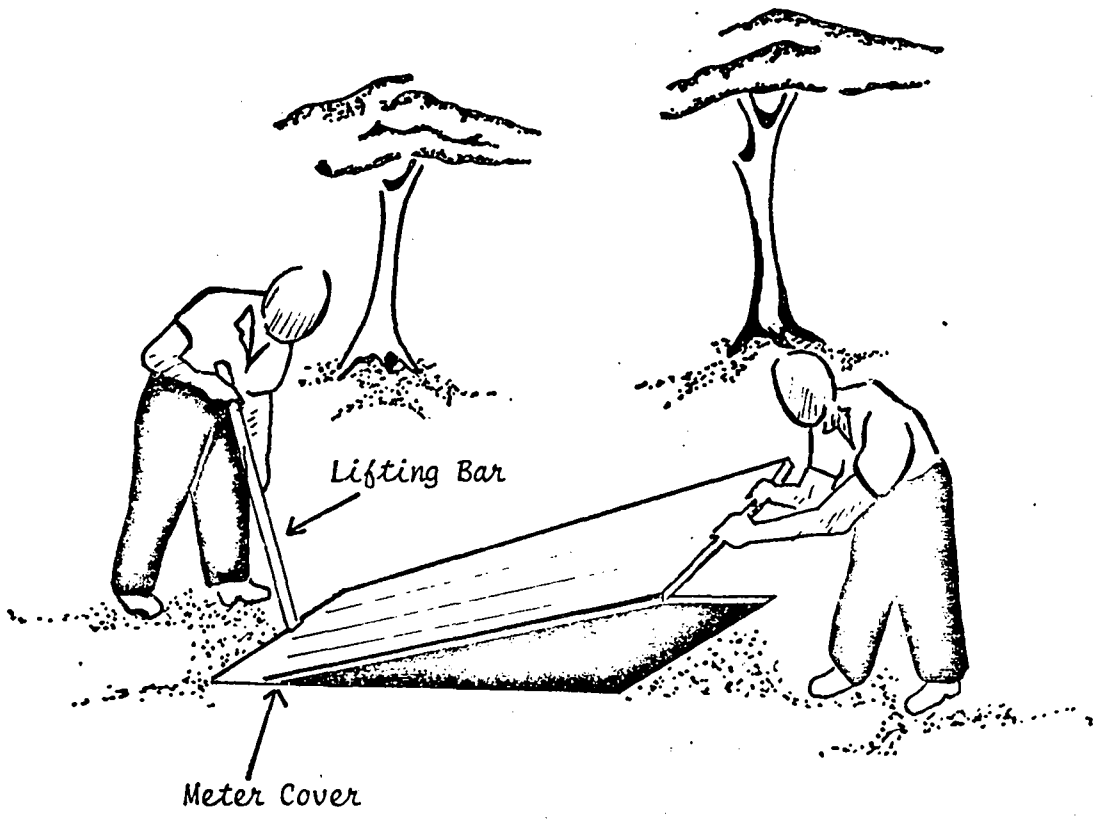
Important STEPS in the operation. STEP: a significant action which advances the operation towards completion.	KEY POINTS: the key to doing the steps correctly, efficiently or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
	4.3 Look for arrow in horizontal position on side of meter. - Install meter in chamber so arrow points in same direction as flow of water in distribution system. 4.4 Meter must sit firmly on support in chamber and not wobble, support must be clean of any rock or debris.
5. Install one gasket between pipe flange, and meter flange at inlet and outlet of meter.	5.1 Number of holes in gasket must correspond with number of holes in flange. 5.2 "Line-up" or match holes in gasket with holes in flange.
6. Bolt meter to branch pipe.	6.1 Put bolts through meter flange, gasket and pipe flange. 6.2 Insert bolts in top and bottom holes first to align flanges and gasket. Then insert remaining bolts. 6.3 Thread nuts onto bolts by hand until bolt head touches meter flange, and nut touches pipe flange. 6.4 Using wrench provided, tighten bolts following sequence shown in sketch. (U1:L3:IS:03).

OPERATION BREAKDOWN SHEET

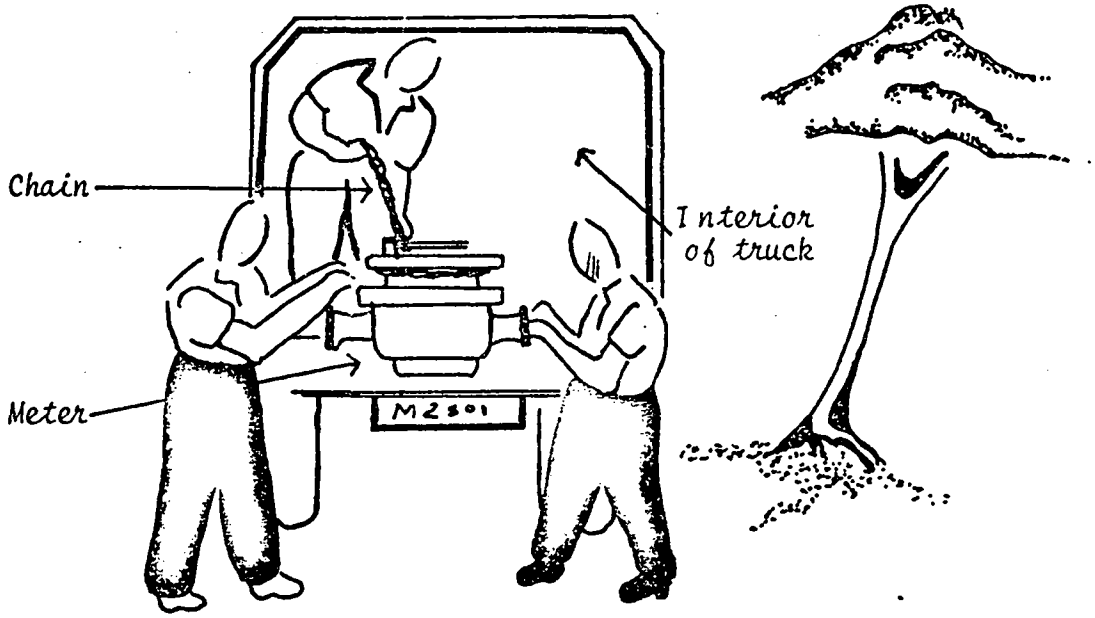
POSITION *Plumber* TASK *Night Line*

OPERATION *Installing Meter on by-pass & Testing joints to connection*

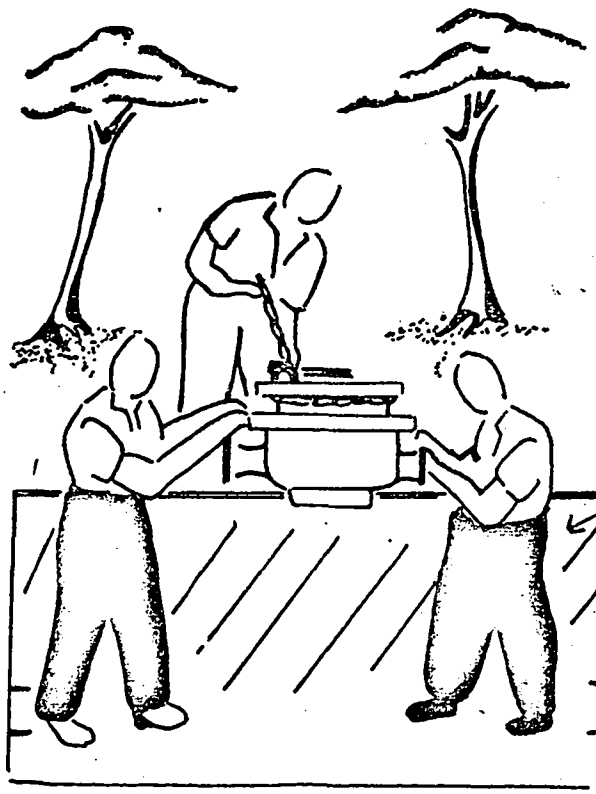
Important STEPS in the operation. STEP: A significant action which advances the operation towards completion	KEY POINTS: The key to doing the steps correctly, efficiently and accurately.
HOW HE DOES IT (STEP)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
7. *Opens valves on both inlet and outlet side of the meter.*	7.1 *Open valves slowly, check valves for leaks, pipe for splits, gasket for leaks.* 7.2 *If there are no leaks close valve again.* (i) *If there are leaks, tighten bolts.* (ii) *If there are still leaks, repair or replace fittings which ever is necessary.* (iii) *Repeat 7.1*



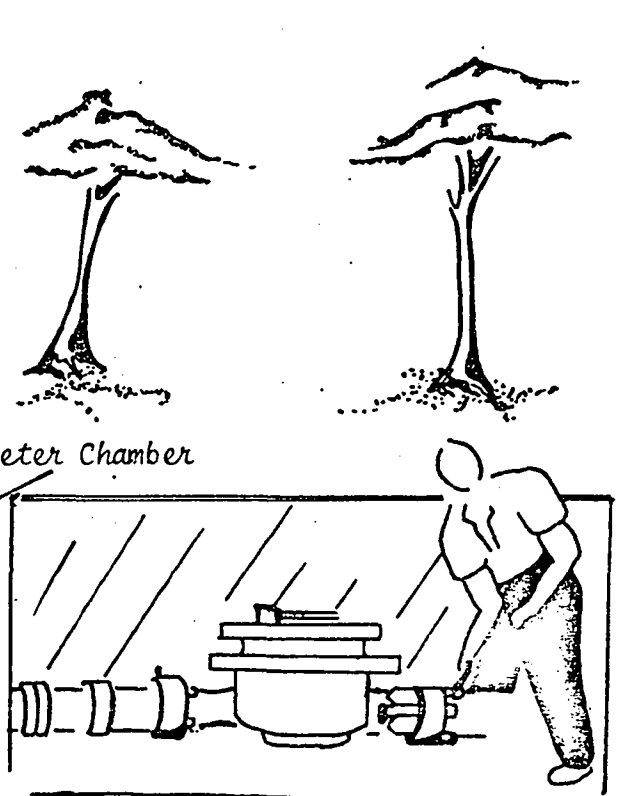
LIFTING METER BOX COVER



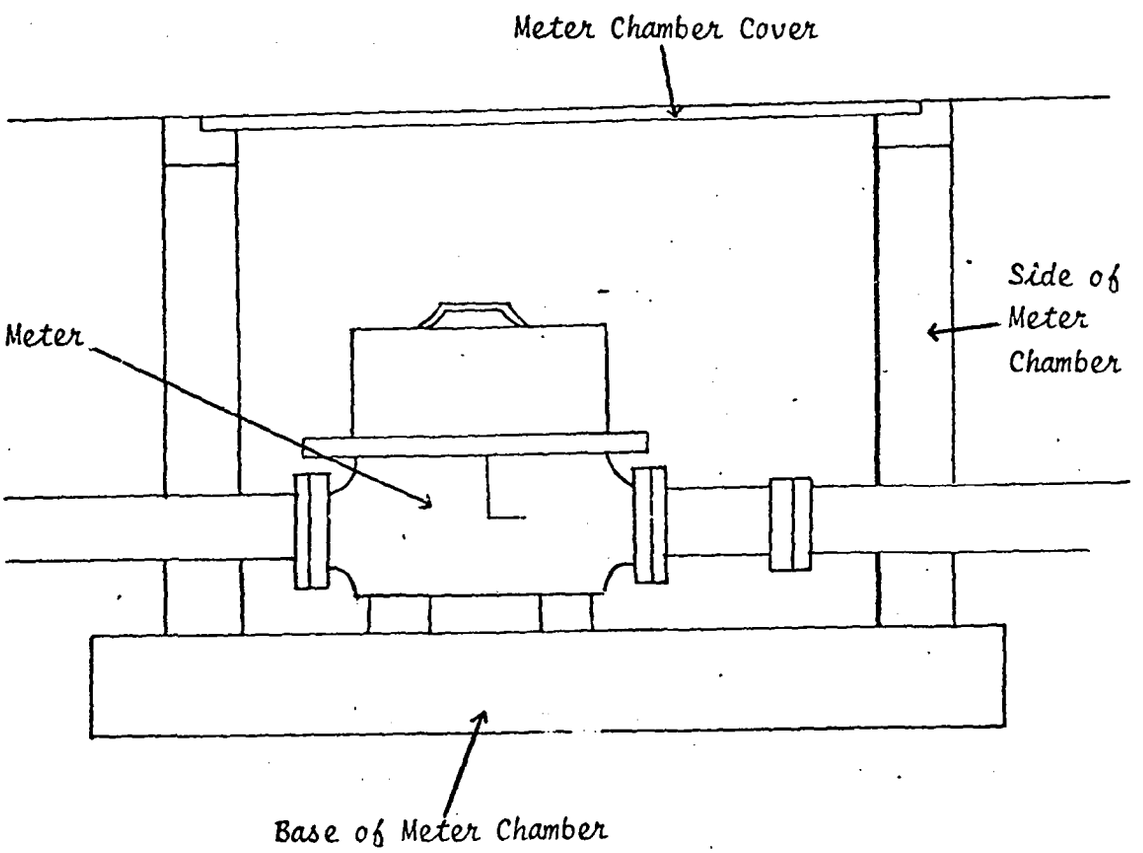
LIFTING METER FROM TRUCK



LIFTING METER INTO METER CHAMBER



METER IN POSITION IN METER CHAMBER



VIEW OF METER IN METER CHAMBER

TRAINING/JOB MANUAL	Leak Detection in a Water Distribution System
UNIT 2	Night Line
LESSON 2	*TRANSPORTING AND CONNECTING A METER TRAILER; DIVERTING WATER THROUGH IT*
ESTIMATED TIME	1 Hour
PREREQUISITES	Senior Plumber or Plumber with 5 years experience

PERFORMANCE OBJECTIVE:

- The trainee will <u>be able to:</u>

  Transport and connect a Meter Trailer and divert water through it.

- Under the following <u>condition:</u>

  Equipment and main connections installed.

- To this <u>standard</u>:

  1. *Location of trailer poses minimum inconvenience to traffic.*
  2. *All water is diverted through the trailer meter.*
  3. *No leak occurs at the connections.*

TRAINING RESOURCES:

Equipment and Supplies:	Trailer Meter, Hose, Hydrant stand post, Valve tool, Sterilizing material, A plan of the district.
Information Sheets:	U2:L2:IS:01, U2:L2:IS:02, U2:L2:IS:03, U2:L2:IS:04.

