

## CHAPTER 4: SANITARY APPLIANCES

**Unit of learning code: CON/CU/PL/CR/04/5/A**

**Related Unit of Competency in Occupational Standard: Install Sanitary Appliances**

### **4.1 Introduction to the unit of learning**

This unit specifies the competencies required to install sanitary appliances. It involves preparing simple working drawings, quantifying and costing sanitary appliances, fixing sanitary appliances and testing and commissioning working of sanitary appliances. It is applied in the construction industry

### **4.2 Summary of Learning Outcomes**

1. Prepare working drawings
2. Quantify sanitary appliances
3. Fix sanitary appliances
4. Test and commission working of sanitary appliances

#### **4.2.1 Learning Outcome 1: Prepare working drawings**

##### **4.2.1.1 Introduction to the learning outcome**

This learning outcome specifies the different working drawings that a plumber will encounter when carrying out sanitary installations. The plumber will be able to interpret and understand how to fit various components from the information contained in the working drawings and specifications.

Preparing simple working drawings,

##### **4.2.1.2 Performance Standard**

1. Drawings are identified and selected based on the job.
2. Scale of the drawing is determined based on the *specifications*.

3. Measurements are converted based on scale.
4. Symbols are identified based on best practices.
5. Sanitary appliances are identified based on the drawing
6. Simple working drawings are Prepared based on specifications
7. Isometric working drawings are drawn based on best practices.
8. Manufacturers drawing of sanitary appliances are interpreted as presented.
9. Assembling of sanitary appliances is identified and interpreted as per manufacturers' drawing.

#### **4.2.1.3 Information Sheet**

##### **Definitions of terms**

- ***Working drawings*** - A comprehensive set of drawings used in a building construction project. They include architectural, structural and other engineering drawings.
- ***Symbol*** is a simplified image of component or things they represent.
- ***Blueprint*** is a reproduction of a technical drawing or engineering drawing using a contact print process on light-sensitive sheets.
- ***A plan*** a view from above showing the arrangement of spaces in building in the same way as a map, but showing the arrangement at a particular level of a building
- ***An elevation*** is a view of a building seen from one side, a flat representation of one front of a building
- ***Block plan*** used in identifying the site and locate the outline of the building in relation to the surrounding.
- ***Cross section***, also simply called a section, represents a vertical plane cut through the object, in the same way as a floor plan is a horizontal section viewed from the top
- ***Detail drawings*** show a small part of the construction at a larger scale, to show how the component parts fit together.

- *Specification* is a precise description of the materials and methods of workmanship to be employed while carrying out the contract work
- *Schedules* give tables of information on ranges of similar items
- *Bill of Quantities* is a measure or price of the amount of materials and labor and other items required for the building work.
- *Ancillary equipment* is machines and other technical things which are used with the main items of equipment to create a complete system.

### **Types of Drawings**

At the design stage, sketch drawings and preliminary drawings will be used to show the designer's intentions. Sketch drawings are also often used by site supervisors and craftsmen to show other operatives how a particular problem might be resolved or how a component can be fabricated on site. Once the design is accepted, production of the working drawings can be done.

These drawings are used in a range of fields namely;

- Mechanical drawings - show information about heating, ventilating, air conditioning and plumbing details in a building.
- A structural drawing includes a plan or set of plans and details for how a building or other structure will be built. They are generally prepared by registered professional engineers, and based on information provided by architectural drawings.
- Architectural drawings are an illustration of what the final product will look like plus an instructional tool on how to achieve it. Architectural drawings can be devoted to depicting an overview of the building i.e., an elevation or they can focus on a particular detail.
- A plumbing drawing, a type of technical drawing, shows the system of piping for fresh water going into the building and waste going out, both solid and liquid. It also includes fuel gas drawings. Mainly plumbing drawing consist of water supply system drawings, drainage system drawings, irrigation system drawings, storm water system drawings.