TRAINING ACTIVITIES

TRAINER ACTIVITY	TRAINEE ACTIVITY
1. Trainer and trainees discuss the transporting and positioning of the Trailer Meter. Refer to U2:L2:IS:01 - 04	1. Discussion
2. Trainer and Trainees travel to site and Trainer explains and demonstrates the procedure for connecting the Trailer Meter, and diverting water through it.	2. Trainees observe, listen and participate in the demonstration.
3. Trainer selects trainees to demonstrate the procedures, under his guidance.	3. Trainees explain and demonstrate the procedures.

OPERATION BREAKDOWN SHEET

U2:L2:IS:01

POSITION *Plumber* TASK *Night Line (Trailer Meter)*

OPERATION *Transporting and connecting a Trailer Meter and diverting water through it*

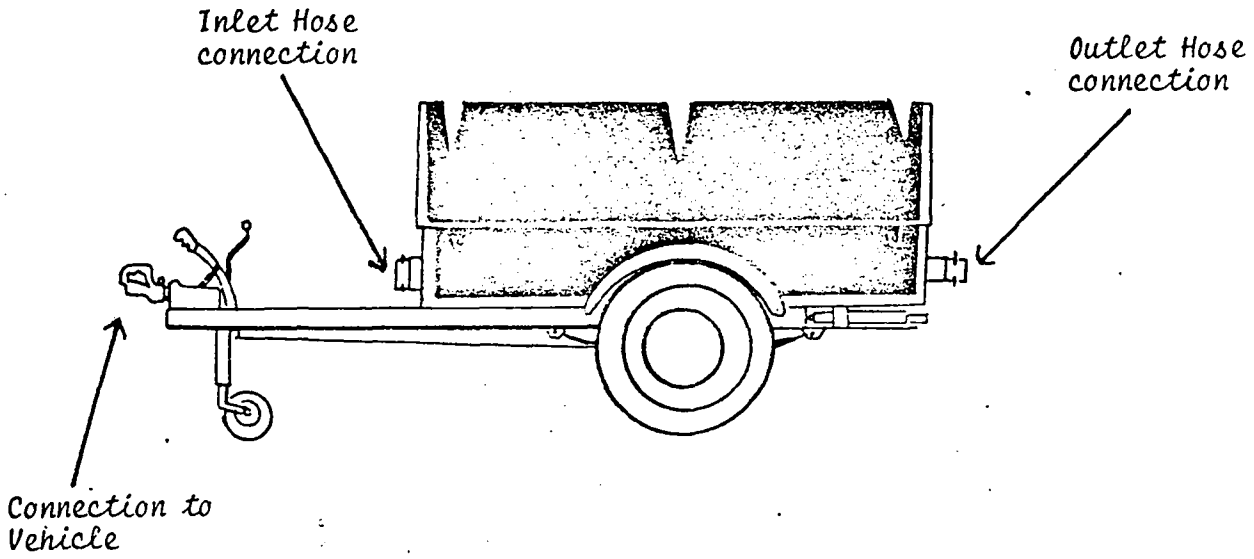
Important STEPS in the operation. STEP: A significant action which advances the operation towards completion	KEY POINTS: The key to doing the steps correctly, efficiently and accurately.
HOW HE DOES IT (STEP)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
1. *Check plan for position of hydrants and valve.*	1.1 *Determine location of street and location of hydrants and valve on the street.*
2. *Travel to site and select best location for Trailer Meter.*	2.1 *Consider traffic regulations - (i) Position to avoid interference with traffic flow, (ii) Use identifying lights if necessary.*
	2.2 *Position trailer so that the chart can be (i) fixed, (ii) read, (iii) removed and also that gear can be adjusted without exposing the person to traffic accident.*
	2.3 *Position of trailer in relation to the hydrant stand post is important. Check length of hose available.*
3. *Connect hose to trailer.*	3.1 *Check type of coupling, whether instantaneous (quick) or screwed.*
	3.2 *Attach hose to inlet and outlet sides of the meter.*
4. *Sterilize hydrants.*	4.1 *Put sterilizing material into hydrant stand-post.*
5. *Fit hydrant stand post into hydrants.*	5.1 *Check whether screw down type or lugged.*
6. *Flush hydrants.*	6.1 *Open hydrant valve and allow to run for 2-3 minutes.*
	6.2 *Close hydrant valve.*

OPERATION BREAKDOWN SHEET

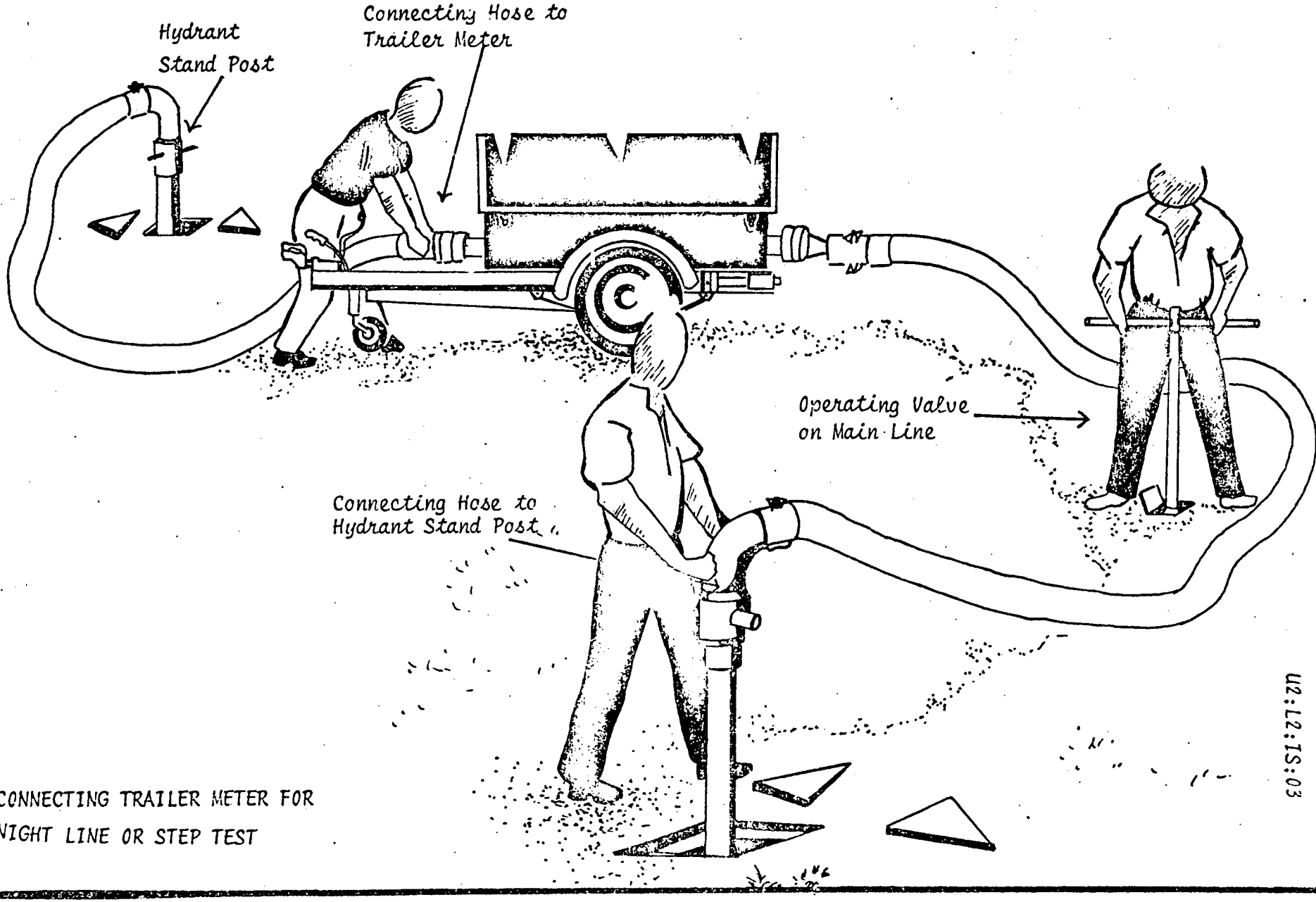
POSITION *Plumber* TASK *Night Line (Trailer Meter)*

OPERATION *Transporting & Connecting a Trailer Meter and diverting water through it.*

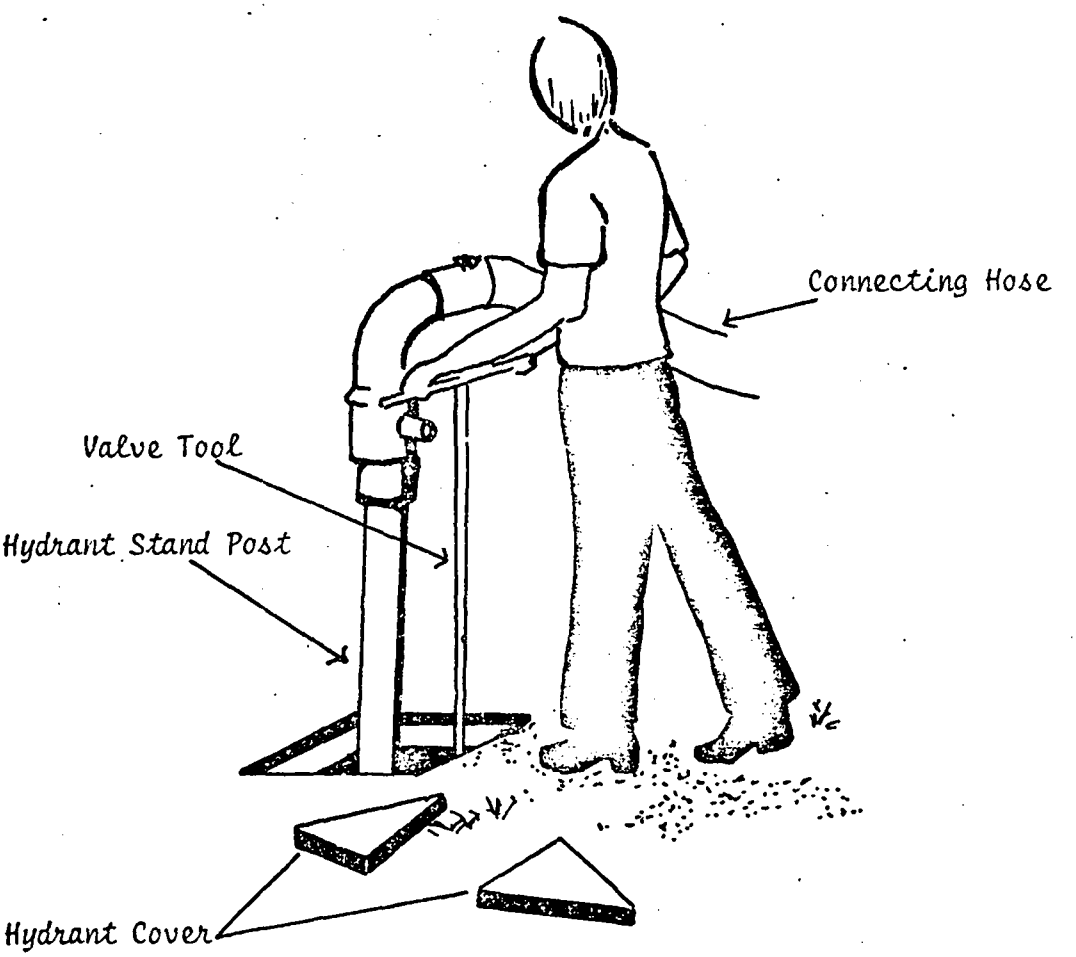
Important STEPS in the operation. STEP: A significant action which advances the operation towards completion	KEY POINTS: The key to doing the steps correctly, efficiently and accurately.
HOW HE DOES IT (STEP)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
7. *Connect hoses to hydrant standpost.*	7. *Check type of coupling.*
8. *Close valve on main feed.*	8.1 *Check operation RH or LH* 8.2 *Check and note if throttled.* 8.3 *Sound to verify closed.*
9. *Open hydrants on inlet side of meter.*	9.1 *First open inlet side slowly -*
10. *Check all connections for leaks*	10.1 *If there are leaks close inlet and outlet valves to meter and open valve on main.* 10.2 *Repair leaks and repeat step 9.*



TRAILER METER



CONNECTING TRAILER METER FOR
NIGHT LINE OR STEP TEST



OPERATING HYDRANT VALVE

TRAINING/JOB MANUAL	Leak Detection in a Water Distribution System
UNIT 2	Night Line
LESSON 3	*IDENTIFYING PARTS OF LEAK DETECTION METER; FITTING AND REMOVING 3 Hour and 24 Hour CHARTS*
ESTIMATED TIME	30 Minutes
PREREQUISITES	Senior Plumber or Plumber with 5 years experience

PERFORMANCE OBJECTIVE:

- The trainee will be able to:

  1. *Identify relevant parts of a Leak Detection Meter*
  2. *Identify, fit and remove 3 hour and 24 hour charts.*

- Under the following condition:

  Given a leak detection meter and charts.

- To this standard:

  Must be performed in 3 minutes and in keeping with procedure outlined.

TRAINING RESOURCES:

Equipment and supplies:	24 hr chart, Leak Detection Meter
Information Sheets:	U2:L3:IS:01, U2:L3:IS:02, U2:L3:IS:03, U2:L3:IS:04, U2:L3:IS:05, U2:L3:IS:06, U2:L3:IS:07, U2:L3:IS:08 U2:L3:IS:09.

TRAINING ACTIVITIES

TRAINER ACTIVITY	TRAINEE ACTIVITY
1. Trainer points out and names parts of leak Detection Meter. U2:L3:IS:02 - 03.	1. Trainees observe, listen, refer to U2:L3:IS:02-03 and make notes, if necessary.
2. Trainer gives trainees an opportunity to point out the main parts of Meter.	2. Trainees identify and name parts of the meter.
3. Trainer displays and differentiates between charts. Refer to U2:L3:IS:04-06	3. Trainees observe, listen, and make notes, if necessary.
4. Trainer explains and demonstrates the fitting and removing of the charts. Refer to U2:L3:IS:01 and U2:L3:IS:07. Trainer pays special attention to the adjustment of the gears.	4. Trainees listen, observe and participate in the demonstration.
5. Trainer gives trainees an opportunity to practice the operations.	5. Trainees practice the fitting and removing of the chart.