## Scales in Drawings

Scaling is used to enlarge or reduce a drawing in size while keeping the proportions of the drawing the same. Scales are generally expressed as ratios and the most common scales used in furniture drawing are 1:1, 1:2, 1:5, and 1:10 for reducing and possibly 2:1 for enlarging.

Scaling is used to either:

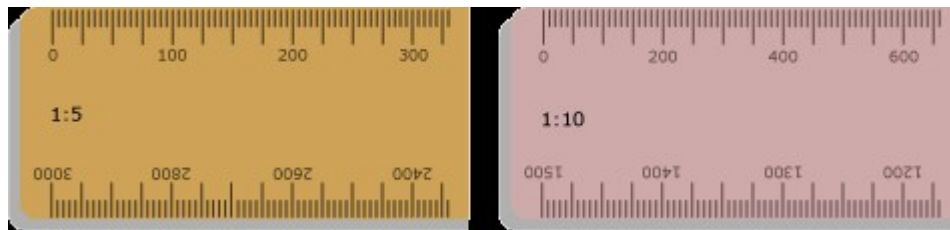
- i. reduce the drawing in size so that it will fit onto the page, or
- ii. enlarge the drawing in size so that all required details are clearly visible.

Scale rules allow us to directly set out measurements onto a drawing without having to convert them to their scaled sizes by using a calculator first.

The whole process is made easier because these conversions are already made for us. On a scale rule which has divisions of 1:5, each division represents 5mm and the measurements on the rule indicate this.

Scale rulers.

On a scale rule which has divisions of 1:10 each division represents 10mm and the measurements on the rule indicate this.



## Conversions of Measurements Based on Scale

Making a measurement smaller or larger is known as scale conversion and requires a common scale factor, which can be used to multiply or divide all measurements by.

To scale a measurement to a smaller measurement, for instance when making a blueprint, simply divide the real measurement by the scale factor. The scale factor is commonly expressed as 1: n or  $1/n$ , where n is the factor.

For example, if the scale factor is 1:8 and the real measurement is 32, divide  $32 \div 8 = 4$  to convert.

To convert a measurement to a larger measurement simply multiply the real measurement by the scale factor.

For example, if the scale factor is 1:8 and the measured length is 4, multiply  $4 \times 8 = 32$  to convert.

### Reducing the Scale Factor

The methods above to convert a measurement assume the scale factor is in the form of 1: n or  $1/n$ , which means some additional work is needed if the ratio is 2:3, for example. When the scale factor is not in an even 1: n ratio it will need to be reduced to 1: n. Use our ratio calculator to reduce a ratio. A ratio can also be reduced by dividing both the numerator and the denominator by the numerator.

For example:  $2/3$  can be reduced by dividing both numbers by 2, which would be  $1/1.5$  or 1:1.5.

$$2 \div 2 = 1$$















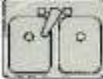



$$3 \div 2 = 1.5$$

scale factor = 1:1.5

### Plumbing symbols

Plumbing symbols are used when drawing house plans and isometric plumbing drawings. The purpose of these symbols is to indicate where the different elements of the plumbing system are positioned.

Table 14: Plumbing symbols for sanitary appliances

	<b>WC</b>	Toilet, floor outlet		<b>LAV</b>	Lavatory
	<b>WC</b>	Toilet, wall hung			Bathtub, recessed type
	<b>WC</b>	Toilet, tank type		<b>DF</b>	Drinking fountain, floor mounted
		Bidet			Drinking fountain, wall hung
	<b>UR</b>	Urinal, wall hung		<b>SHWR</b>	Shower, stall type
	<b>S</b>	Sink, general			Shower, handcapped
	<b>FS</b>	Sink, floor		<b>HWT</b>	Hot Water Tank
	<b>KS</b>	Sink, kitchen		<b>WH</b>	Water Heater
	<b>MS</b>	Sink, mop			
	<b>SS</b>	Sink, utility			

**Table 15:** *plumbing symbols*

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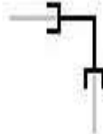
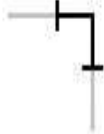