OPERATION BREAKDOWN SHEET

POSITION: Plumber TASK: Night Line

OPERATION: Identifying parts of Leak Detection Meter; fitting and removing charts

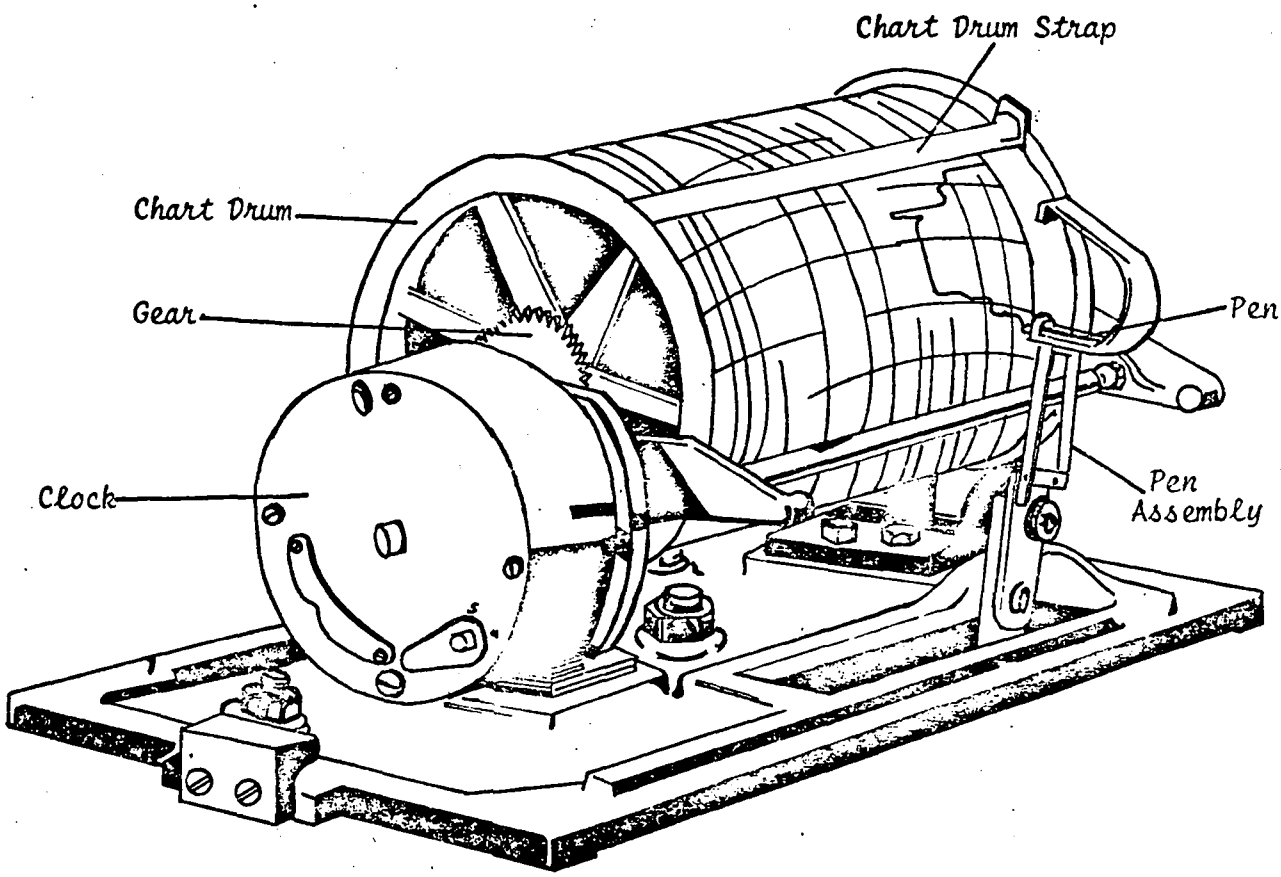
Important STEPS in the operation. STEP: a significant action which advances the operation towards completion.	KEY POINTS: the key to doing the steps correctly, efficiently or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
4. Adjust pen on the chart.	4.1 Place pen arm, with pen, onto meter. 4.2 Adjust pen arm on to chart so that the pen is on the zero line. 4.3 Check time on your watch and set pen to the time on the chart which is equivalent to the time on the watch. 4.4 Replace meter cover.
5. Remove 24 hr. chart.	5.1 Remove meter cover. 5.2 Release pen arm and pen by pulling it away from the drum. 5.3 Lift drum from the cradle. 5.4 Release the drum strap. 5.5 Remove the chart. 5.6 Replace the drum strap and replace the drum in the cradle. 5.7 Replace meter cover.
6. Some procedure for fitting and removing 3 hr. chart.	6.1 Be sure to adjust 3 hr. gear on the clock. 6.2 Make sure that 3 hr. gear on clock matches with 3 hr. gear on drum meshes.
NB: (i) The 24 hour chart is used during the NIGHT LINE (ii) The 3 hour chart is used during the STEP TEST	

OPERATION BREAKDOWN SHEET

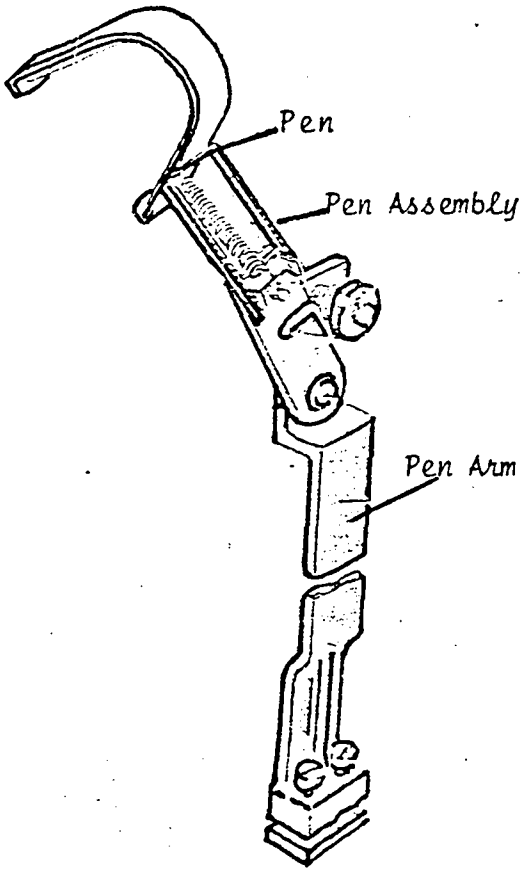
POSITION: Plumber TASK: Night Line

OPERATION: Identifying parts of Leak Detection Meter; Fitting and removing Charts.

Important STEPS in the operation. STEP: a significant action which advances the operation towards completion.	KEY POINTS: the key to doing the steps correctly, efficiently or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
1. Identify parts of Leak Detection Meter.	1. Identify all relevant parts of the Leak Detection Meter. U2:L3:IS:02.
2. Select 24 hr chart.	2.1 Check size of meter (3", 4", or 6") and select appropriate chart
3. Fit 24 hr chart.	3.1 Lift cover off meter. 3.2 Lift drum off drum cradle. 3.3 Release drum strap. 3.4 Fit chart so that highest number of gallons per hour on the chart is to the end of the drum with the gears, and is nearest the clock. 3.5 Rotate the drum and fit the chart smoothly and lightly on the total surface of the drum. 3.6 Replace the drum strap. 3.7 Replace drum (with chart) into drum cradle. 3.8 Fit gears on the drum to mesh with corresponding gears on clock. Gear marked D on drum on relative gear on clock. Idler rod at other end of drum must sit in cradle and turn freely.



LEAK DETECTION METER WITHOUT METER COVER



PEN ARM WITH HOLDER ASSEMBLY

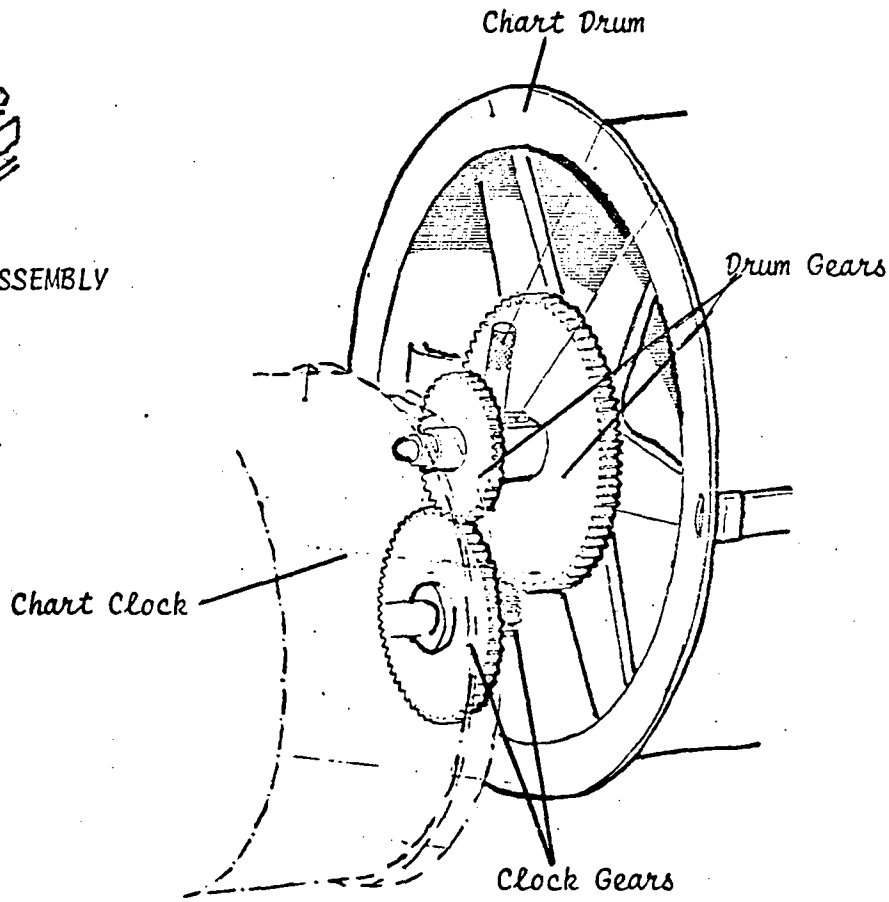
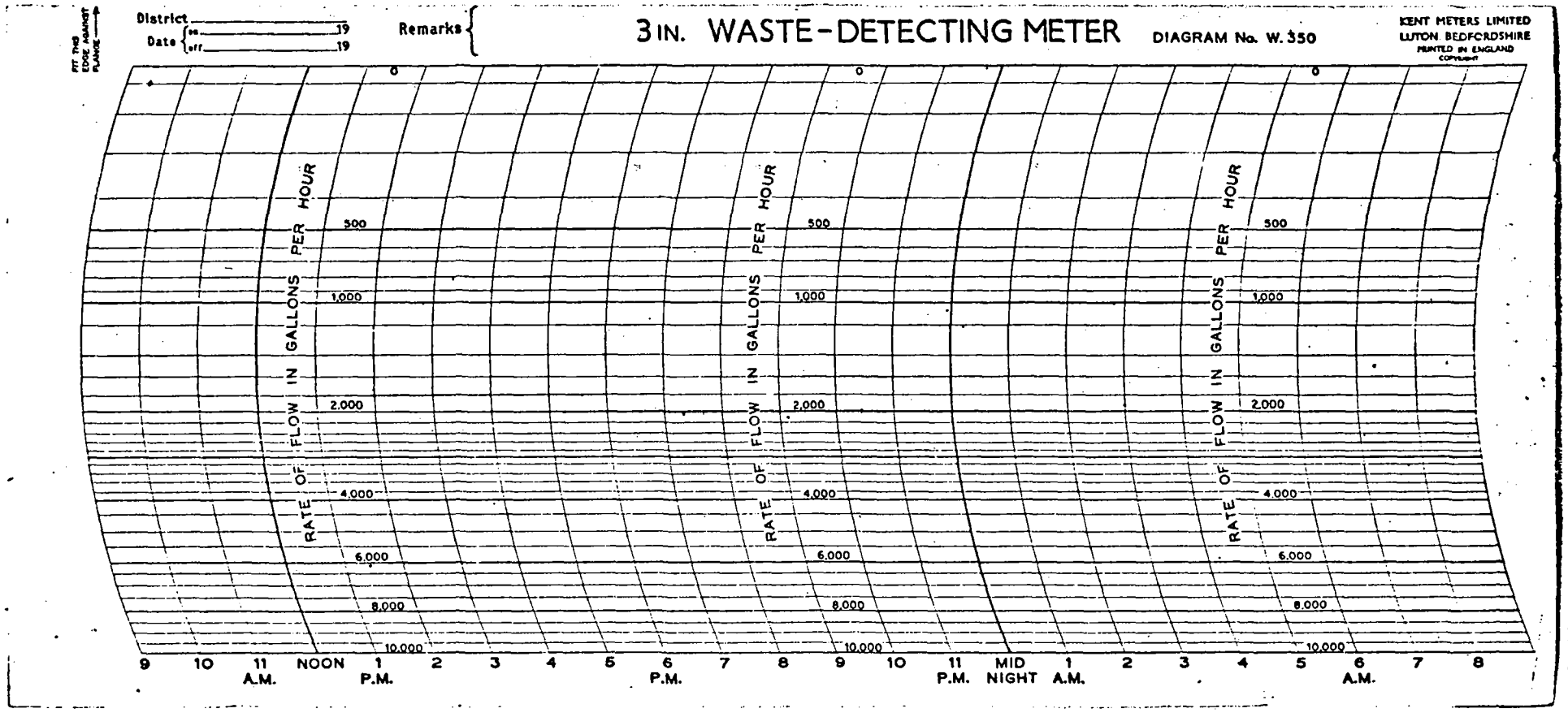
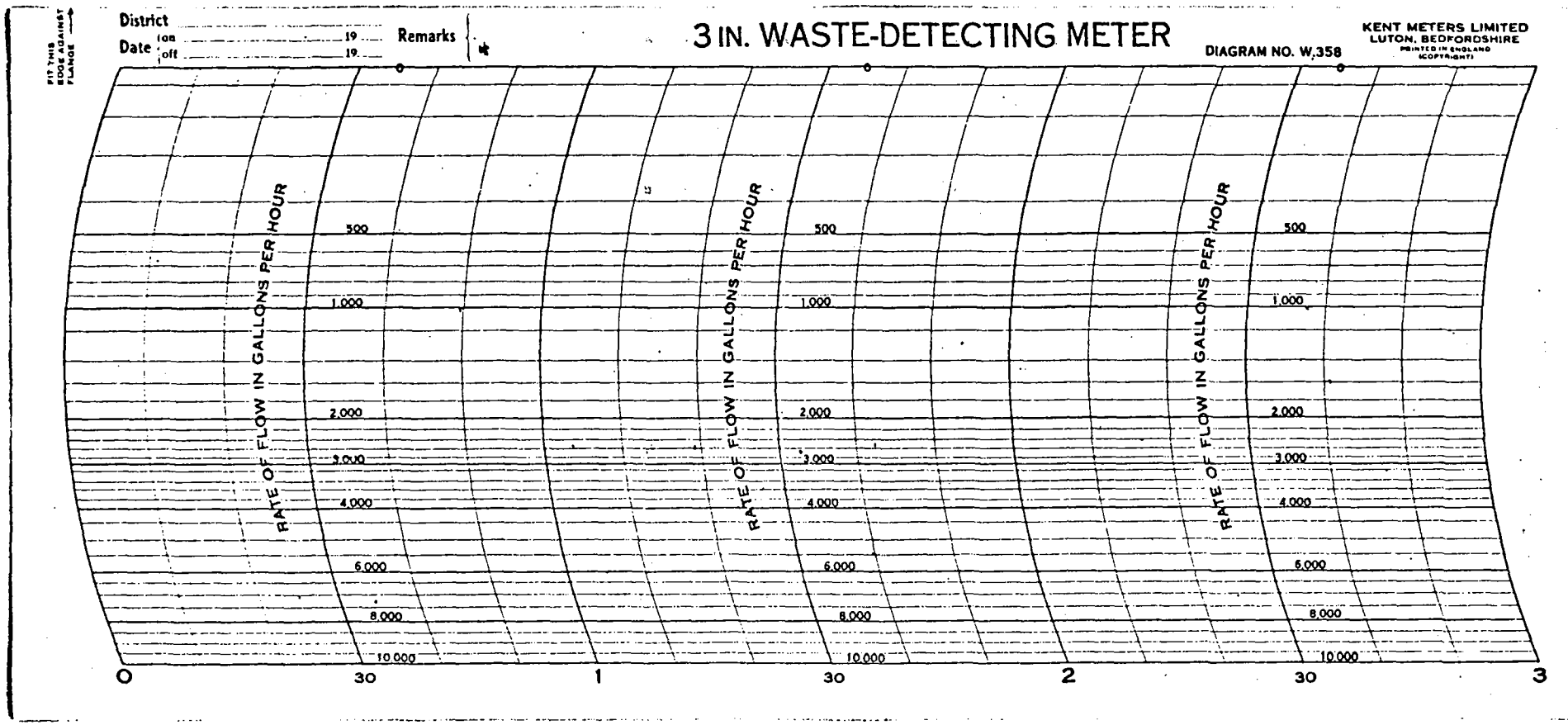


CHART SPEED GEARS



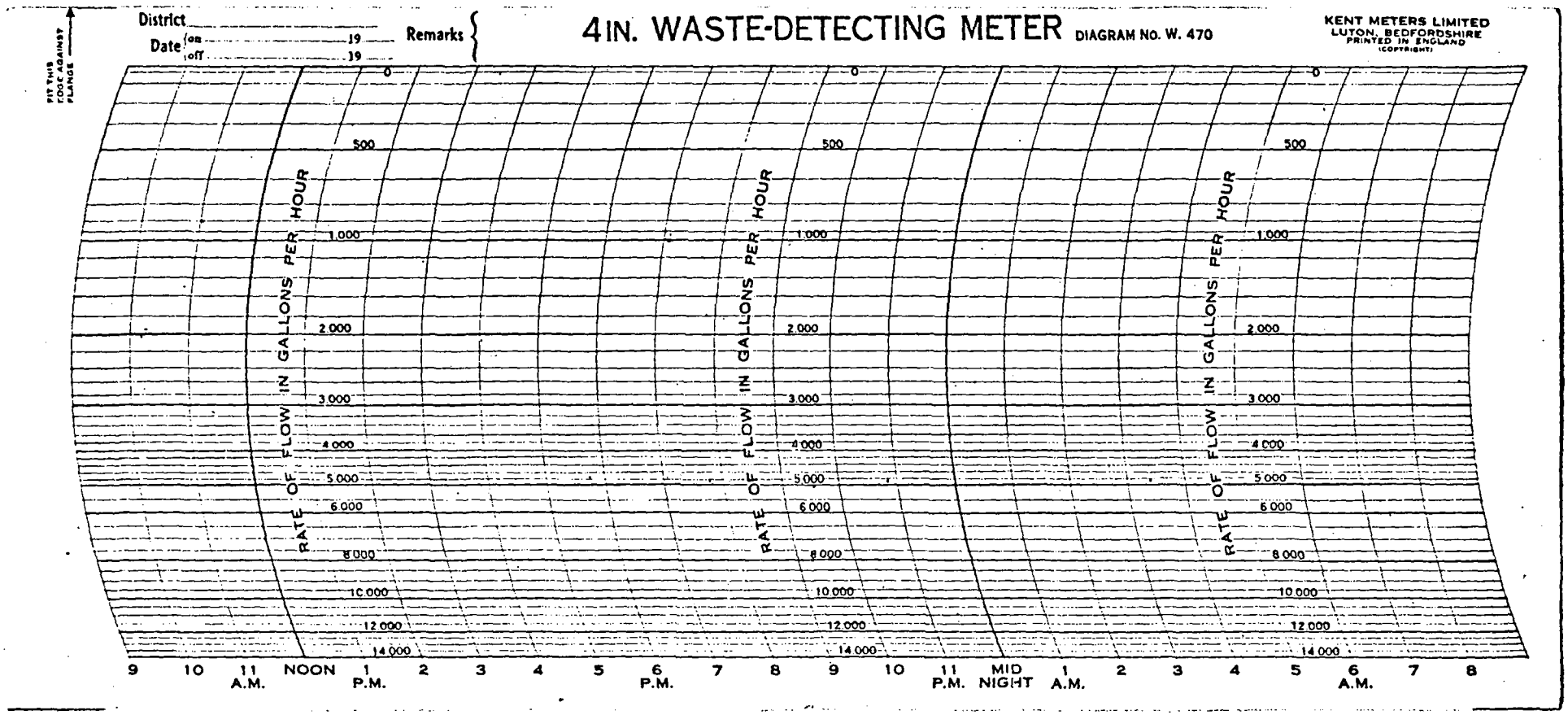
24 HOUR 3 IN. CHART



3 HOUR 3 IN. CHART

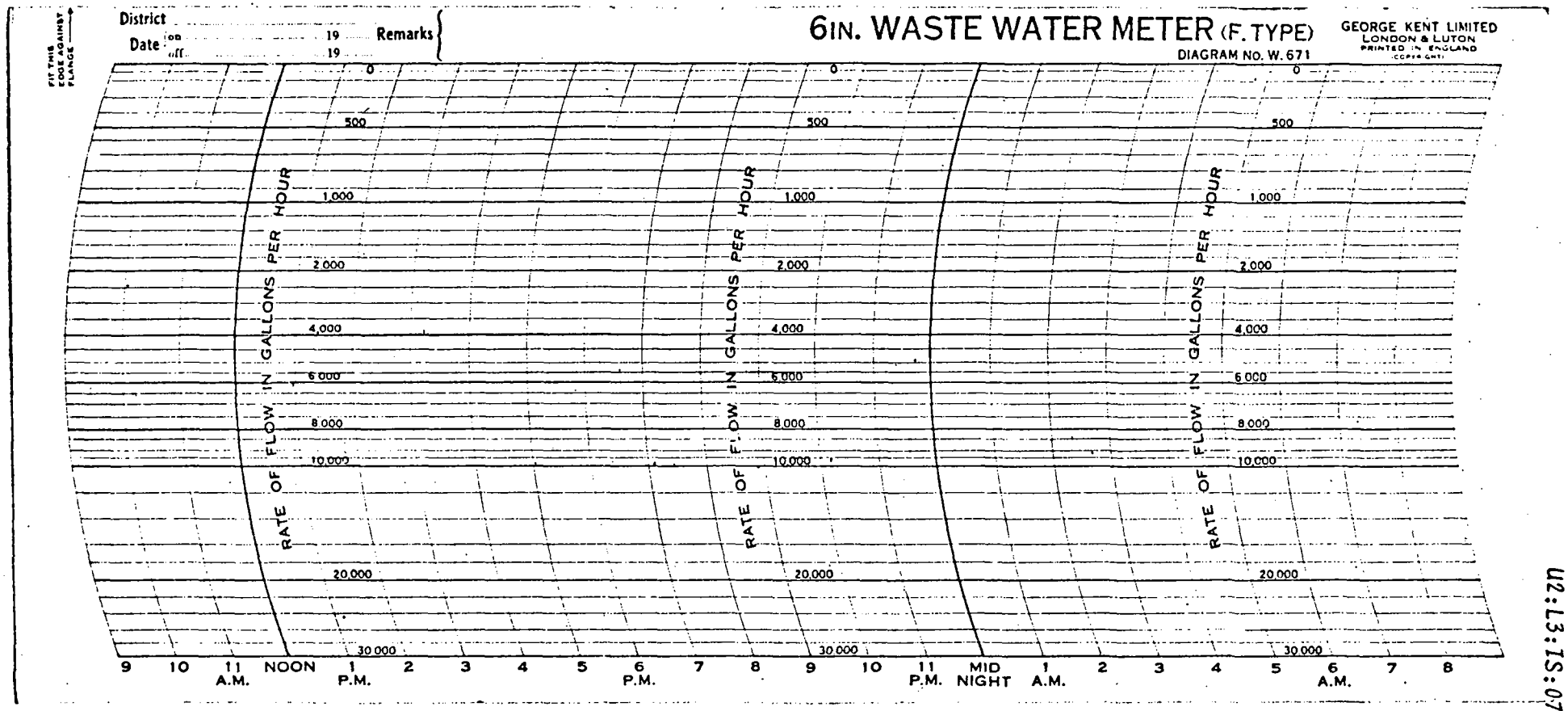
84

U2:L3:IS:05



24 HOUR 4 IN. CHART

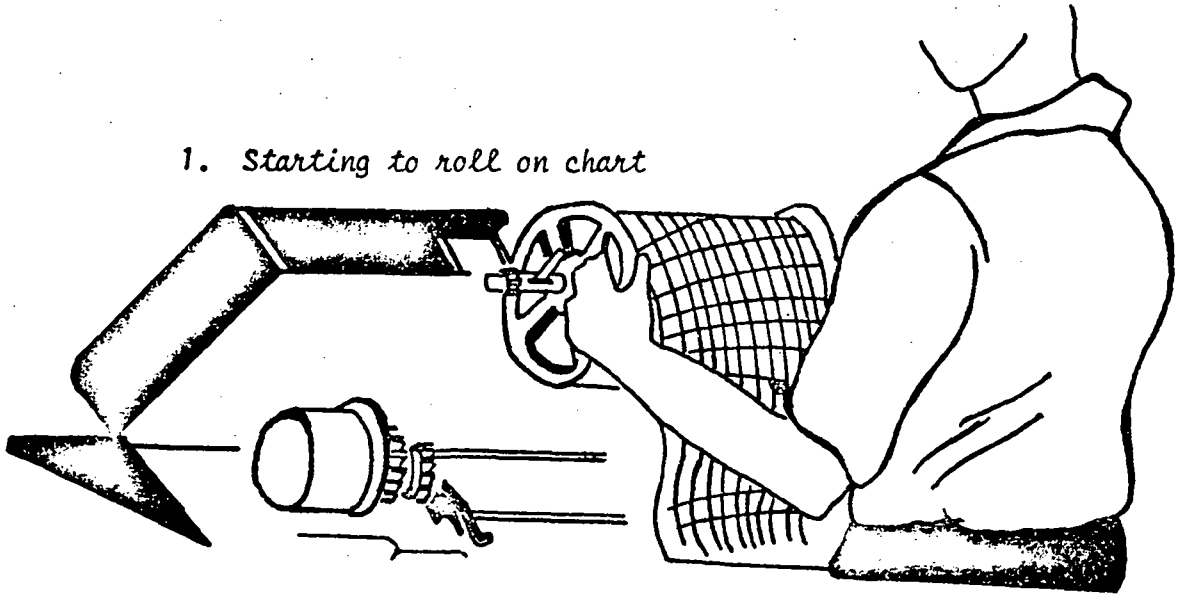
U2:L3:IS:06



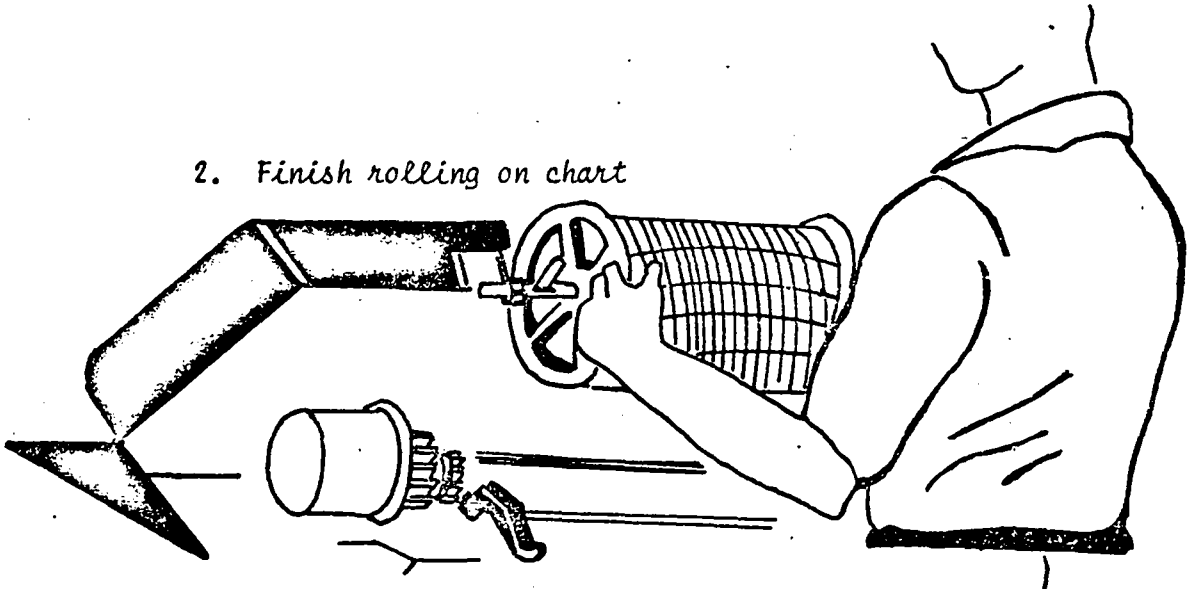
24 HOUR 6 IN. CHART

U2:L3:IS:07

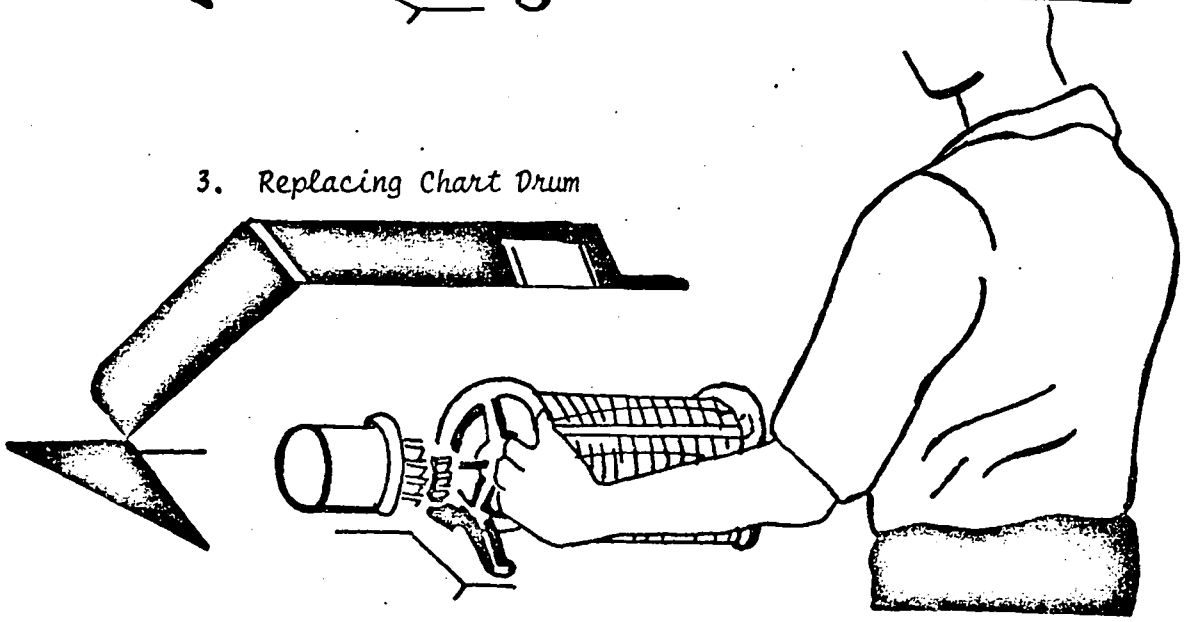
1. Starting to roll on chart

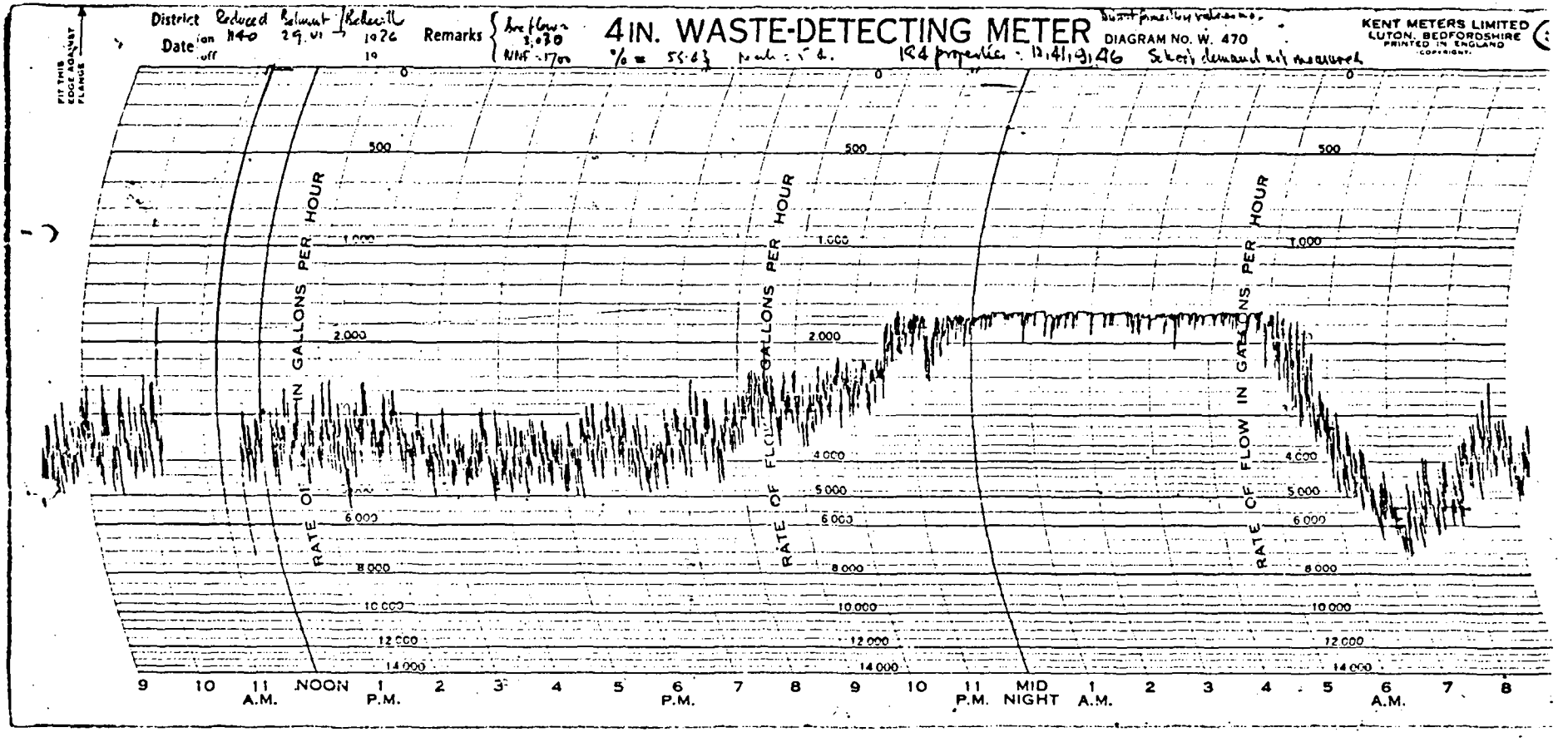


2. Finish rolling on chart

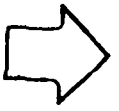


3. Replacing Chart Drum





24 HOUR CHART AFTER THE COMPLETION OF A NIGHT LINE

TRAINING/JOB MANUAL	Leak Detection in a Water Distribution System
UNIT 2	Night Line
LESSON 4 	*LOCATING AND CLOSING BOUNDARY VALVES; CARRYING OUT AN ISOLATION TEST*
ESTIMATED TIME	30 Minutes
PREREQUISITES	Senior Plumber or Plumber with five years experience.

PERFORMANCE OBJECTIVE:

- The trainee will <u>be able to</u>:

  List and explain the procedure for locating and closing boundary valves, and carrying out an isolation test.

- Under the following <u>condition</u>:

  From recall.

- To this <u>standard:</u>

  Must be in keeping with procedures for checking valves, and the sequence must be correct.

TRAINING RESOURCES:

Equipment and Supplies:	Plan of a district.
Information Sheet :	U2:L4:IS:01,

TRAINING ACTIVITIES

TRAINER ACTIVITY	TRAINEE ACTIVITY
1. Trainer distributes, explains and discusses the Operation Breakdown Sheet - U2:L4:IS:01.	1. Trainees read and discuss with trainer.
2. Trainer explains and discusses how to identify the hydrant located at the highest point in the district.	2. Trainees discuss with trainer and take notes.
3. Trainer reviews Operation Breakdown Sheet U2:L4:IS:01 and emphasises the sequence of operations and steps.	3. Review.
4. Trainer instructs individual trainees to list operation and steps in proper sequence.	4. Trainees list operations and steps in the correct sequence.

OPERATION BREAKDOWN SHEET

POSITION: Plumber TASK: Night Line

OPERATION: Locating and closing boundary valves; Carrying out an Isolation Test

Important STEPS in the operation. STEP: a significant action which advances the operation towards completion.	KEY POINTS: the key to doing the steps correctly, efficiently or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
1. Locate and close Boundary valves.	1.1 Identify location of valves on plan of district. 1.2 Travel to location and close each valve - Note whether LH or RH. 1.3 Check whether throttled or not. 1.4 Sound valve to find out if it is fully closed. 1.5 If there is a sound, open the valve to about (2) two or (3) three turns, then shut rapidly and tightly. 1.6 If there is still a sound repeat Step 1.5. 1.7 If sound persists the valve needs repairing - must be repaired or replaced before proceeding with the Night Line.
2. Perform Isolation Test.	2.1 Identify hydrant at the highest point of the district. 2.2 Close valve on the main line - all boundary valves already closed. 2.3 Sound valve to be sure it is fully closed.

OPERATION BREAKDOWN SHEET

POSITION: Plumber TASK: Night Line

OPERATION: Locating and closing boundary valves, Carrying out an Isolation Test

Important STEPS in the operation. STEP: a significant action which advances the operation towards completion.	KEY POINTS: the key to doing the steps correctly, efficiently or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
	2.4 Travel to hydrant and open hydrant valve slowly - flow should drop in 2 to 3 minutes. 2.5 If flow drops, close the hydrant and proceed with the Night Line. 2.6 If flow continues, check for any inlet source - possibly there is a cross connection or boundary valve(s) left open by mistake.

TRAINING/JOB MANUAL — Leak Detection in a Water Distribution System

UNIT 2 — Night Line

LESSON 5 — *CONSTRUCTING A CHECK LIST FOR PERFORMING A NIGHT LINE*

ESTIMATED TIME — 1 hour

PERFORMANCE OBJECTIVE:

- The trainee will <u>be able to</u>:

  construct a Check List for performing a Night Line.

- Under the following <u>condition</u>:

  given operation breakdown sheets and training activities for Unit 2.

- To this <u>standard</u>:

  all operations and important steps must be included. the sequence must be correct.

TRAINING RESOURCES

Equipment and Supplies: Pencil and note pad.

Information Sheets: U2:L5:IS:01. U2:L5:IS:02

TRAINING ACTIVITIES

TRAINER ACTIVITY	TRAINEE ACTIVITY
1. Trainer and trainees review and discuss the Operation Breakdown Sheets and training activities for each lesson in this unit.	1. Discussion.
2. Trainer provides guidance to the trainees as they list the operations and important steps.	2. Trainees list the operations and important steps as they review each lesson.