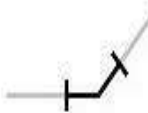



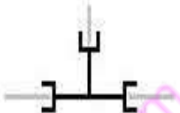
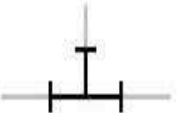




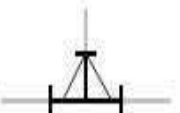









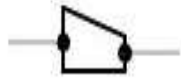
Image	Fittings	Butt weld Symbol	Socket Weld Symbol	Threaded Symbol	Fittings	Image
	Elbow 90°				Elbow 90°	
	Elbow 45°				Elbow 45°	
	Tee equal				Tee equal	
	Tee reducing				Tee reducing	
	Cap				Cap	
	Reducer concentric		...	...	Reducer concentric	...
	Reducer eccentric		...	...	Reducer eccentric	...
Image	Fittings	Butt weld Symbol	Socket Weld Symbol	Threaded Symbol	Fittings	Image



Image	Valves	Butt weld Symbol	Flanged Symbol	Socket or Threaded Symbol	Valves	Image
	Gate				Gate	
	Globe				Globe	
	Ball				Ball	
	Plug				Plug	
	Butterfly			...	Butterfly	
	Needle				Needle	
	Diaph	...			Diaph	
	Y-type				Y-type	
	Three way				Three way	
	Check				Check	
	Bottom	...		...	Bottom	
	Relief	...		...	Relief	
	Control straight	...		...	Control straight	
	Control angle	...		...	Control angle	
Image	Valves	Butt weld Symbol	Flanged Symbol	Socket or Threaded Symbol	Valves	Image

## **Isometric Pipework Drawings**

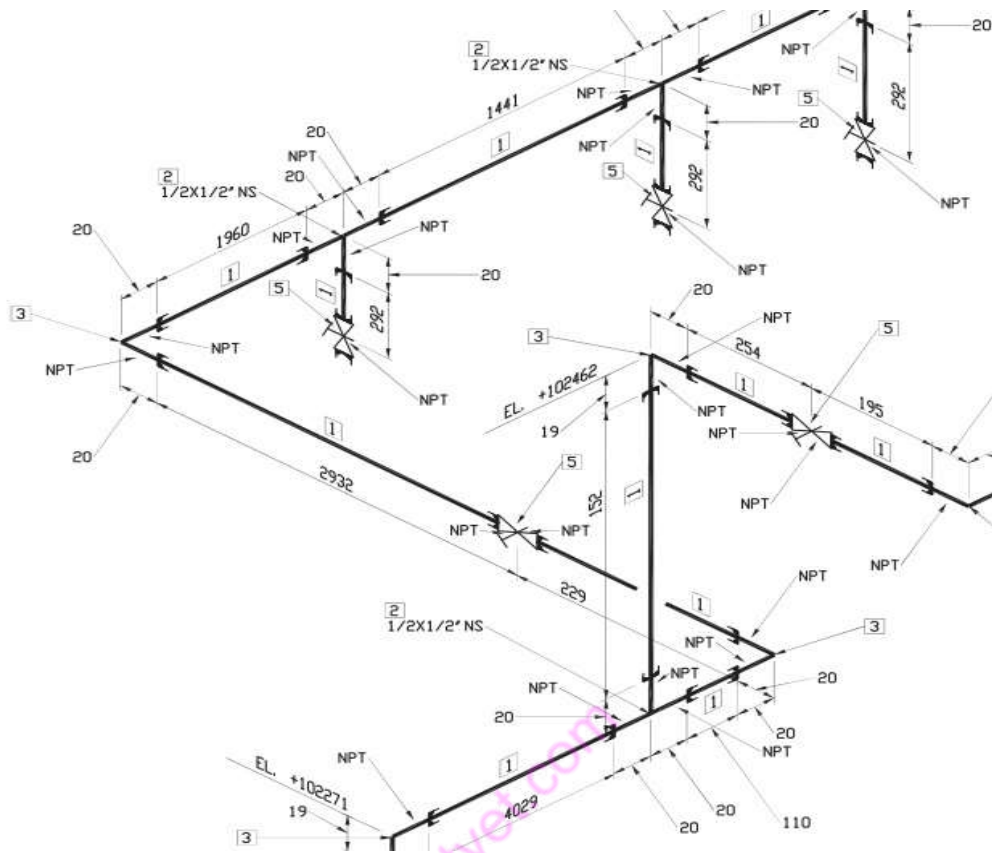
Piping isometric drawing is an isometric representation of single pipe line in a plan. It is the most important deliverable of piping engineering. Piping fabrication work and assembly is based on isometric drawings.

Piping isometric drawing consists of three sections. Main graphic section consists of isometric representation of a pipe line route in 3D space, which includes following information:

- vi. Line number.
- vii. Flow Direction.
- viii. Support Tags and location.
- ix. Piping Components location.
- x. Weld Locations.

*Example of a pipework isometric drawing*

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Section on left or right side of a Plumbing drawing consists of a schedule of Material Section for the portion of line shown in isometric graphic. It includes following information for all components:

- vii. Component Description.
- viii. Component Material Code.
- ix. Nominal Size.
- x. Quantity.
- xi. Whether shop material or field material.
- xii. Number of Spools.

Title bar section at the bottom consists of following information:

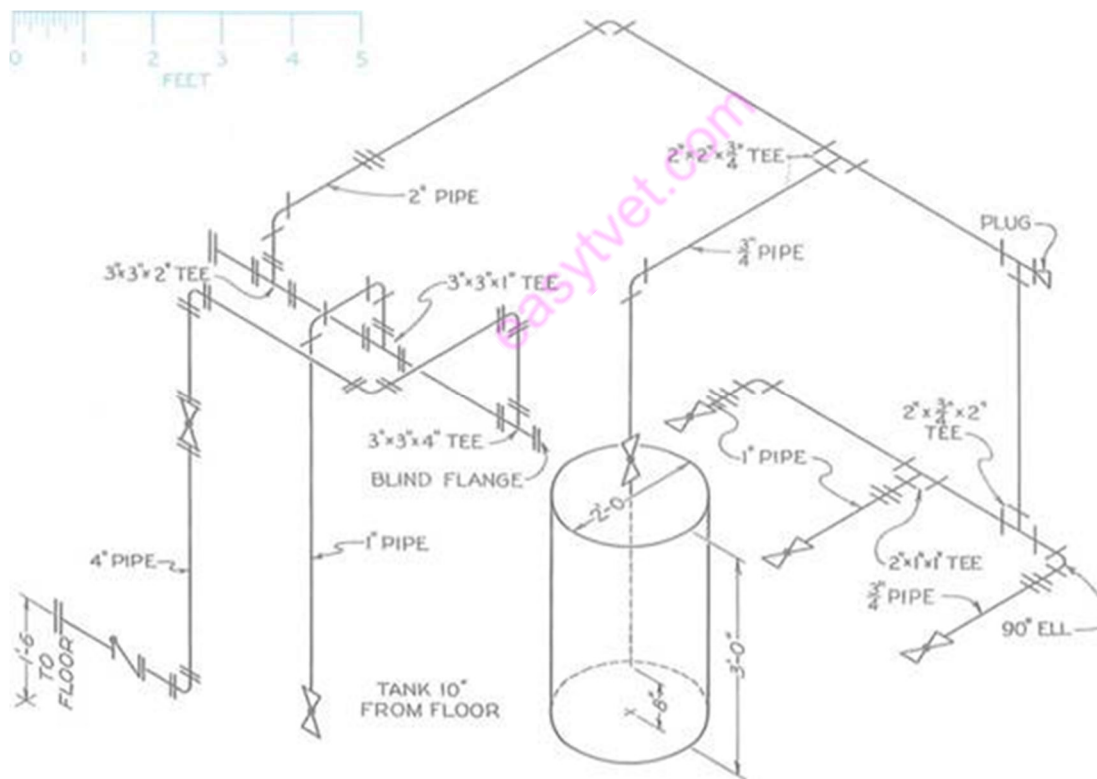
- Project details such as client name

- engineering office name
- project name
- project number

#### 4.2.1.4 Learning Activities

Produce a freehand sketch of the isometric pipework diagram shown below.