3. Trainer assists trainees in organising their notes into the correct sequence - U2:L5:IS:01-02.	3. Trainees organise their notes into the correct sequence.
4. Trainer distributes U2:L5:IS:01 -02.	4. Trainees read U2:L5:IS:01 - 02. and re-organise their notes into proper sequence if necessary.

Check List for Performing a Night Line Using a Leak Detection Meter on By-Pass

1. Install Meter on By-pass	1.1 Select correct size meter 3", 4", or 6".
	1.2 Select correct number and size gaskets, bolts and nuts.
	1.3 Select correct tools.
	1.4 Locate meter chamber.
	1.5 Fit meter so that arrow on meter points in same direction as water flow.
	1.6 Bolt meter to branch pipe following procedure outlined.
2. Check for Leaks	2.1 Close valve on main line.
	2.2 Open inlet valve slowly, then open outlet valve slowly.
	2.3 Check valves for leaks, pipe for splits, and gaskets for leaks.
	2.4 Repair leaks and repeat steps 2.1 - 2.3.
	2.5 If no leaks, close inlet valve (ii) outlet valve and (iii) open valve on the main line.
3. Locate and close boundary valves.	3.1 Travel to each valve and close it.
	3.2 Observe strictly the procedure of sounding and closing valves.
	3.3 Observe condition of valve whether throttled or not.

Check List for Performing a Night Line Using a Leak Detection Meter on By-Pass

4. Fit 24 hour Chart	4.1 Select correct type chart 3", 4", or 6".
	4.2 Remove drum from cradle.
	4.3 Fit chart as outlined in the procedure.
	4.4 Fit clock into cradle.
	4.5 Adjust 24 hr gear to clock.
	4.6 Adjust 24 hr gear to drum.
	4.7 Replace drum as outlined in the procedure.
	4.8 Fit pen into pen arm.
	4.9 Replace pen arm as outlined in the procedure.
	4.10 Place pen at zero position on the chart.
	4.11 Check time and place pen on correct time on the chart.
5. Perform isolation test.	5.1 Close valve on the main line - all boundary valves must be already closed.
	5.2 Travel to hydrant at highest point and open it.
	5.3 Close hydrant and proceed with the Night Line, if the flow drops in 2 to 3 minutes.
	5.4 Close hydrant and check thoroughly for open valves and connections if flow persists.
	5.5 Proceed with Night-Line after locating and correcting discrepancy.

Check List for Performing a Night Line Using a Leak Detection Meter on By-Pass

6. Divert water through the Meter.	6.1 Operation three (3) must be completed.
	6.2 Open inlet valve to the meter slowly and open the outlet valve slowly.
	6.3 The valve on the main line must be kept close.
7. Remove the 24 hour chart.	7.1 Close inlet valve to meter and then close outlet valve.
	7.2 Release pen and pen arm from the drum.
	7.3 Remove the drum from the cradle.
	7.4 Remove the chart from the drum.
	7.5 Replace the drum.
	7.6 Replace pen arm and cover.
8. Return water to district by the original distribution.	8.1 Open valve on the main line.
	8.2 Open all boundary valves previously closed.
	8.3 Observe strictly the throttling of valves.
	8.4 Sound each valve to be sure water is feeding through.

Check List for Performing a Night Line - Using a Trailer Meter

1. Transport and connect Trailer Meter.

1.1 Select Trailer Meter.

1.2 Select all tools and other necessary equipment.

1.3 Check plan of district for location of Trailer Meter connections.

1.4 Transport Trailer Meter to site.

1.5 Select position on site according to the procedures outlined - U2:L2:IS:01.

1.6 Attach hose to inlet and outlet sides of the meter.

1.7 Fit hydrant standpost into hydrants.

1.8 Sterilize the hydrants.

1.9 Flush hydrants.

1.10 Connect hoses to hydrant standposts.

2. Check for leaks.

2.1 Close valve on main line.

2.2 Open inlet valve slowly, then open outlet valve slowly.

2.3 Check valves and hose connections for leaks.

2.4 Repair leaks and repeat steps 2.1 - 2.3.

2.5 Close (i) inlet valve (ii) outlet valve (iii) open valve on the main line.

Check List for Performing a Night Line Using a Trailer Meter

3. Locate and close boundary valves.	3.1 Travel to each valve and close it.
	3.2 Observe strictly the procedure of sounding and closing valves.
	3.3 Observe condition of valve whether throttled or not.
4. Fit 24 hour chart.	4.1 Select correct type chart 3", 4", or 6".
	4.2 Remove drum from cradle.
	4.3 Fit chart as outlined in the procedure.
	4.4 Fit clock into cradle.
	4.5 Adjust 24 hr gear to clock.
	4.6 Adjust 24 hr gear to drum.
	4.7 Replace drum as outlined in the procedure.
	4.8 Fit pen into pen arm.
	4.9 Replace pen arm as outlined in the procedure.
	4.10 Place pen at zero position on the chart.
	4.11 Check time and place pen on correct time on the chart.
5. Perform isolation test.	5.1 Close valve on the main line - all boundary valves must be already closed.
	5.2 Travel to hydrant at highest point and open it.
	5.3 Close hydrant and proceed with the Night Line, if the flow drops in 2 to 3 minutes.