*isometric pipe drawing*



#### Materials Required

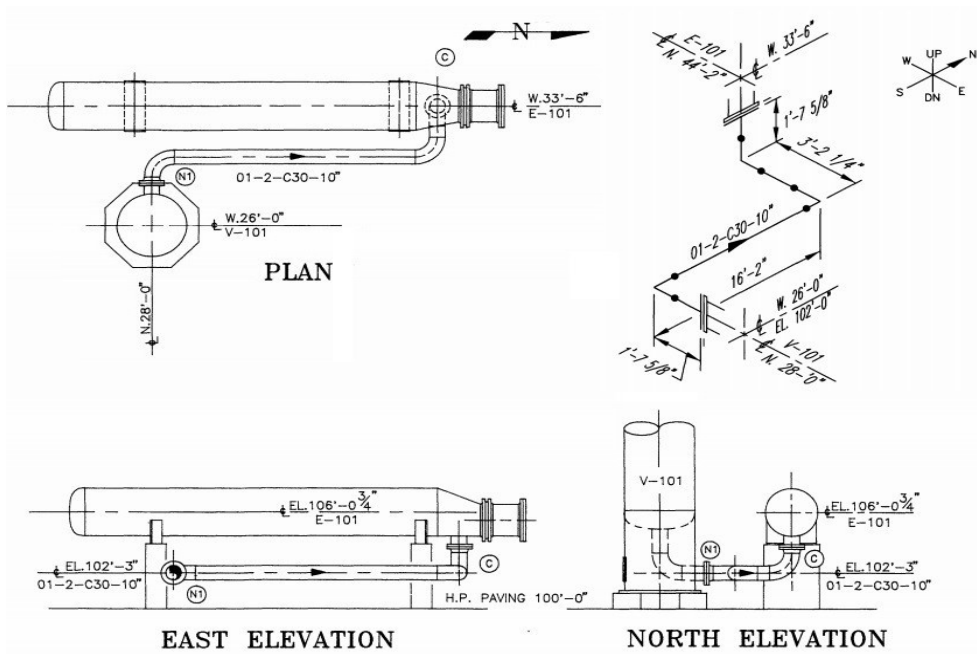
- Scale rule
- Pencils
- Eraser
- Drawing paper
- Drawing board
- T-square

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#### **4.2.1.5 Self-Assessment**




1. What does a 1/2 scale mean?
2. Draw a free hand sketch of the isometric pipework drawing shown below.



*isometric pipework drawing*



Match column A with column B.

Table 16: Plumbing symbols questions

A	B
Symbol	
1. Tee	A. WC
2. Elbow 90°	B. 
3. Wye	C. 
4. Union	D. LAV
5. Elbow 45°	E. 
Abbreviation	
6. Water Closet	F. UR
7. Shower	G. SH

8. Lavatory	H. 
9. Floor Drain	I. 
10. Urinal	J. FD

Convert the following measurements as required in the given.

a. 64 cm ----- inches

b. 59 yards----- feet

c. 95.5 dm -----meter

d. 19 inches -----centimetre

e. 47 feet ----- inches

f. 4 m -----cm

g. 9 yards feet

h. 5.5 dm ----- meter

i. 9meters ----- centimetre

j. 7 feet -----inches

#### 4.2.1.6 Tools, Equipment, Supplies and Materials

- Scale rule
- Pencils
- Eraser
- Drawing paper
- Drawing board
- T-square

#### **4.2.1.7 References**

Mays, L., 2001. Water resources engineering. New York: Wiley.