Check List for Performing a Night Line - Using a Trailer Meter

5.	Perform isolation test.	5.4 Close hydrant and check thoroughly for open valves at connections.
		5.5 Proceed with Night Line after locating or correcting discrepancy.
6.	Divert water through the Meter.	6.1 Operation three (3) must be completed.
		6.2 Open inlet valve to the meter slowly and open the outlet valve slowly.
		6.3 The valve on the main line must be kept close.
7.	Remove the 24 hour chart.	7.1 Close inlet valve to meter and then close outlet valve.
		7.2 Release pen and pen arm from the drum.
		7.3 Remove the drum from the cradle.
		7.4 Remove the chart from the drum.
		7.5 Replace the drum.
		7.6 Replace pen arm and cover.
8.	Return water to district by the original distribution.	8.1 Open valve on the main line.
		8.2 Open all boundary valves previously closed.
		8.3 Observe strictly the throttling of valves.
		8.4 Sound each valve to be sure water is feeding through.

TRAINING/JOB MANUAL — Leak Detection in a Water Distribution System

UNIT 2 — Night Line

LESSON 6 — *PLANNING AND CARRYING OUT A NIGHT LINE*

ESTIMATED TIME — 4 - 6 Hours

PREREQUISITES — Previous Lessons in Unit 2

PERFORMANCE OBJECTIVE:

- The trainee will be able to:

  Plan and carry out a Night Line.

- Under the following condition:

  Preparation of the district completed.
  Given a plan of the district and the check list developed in U2:L5

- To this standard:

  To the satisfaction of the trainer.

TRAINING RESOURCES:

Equipment and Supplies:	See list of equipment and supplies at the beginning of this Unit.
Information Sheet:	U2:L6:IS:01

TRAINING ACTIVITIES

TRAINER ACTIVITY	TRAINEE ACTIVITY
1. Trainer and trainee discuss list and select ALL equipment and supplies which will be needed to carry out the Night Line.	1. Discussion
2. Trainer and Trainees discuss the sequence of operations and steps necessary for the successful performance of Night Line U2:L6:IS:O1.	2. Discussion
3. Trainer provides guidance and assistance, if it is necessary.	3. Trainees carry out the Night Line, with the guidance and assistance of the trainer. Refer to U2:L5:IS:O1 and U2:L5:IS:O2.

OPERATION BREAKDOWN SHEET

POSITION: Plumber TASK: Night Line

OPERATION: Plan and carry out a Night Line - using Leak Detection Meter

Important STEPS in the operation. STEP: a significant action which advances the operation towards completion.	KEY POINTS: the key to doing the steps correctly, efficiently or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
1. Select equipment and supplies.	1.1 Review list of equipment and supplies from previous lessons.
	1.2 Select ALL equipment and supplies.
2. Study check list.	2.1 Memorize all operations and important steps.
3. Travel to field.	3.1 Decide on plan of action.
	3.2 Decide how individual trainees will participate in the exercise.
4. Carry out the Night Line.	4.1 Refer to the check list, if it is necessary.
	4.2 Seek advice and help from the trainer, if it is necessary.
5. Complete the exercise.	5.1 Collect and check all equipment and supplies.
	5.2 Discuss and collect relevant observations made during the exercise.
	5.3 Return equipment and supplies as well as list of relevant observations to the appropriate authorities.

TRAINING/JOB MANUAL

Leak Detection in a Water Distribution System

UNIT 3

STEP TEST

WHAT IS THIS UNIT ALL ABOUT?

This Unit deals with a section of Leak Detection known as a Step Test. A Step Test will indicate the amount of water lost (if any) in every individual street. Since a Step Test isolates each street, only those streets with leakage will be indicated on the charts and only those streets will require investigation.

WHY DOES THE TRAINEE NEED THIS?

To find the leaks, the trainee must define the district where leaks are suspected or which is part of his overall detection plan.

WHAT DOES THE TRAINEE NEED TO KNOW BEFORE BEGINNING?

The trainee should be able to:

1. Read engineering drawings and plans.
2. Recognize various components in piping such as types of valves, tees, elbows, spigots, etc.
3. Operate a leak detection meter.
4. Recognize a leak by using a sounding rod or a leak detection meter.
5. Keep records and take field notes as directed.
6. Supervise and lead his workers in their work; installation of a meter; opening and closing valves; as well as sounding the valves.

WHAT EQUIPMENT AND SUPPLIES ARE NEEDED?

ITEM	LESSONS				
	1	2	3	4	5
Leak Detection Meter	x				x
(3) three hour chart	x				x
A plan of the district		x	x		x
Pencil		x	x	x	x
Valve tool			x		x
Sounding Rod			x		x
Note pad				x	

WHAT SUPPLEMENTARY MATERIALS WILL HELP?

District plan and notes from previous two units.

WHAT ARE THE OBJECTIVES?

The trainee will <u>be able to</u>:

1. (1) Explain the function of a circulating valve.

   (11) Identify the circulating valves.

   (111) Select the valves to be operated

2. Locate and operate the circulating and boundary valves selected for the Step TEst.

3. Construct a check list for performing a Step Test.

4. Plan and perform a Step Test.

NUMBER OF LESSONS AND TOTAL INSTRUCTIONAL TIME

Total Lessons: 5

Total Time: 16 hours - 20 minutes

TRAINING/JOB MANUAL — Leak Detection in a Water Distribution System

UNIT 3 — Step Test

LESSON 1  *IDENTIFYING CIRCULATING VALVES AND SELECTING VALVES TO BE OPERATED DURING STEP TEST*

ESTIMATED TIME — 1 hour

PREREQUISITES — Ability to read and interpret a plan.

PERFORMANCE OBJECTIVE:

- The trainee will <u>be able to</u>:

  explain the function of a circulating valve.
  identify the circulating valves.
  select the valves to be operated.

- Under the following <u>condition</u>:

  given a plan of the district.
  knowing the boundary valves.

- To this <u>standard</u>:

  all circulating valves must be identified.
  at least 24 valves should be selected and no more than 30.

TRAINING RESOURCES

Equipment and Supplies: A plan of the district

Information Sheets: U3:L1:IS:01, U3:L1:IS:02, U3:L1:IS:03.

TRAINING ACTIVITIES

TRAINER ACTIVITY	TRAINEE ACTIVITY
1. Trainer, using chalk board sketches and explains the function of circulating valves in the system.	1. Trainees listen, observe and take notes.
2. Trainer identifies a few circulating valves on the plan of the district U3:L1:IS:03, and gives reasons for his selection.	2. Trainees follow the explanations and discuss with the trainer.
3. Trainer and trainees discuss and identify all circulating valves, and boundary valves in the district.	3. Discussion
4. Trainer distributes and discusses U3:L1:IS:02 with the trainees.	4. Trainees read and discuss U3:L1:IS:02 with the trainer.
5. Trainer discusses and records on U3:L1:IS:02 the valves which can be conveniently operated during the Step Test.	5. Trainees participate in the discussion and record valves on U3:L1:IS:02.

N.B: An accepted practice is that about 24 valves should be operated during the Step Test.

OPERATION BREAKDOWN SHEET

L3:L1:IS:01

POSITION Plumber TASK Step Test

OPERATION Identifying circulating valves and selecting valves to be operated during the Step Test

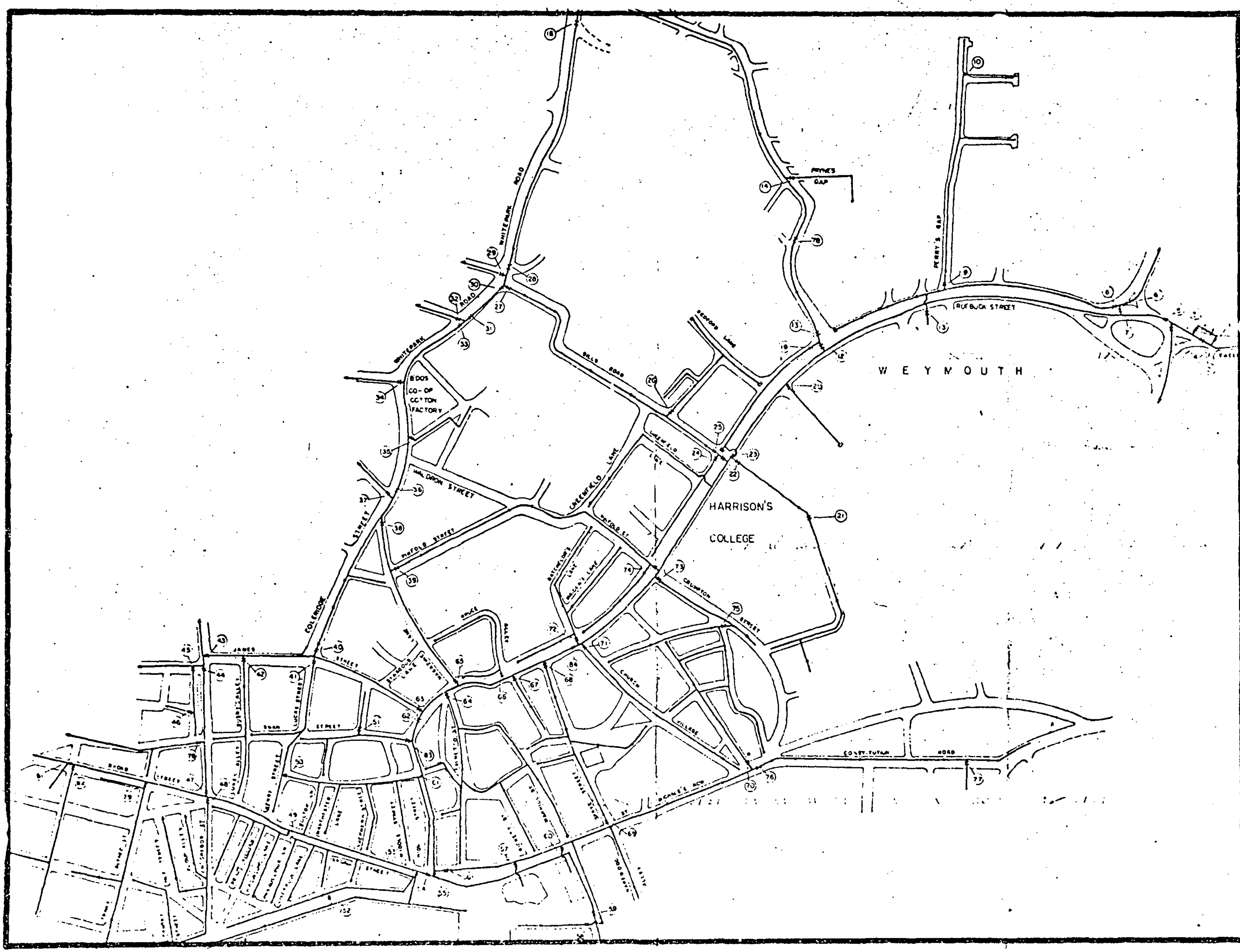
Important STEPS in the operation. STEP: A significant action which advances the operation towards completion	KEY POINTS: The key to doing the steps correctly, efficiently and accurately.
HOW HE DOES IT (STEP)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
1. Study plan of district. 2. Identify valves in the District. 3. Identify circulating vlaves. 4. Identify boundary valves. 5. Select valve to be operated during the Step Test. 6. Record valves on the relevant form. 7. Cross check to be sure that valve number and location on the plan is the same as on the form.	

WATERWORKS DEPARTMENT - BARBADOS

Waste Control - Programme Sheet

District Date of Test I/C Sheet of

Step No.	Valve No.	Location of Valve	LH/RH	Normally O/C	Time Valve Closed	Time Valve Opened	Boundaries of Step	No. of Services	Length of Mains	Remarks


WHITEPARK ROAD
PRYNE'S GAP
PERRY'S GAP
ROEBUCK STREET
W E Y M O U T H
BEDFORD LANE
HILLS ROAD
B'DOS CO-OP COTTON FACTORY
WALDRON STREET
GREENFIELD LANE
HARRISON'S COLLEGE
CRUMPTON STREET
COLERIDGE STREET
JAMES
STREET
SWAN STREET
LUCAS STREET
CHURCH
VILLAGE
CONSTITUTION ROAD
BROAD STREET

TEAINING/JOB MANUAL — Leak Detection in a Water Distribution System

UNIT 3 — Step Test

LESSON 2 — *LOCATING, OPERATING AND RECORDING 'FINDINGS' OF VALVES SELECTED*

ESTIMATED TIME — 1 - 2 hours

PREREQUISITES — Unit 3 Lesson 1

PERFORMANCE OBJECTIVE:

- The trainee will <u>be able to</u>:

  locate and operate the valves selected for the Step Test.
  write down the findings during the operation.

- Under the following <u>condition</u>:

  While in the field.

- To this <u>standard</u>:

  as outlined in the procedure.

TRAINING RESOURCES

Equipment and Supplies: A plan of the district, valve tool, sounding rod.

Information Sheets: U3:L2:IS:01, U3:L2:IS:02.

TRAINING ACTIVITIES

TRAINER ACTIVITY	TRAINEE ACTIVITY
1. Trainer and trainees identify the selected valves on the plan of the district. See U3:L2:IS:O2.	1. Identify selected valves.
2. Trainer and trainees identify the valve farthest away from the meter and discuss the best sequence for closing the valves.	2. Discussion.
3. Trainer and trainee travel through the district and locate each valve. The route with the shortest travelling time between valves is chosen and the reason is explained to the trainees. Trainees are also told why it is necessary to know the exact location and operation of each valve.	3. Trainees participate in locating each valve.
4. Trainer selects a few of the valves to be operated, and explains and demonstrates the procedure for closing these valves, and recording the findings.	4. Trainees listen, observe and participate in the demonstration.
5. Trainer allows trainees to practice the procedure for closing these valves, and recording the findings. Use U3:L2:IS:O2.	5. Trainees practice closing the valves and recording the findings under the guidance of the trainer. Use U3:L2:IS:O2.

N.B: If a particular valve cannot be closed in a 5 minute interval, then the true time the valve is closed should be recorded.

OPERATION BREAKDOWN SHEET

POSITION: Plumber TASK: Step Test

OPERATION: Locating, operating and recording the findings of the valves selected for the Step Test

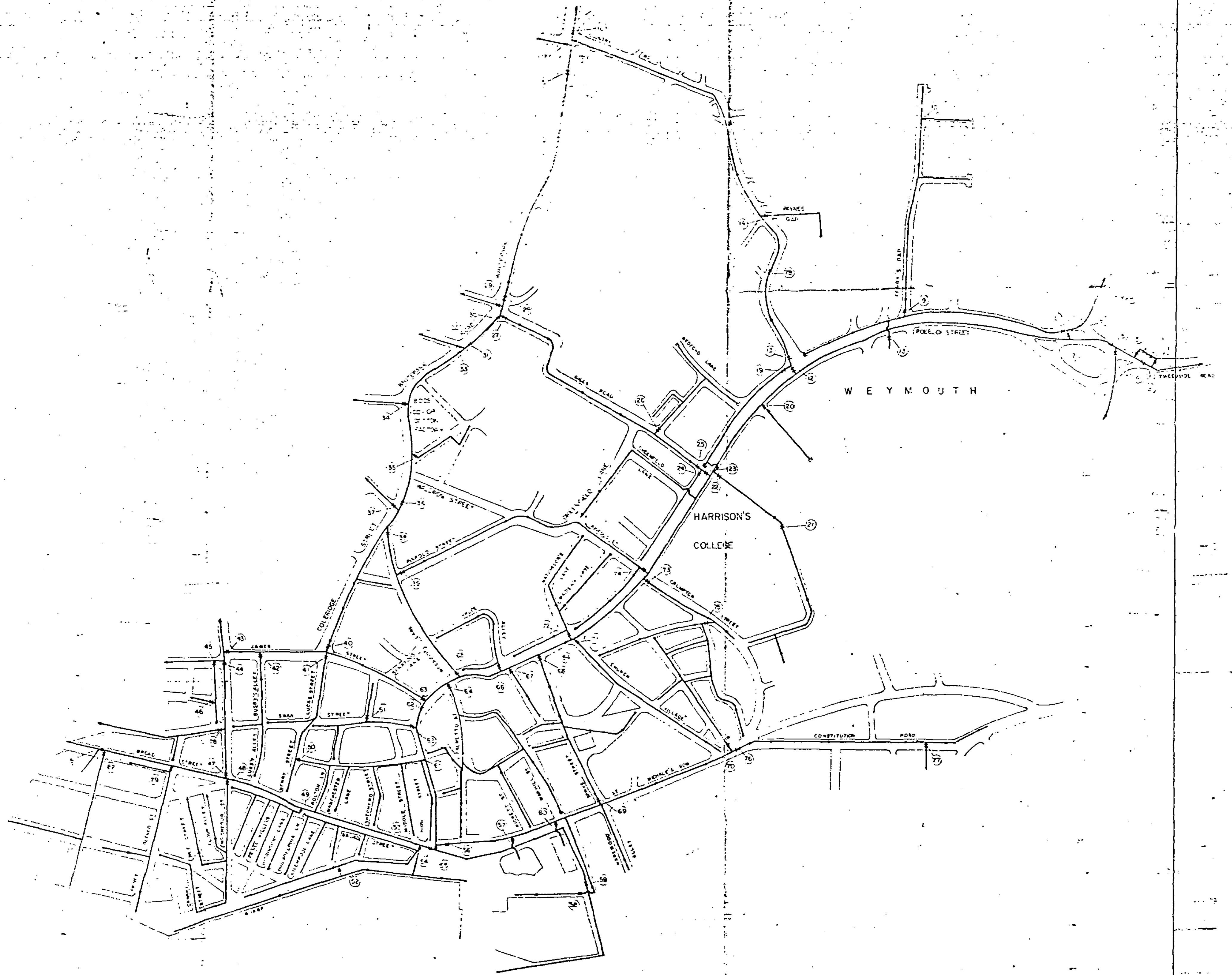
Important STEPS in the operation. STEP: a significant action which advances the operation towards completion.	KEY POINTS: the key to doing the steps correctly, efficiently or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
1. Locate valves.	1.1 Check plan for location of valves.
	1.2 Travel to location and determine actual position of the valve.
2. Check operation of each valve.	2.1 Observe valve box cover - square indicates L.H turn, round indicates R.H turn.
	2.2 Verify the operation of the valve - LH or RH.
	2.3 Check whether opened or closed.
	2.4 Check whether throttled or not.
3. Determine sequence for operating valve.	3.1 Operate the valve farthest away from the meter, or the valve which controls the section of main at the end of the area, first.
	3.2 Operate each valve and move toward the meter.
	3.3 In cases where the distance of the last valve is far from the meter, it might be convenient to shut off the "spurrs" first and work in sequence back to the meter.

OPERATION BREAKDOWN SHEET

POSITION: Plumber TASK: Step TEst

OPERATION: Locating, operating and recording the findings of the valves selected for the Step Test.

Important STEPS in the operation. STEP: a significant action which advances the operation towards completion.	KEY POINTS: the key to doing the steps correctly, efficiently or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
4. Close valve and record findings.	4.1 Half-close the valve. 4.2 Sound valve and record finding on on record sheet. 4.3 Check time and close valve on the minute - 5 minute after closure of last valve. 4.4 Sound valve tightly and record findings on record sheet. 4.5 Repeat 4.1 - 4.4 for each valve to be operated. NB: If by chance a particular valve cannot be closed in the 5 minute interval, then the true time the valve is closed should be recorded.



CIRCULATING VALVES S.T. ONLY				
VALVE NO	CLOSE R/L	LOCATION	TIME CLOSED	TIME OPEN
15				
27				
39				
[illegible]				
[illegible]				
65				
70				

BOUNDARY VALVES (NL + ST)				
VALVE NO	CLOSE R/L	LOCATION	TIME CLOSED	TIME OPEN
16				
17				
4				
8				
29				
[illegible]				
[illegible]				
[illegible]				
[illegible]				
[illegible]				
[illegible]				
[illegible]				
[illegible]				

STEP NO	VALVE NO	CLOSE R/L	LOCATION	TIME CLOSED	TIME OPEN	SOUND 1/2	SOUND FULL	REMARKS
1	9	R	PERRY GAP + ROEBUCK St					
2	12	R	COUNTRY ROAD + ROEBUCK STREET					
3								
4	23	R	GILLS RD. + ROEBUCK St					
5	74	R	PINFOLD STREET + ROEBUCK STREET					
6	73	R	CRUMPTONS STREET AND ROEBUCK STREET					
7	72	R	CHRICHLOWS ALLEY – ROEBUCK STREET					
8	71	R	CHURCH VILLAGE – [illegible] STREET					

STEP NO	VALVE NO	CLOSE R/L	LOCATION	TIME CLOSED	TIME OPEN	SOUND 1/2	SOUND FULL	REMARKS
9	68	R	SPRY STREET + ROEBUCK St					
10	66	R	BRUCE ALLEY + ROEBUCK St					
11	65	R	MAGAZINE LANE + ROEBUCK STREET					
12	64	R	PALMETTO SQUARE					
13	83	R	SWAN STREET + HIGH STREET					
14	61	R	VICTORIA STREET AND HIGH STREET					
15	48	R	CORNER HARRISON AND BROAD STREET					
16	79	R	PLANTATION ROAD [illegible]					

STEP NO	VALVE NO	CLOSE R/L	LOCATION	TIME CLOSED	TIME OPEN	SOUND 1/2	SOUND FULL	REMARKS
17	49	R	MIDWAY BROAD STREET					
18	53	R	WHARF + BROAD ST.					
19	54	R	TOP OF BROAD STREET					
20	76	R	CONSTITUTION ROAD					
21	28	R	WHITEPARK + GILLS RD.					
22	36	R	WHITEPARK AND SOBERS LANE					
23	40	R	COLERIDGE STREET AND JAMES STREET					
24	41	R	JAMES STREET AND LUCAS STREET					

STEP NO	VALVE NO	CLOSE R/L	LOCATION	TIME CLOSED	TIME OPEN	SOUND 1/2	SOUND FULL	REMARKS
25	42	L	BUSBY ALLEY + JAMES St					
2	56	R	TRAFALGAR St CONSTITUTION + BROAD St					
27	63	R	JAMES STREET + ROEBUCK STREET					
28	62	R	MIDWAY & JAMES St					
29	84	R	MIDWAY AND CARLTON BROWNE					
30	8	R	ROEBUCK STREET AND HINDSBURY ROAD					
31	3	R	METER					

WATERWORKS DEPARTMENT

BARBADOS

8

TRAINING/JOB MANUAL — Leak Detection in a Water Distribution System

UNIT 3 — Step Test

LESSON 3 — *CONSTRUCTING A CHECK LIST FOR PERFORMING A STEP TEST*

ESTIMATED TIME — 1 hour

PREREQUISITES — Completion of Unit 2 and U3:L1 & U3:L2.

PERFORMANCE OBJECTIVE:

- The trainee will <u>be able to</u>:

  construct a check list for performing a Step Test.

- Under the following <u>condition</u>:

  given a check list for performing a Night Line and operation break down sheet for previous lesson in this unit.

- To this <u>standard</u>:

  all operations and important steps must be included. the sequence must be correct.

TRAINING RESOURCES

Equipment and Supplies: Pencil and note pad.

Information Sheets: U3:L3:IS:01,

TRAINING ACTIVITIES

TRAINER ACTIVITY	TRAINEE ACTIVITY
1. Trainer divides trainees into groups, and instructs them to study check list for Night Line as well as Operation Breakdown Sheets, and training activities for Unit in order to develop a check list for Step Test. Refer to check list for Night Line U2:L5:IS:01 & U2:L5:IS:02.	1. Develop check list for step test.
2. Trainer allow leaders of the groups to read their draft check list.	2. Trainee leaders read their draft and each is discussed.
3. Trainer distributes U3:L3:IS:01 for discussion.	3. Trainees read and discuss U3:L3:IS:01, and compare to their drafts.

Check List for Performing a Step Test Using a Leak Detection Meter on By-pass

1. Install Meter on by-pass.	1.1 Select correct size meter 3", 4", or 6".
	1.2 Select correct number and size gaskets, bolts and nuts.
	1.3 Select correct tools.
	1.4 Locate meter chamber.
	1.5 Fit meter so that arrow on meter points in same direction as water flow.
	1.6 Fit gaskets and bolt meter to branch, pipe following procedure outlined.
2. Check for leaks.	2.1 Close valve on main line.
	2.2 Open inlet valve slowly, then open outlet valve slowly.
	2.3 Check valves for leaks, pipe for splits, and gaskets for leaks.
	2.4 If leaks, repair leaks and repeat steps 2.1 - 2.3.
	2.5 If no leak, (i) close inlet valve (ii) outlet valve and (iii) open valve on main line.
3. Close boundary valves.	3.1 Check plan to locate boundary valves.
	3.2 Travel to each valve and observe condition, whether throttled or not, when closing.
	3.3 Observe strictly the procedure for sounding and closing valves.

Check List for Performing a Step Test
Using a Leak Detection Meter on By-pass

4. Close circulating valves.	4.1 Check plan to locate circulating valves.
	4.2 Check plan to see whether valve is opened or closed.
	4.3 Travel to each valve, observe condition, whether throttled or not, when closing.
	4.4 Observe strictly the procedure for sounding and closing valves.
5. Fit (3) three hour chart on meter.	5.1 Select correct type chart 3", 4", or 6".
	5.2 Remove drum from cradle.
	5.3 Fit chart as outlined in procedure.
	5.4 Adjust (3) three hour gear on the clock.
	5.5 Fit clock into cradle.
	5.6 Fit drum into cradle.
	5.7 Make sure that 3 hour gear on clock mesh with 3 hour gear on drum.
	5.8 Replace pen arm, with pen as outlined in procedure.
	5.9 Place pen at zero position on the chart.
	5.10 Check time and place pen on correct time on the chart.
6. Perform Isolation Test.	6.1 Close valve on main line - all boundary valves must be already closed.
	6.2 Travel to hydrant at highest point and open it.

Check List for Performing a Step Test
Using a Leak Detection Meter on By-Pass

6. Perform isolation Test.	6.3 Close hydrant if flow drops in 2 to 3 minutes.
	6.4 If flow persist, close hydrant and check thoroughly for open. valve and connections.
	6.5 Proceed with Night-Line after locating and correcting discrepancy.
7. Divert Water through the meter.	7.1 Open inlet valve to the meter slowly and open the outlet valve slowly.
	7.2 The valve on the main line must be left closed.
	7.3 Using stop watch or other watch, verify after ten minutes that drum is rotating freely. Pen should have recorded 10 minutes on the chart.
8. Close valves to be operated at 5 minute intervals.	8.1 Check record sheets for valves to be operated.
	8.2 Cross check with plan for location of valves.
	8.3 Travel to each valve and operate it.
	8.4 Half close valve. Sound it, and record findings.
	8.5 Shut on the minute, sound, and record findings and time closed.
	8.6 Repeat 8.4 and 8.5 for each valve to be operated.

Check List for Performing a Step Test

Using a Leak Detection Meter on By-Pass

9. Remove (3) three hour chart.	9.1 Close inlet valve to meter and then close outlet valve.
	9.2 Release pen arm from the drum.
	9.3 Remove the drum from the cradle.
	9.4 Remove the chart from the drum.
	9.5 Replace the drum.
	9.6 Replace the pen arm and cover.
10. Return water to district by the original distribution.	10.1 Open valve on the main line.
	10.2 Open all valves previously closed.
	10.3 Observe strictly the throttling of valves.
	10.4 Sound each valve to be sure water is feeding through.
	10.5 Record time, on district plan, when valves were opened.

NB: In order to save time, the circulating valves can be closed during the day where it does not interfere with the distribution, or cause low pressures in the particular area.

TRAINING/JOB MANUAL	Leak Detection in a Water Distribution System
UNIT 3	Step Test
LESSON 4	*PERFORMING A STEP TEST*
ESTIMATED TIME	9 - 12 hours
PREREQUISITES	Ability to perform a Night Line

PERFORMANCE OBJECTIVE:

- The trainee will <u>be able to</u>:

  plan and perform a Step Test.

- Under the following <u>condition</u>:

  given the check list developed in U3:L4.

- To this <u>standard</u>:

  to the satisfaction of the trainer.

TRAINING RESOURCES

Equipment and Supplies:	See List of equipment and supplies at the front of the unit.
Information Sheet:	Refer to U2:L6:IS:01 and U3:L3:IS:01.

TRAINING ACTIVITIES

TRAINER ACTIVITY	TRAINEE ACTIVITY
1. Trainer and trainee discuss list and select ALL equipment and supplies, which will be needed to carry out the Step Test.	1. Trainees and trainer discuss list and select ALL equipment and supplies which will be needed to carry out Step Test.
2. Trainer and trainees discuss the sequence of operations and steps, necessary for the successful performance of a Step Test. Refer to U2:L6:IS:O1. & U3:L3:IS:O1.	2. Discussion
3. Trainer provides guidance and assistance during the Step Test.	3. Trainees carry out the step test, with the guidance and assistance of the trainer.

UNIT 4 *LOCATING AND REPAIRING LEAKS*

WHAT IS THIS UNIT ALL ABOUT?

On completion of the Step Test the (3) three hour chart is studied and interpreted to determine the streets on which leaks are suspected.

This Unit deals with the procedure for identifying leaks which exist in a particular street as indicated by the results of the Step Test.

It can also assist the Supervisor in accelerating repairs to these leaks.

WHY DOES THE TRAINEE NEED THIS?

The satisfactory conclusion of Leak Detection survey lies in the ultimate location and repair of leaks.

WHAT DOES THE TRAINEE NEED TO KNOW BEFORE BEGINNING?

The Trainee should be able to:

1. Prepare a district for Leak Detection.
2. Perform a Night Line.
3. Perform a Step Test.

WHAT SUPPLIES AND EQUIPMENT ARE NEEDED?

ITEM	LESSONS		
	1	2	3
(3) three hour chart	x		
Leak Detection Equipment		x	
Pencil	x	x	x
Note Pad	x	x	x
Area Plan	x		

WHAT SUPPLEMENTARY MATERIALS WILL HELP?

None.

WHAT ARE THE OBJECTIVES?

The trainee will <u>be able to</u>:

1. Review a (3) three hour chart and Record the streets suspected of leaks.

2. Supervise a search party and demonstrate how to detect leaks.

3. List the tasks for supervising a leak repair crew.

TRAINING/JOB MANUAL	Leak Detection in A Water Distribution System
UNIT 4	Locating and Repairing Leaks
LESSON 1	*REVIEWING CHART TO DETERMINE STREETS WITH LEAKS*
ESTIMATED TIME	30 minutes
PREREQUISITES	Ability to read and interpret a chart

PERFORMANCE OBJECTIVE:

- The trainee will <u>be able to</u>:

  Review a (3) three hour chart and record streets suspected with leaks.

- Under the following <u>condition</u>:

  After carrying out a Step Test.

- To this <u>standard</u>:

  All streets suspected of leaks must be identified

TRAINING RESOURCES:

Equipment and supplies:	(3) three hour chart
	Area Plan
Information Sheet:	U4:L1:IS:01 - 02.

TRAINING ACTIVITIES

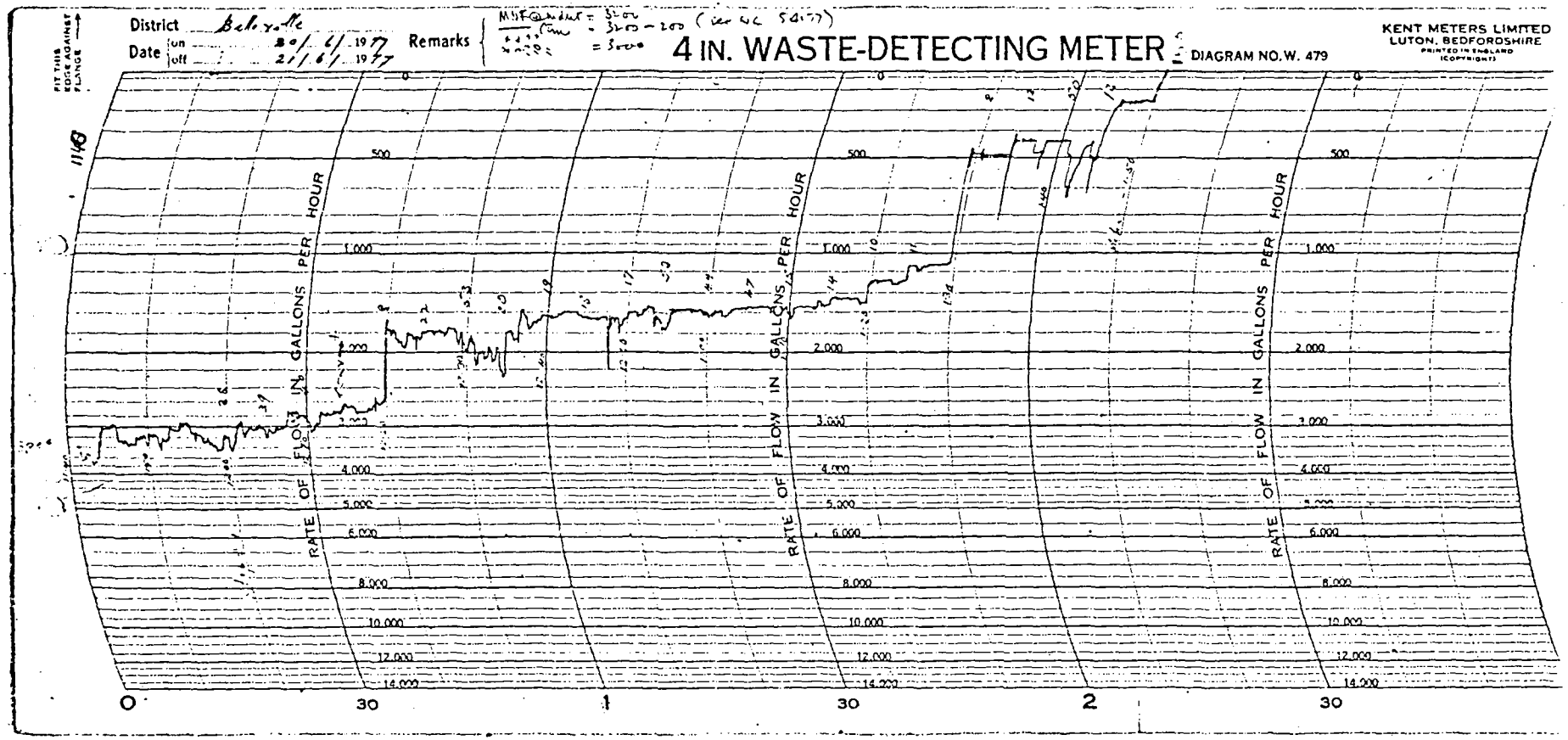
TRAINER ACTIVITY	TRAINEE ACTIVITY
1. Trainer distributes and discusses chart used during a Step Test. Trainer explains the significance of Sharp "jump" or "drops" on the chart.U4:L1:IS:02.	1. Trainees read and discuss the chart with the trainer.
2. Trainer and trainees study each street in relation to the results on the chart, and decide whether or not it should be checked for leaks.	2. Study with trainer.
3. Trainer asks trainee to complete a list of the streets that should be checked for leaks.	3. Trainees make a list of the streets that should be checked for leaks.

OPERATION BREAKDOWN SHEET

POSITION: *Superintendent* TASK: *Interpret chart*

OPERATION: *Review chart to determine streets with leaks*

Important STEPS in the operation. STEP: a significant action which advances the operation towards completion.	KEY POINTS: the key to doing the steps correctly, efficiently or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
1. *Receive and review chart.*	1.1 *Look at chart.* 1.2 *Read graph. Look for large and sharp "jump" or "drop" (at least 200 gph).* 1.3 *Read graph for whole test period. Record other leaks (if found).* 1.4 *Determine valve numbers and street where "jump" occured on chart.*
2. *Review with searchers.*	2.1 *Indicate which streets and between which valve numbers to search for leaks.* 2.2 *Determine street on area plan.*



3 HOUR CHART AFTER COMPLETION OF STEP TEST

TRAINING/JOB MANUAL	Leak Detection in a Water Distribution System
UNIT 4	Locating and Repairing Leaks
LESSON 2	*SUPERVISING AND DEMONSTRATING HOW TO DETECT LEAKS*
ESTIMATED TIME	3 Hours
PREREQUISITES	Unit 4, Lesson 1

PERFORMANCE OBJECTIVE:

- The trainee will be able to:

  Supervise a search party and deomonstrate how to detect leaks.

- Under the following condition:

  Given a list of streets suspected of leaks.

- To this standard:

  All leaks must be located, marked and recorded.

TRAINING RESOURCES:

Equipment and Supplies:	Leak Detection equipment List of streets suspected of leaks.
Information Sheet:	U4:L2:IS:01.

TRAINING ACTIVITIES

TRAINER ACTIVITY	TRAINEE ACTIVITY
1. Trainer and Trainees discuss the type of equipment used to detect leaks.	1. Discussion
2. Trainer and Trainees review list of streets which must be checked for leaks.	2. Review
3. In the field the trainer explains and demonstrates the procedure for detecting leaks. Refer to U4:L2:IS:01	3. Trainees listen, observe and participate.
4. Trainer supervises and assists trainees in the location of leaks.	4. Trainees locate and record leak under the supervision of the trainer.

OPERATION BREAKDOWN SHEET

POSITION *Supervisor* TASK *Locate and Repair Leaks*

OPERATION *Supervising Search Party and Demonstrating how to detect Leaks*

Important STEPS in the operation. STEP: A significant action which advances the operation towards completion	KEY POINTS: The key to doing the steps correctly, efficiently and accurately.
HOW HE DOES IT (STEP)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
1. *Select leak detection equipment.*	1.1 *Know who is responsible for storage and maintenance of equipment.* 1.2 *Know the various types of leak detection equipment.* 1.3 *Know the conditions under which each type is used or the specific use of each type.* 1.4 *Know how to use or operate each type of equipment.*
2. *Review list of streets suspected of leaks*	2.1 *Cross check list with plan of the district.*
3. *Travel to district and locate each street.*	
4. *Locate valves between which the leaks are suspected.*	
5. *Check service connection between valves.*	5.1 *Locate the first service connection between the valves.* 5.2 *Open the ferrule column and sound ferrule with a sounding rod.* 5.3 *If sound, ask consumer to shut all water outlets.* 5.4 *Shut boundary stop cock and sound again.*

OPERATION BREAKDOWN SHEET

POSITION: *Supervisor* TASK: *Locate and Repair Leaks*

OPERATION: *Supervising a Search Party and demonstrating how to detect leaks*

Important STEPS in the operation. STEP: a significant action which advances the operation towards completion.	KEY POINTS: the key to doing the steps correctly, efficiently or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
5. *Check service connections between valves.*	5.5 *If sound, burst between stop cock and ferrule or leaking ferrule.* 5.6 *If no sound, open stop cock and listen again.* 5.7 *If sound, leak on consumer's service pipe.* 5.8 *Make appropriate mark on asphalt in the road.* 5.9 *Record the location on form/notes.* 5.10 *If no leaks proceed to next service connection.* 5.11 *Repeat for each service connection. between valves.*
6. *Check main between valve.*	6.1 *Sound the line of the main between the valves at (2) two feet intervals.* 6.2 *If there is a sound of water escaping follow the sound until it is loudest.* 6.3 *Mark the spot.* 6.4 *Record the location on form/notes.*

OPERATION BREAKDOWN SHEET

POSITION: *Supervisor* TASK: *Locate and Repair Leaks*

OPERATION: *Supervising a Search Party and demonstrating how to detect leaks.*

Important STEPS in the operation. STEP: a significant action which advances the operation towards completion.	KEY POINTS: the key to doing the steps correctly, efficiently or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
NB: The quantity of leaks indicated by the chart is usually due to the faults on the service connections. *The main between the valves is checked only when the quantity of leaks on the service connection does not equate to that indicated by the chart.*	

TRAINING/JOB MANUAL	Leak Detection in a Water Distribution System
UNIT 4	Locating and Repairing Leaks
LESSON 3	*SUPERVISING A LEAK REPAIR CREW*
ESTIMATED TIME	45 minutes
PREREQUISITES	Unit 4, Lesson 2

PERFORMANCE OBJECTIVE:

- The trainee will be able to:

  list the tasks for supervising a leak repair crew.

- Under the following condition:

  given the location of the leaks.

- To this standard:

  all tasks must be recorded.

TRAINING RESOURCES

Equipment and Supplies: Pencil and note pad.

Information Sheet: U4:L3:IS:01.

TRAINING ACTIVITIES

TRAINER ACTIVITY	TRAINEE ACTIVITY
1. Trainer and trainees discuss and list the equipment and supplies used to repair leaks. See U4:L3:IS:01.	1. Discussion
2. Trainer and trainees discuss and list ways in which the repair crew is helped to locate the leaks.	2. Discussion
3. Trainer and trainees discuss the inputs which the supervisor will make in the field to assist the repair crew.	3. Discussion.

OPERATION BREAKDOWN SHEET

POSITION: *Supervisor* TASK: *Locate and repair Leaks*

OPERATION: *Supervising a Leak Repair Crew*

Important STEPS in the operation. STEP: a significant action which advances the operation towards completion.	KEY POINTS: the key to doing the steps correctly, efficiently or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
1. *List repair equipment.*	1.1 *Include, picks, shovels, valves connection pipe, ferrules, ferrule washers, tap washers, hydrants taps and stop cocks (all sizes). W.C bowls, valves, solder PR V/washers.*
2. *Direct crew to location of leak.*	2.1 *Prepare list of streetswith leaks.* 2.2 *Discuss location of leaks with crew using a plan.* 2.3 *Explain how to identify (i) the places to be excavated and repaired (ii) service connections to be repaired.*
3. *Travel to district.*	3.1 *Point out mark where excavation and repair is to be done.* 3.2 *Point out service connections to be repaired.* 3.3 *Supervise excavation.* 3.4 *Explain precautions (i) check for other service lines (ii) do not damage water main during excavation.* 3.5 *Explain to repair crew how to record materials used, and other relevant information.* 3.6 *Supervise repair work.*

OPERATION BREAKDOWN SHEET

POSITION: *Supervisor* TASK: *Locate and repair leaks*

OPERATION: *Supervising a Leak Repair Crew*

Important STEPS in the operation. STEP: a significant action which advances the operation towards completion.	KEY POINTS: the key to doing the steps correctly, efficiently or accurately.
HOW HE DOES IT (Step)	POINTERS TO BE OBSERVED IN PERFORMING THE STEP
3. *Travel to district*	3.7 *Report to supervisor officer(s) problems that are outside the responsibility of the supervisor.* 3.8 *Check work done on service connections.* 3.9 *Act a laison between repair crew and beligerant customers.* 3.10 *Act as a source of information for enquiring consumers.* 3.11 *Check "back fill" to be sure it meets required standard.*