Cauldwell, R., 2005. Remodel plumbing. Newtown, CT: Taunton Press, pp.24-35.

Blower, G., (2007). Plumbing. Welwyn Garden City: Pearson Education UK.

Rendow Yee., (2002). Architectural drawings: a visual compendium of types and methods.

Thompson., (2007). Architectural design procedures, Second Edition. Architectural Press

#### **4.2.1.8 MODEL ANSWERS**

1. What does a 1/2 scale mean?
  - Half scale is 1:2. One unit on the drawing equals two units on the object. This means the drawing of the object is twice as large as the object itself.
2. Identify the symbols on this pipework isometric drawing.
  - Pipe
  - Flow direction
  - Coupler
  - Nipple



3. A. Identification

- i. Prints
- ii. Specifications
- iii. Symbols
- iv. Abbreviation

B. Matching Type

- 1. C
- 2. E
- 3. H
- 4. I
- 5. B
- 6. A
- 7. G
- 8. D
- 9. J
- 10. F

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C. Units conversion

1.  $64 \text{ cm} \times 1 \text{ inch} = 25.20 \text{ inch}$

$2.54 \text{ cm}$

2.  $59 \text{ yards} \times 3 \text{ ft} = 177 \text{ ft}$

$1 \text{ yard}$

3.  $95.5 \text{ dm} \times 1 \text{ m} = 9.55 \text{ m}$

$10 \text{ dm}$

4. 19 inches x 2.54

cm = 48.26cm

1 inch

5. 47 feet x 12 inches = 5.64 inches

6). 4 m -----400cm

7). 9 yards ----- 27 feet

8). 5.5 dm----- .55meter

9). 9meters ----- 900centimetre

10). 7 feet ----- 84inches

## 4.2.2 Learning outcome 2: Quantify sanitary appliances

### 4.2.2.1.Introduction to the learning outcome

This learning guide helps the trainee to identify the supplies and materials required for installation of sanitary appliances.

### 4.2.2.2.Performance Standard

1. Materials and Supplies required for fixing are identified based on requirements of the job.
2. Schedule of sanitary appliances is prepared based on the drawing.
3. Materials and supplies required are measured and estimated based on working drawings and specifications
4. Sanitary appliances are costed based on best practice

### 4.2.2.3.Information Sheet

#### Definitions of terms

- *Discharge Pipe*- means any pipe which is intended to convey discharges from sanitary fixtures or sanitary appliances and includes a waste pipe, combined waste pipe, branch discharge pipe and discharge stack
- *Drain* - pipe normally laid below ground level including fittings and equipment and intended to convey foul water or surface water to an outfall.
- *Drain vent pipe* means any pipe which is intended to permit the movement of air into and out of a drain or sewer
- *Fitting or Fixture* -any article which is intended to remain permanently attached to and form part of a building
- *Fixture discharge pipe* - a discharge pipe which is used to convey waste from a single sanitary fixture or sanitary appliance to a branch discharge pipe, a discharge stack or directly to
  - the drain
- *Fixture vent pipe* - a vent pipe which is connected to a fixture discharge pipe or the sanitary fixture itself
- *Foul water drainage system* - drains, joints. and fillings normally laid underground and used specifically for the conveyance of foul water from the plumbing system to an outfall
  - Gully trap* - a fitting designed to prevent foul air escaping from the drainage system and used to receive the discharge from waste pipes,
  - Sanitary appliance* - an appliance which is intended to be used for sanitation, but which is not a sanitary fixture.

#### Sanitary Appliances

Sanitary Appliances are referred to as sanitary fittings and include all fixed appliances in which water is either used for flushing foul matter away or in which water is used for cleaning, culinary and drinking purposes.

They are divided into two classes namely;

- a) Soil appliances – which includes WCs and urinals. The discharge is directed to the soil. The type of waste discharged is in the form of fluids with solid matter.
- b) Waste appliances – includes wash-basins, baths, showers, sinks and bidets. The discharge from these appliances is described as waste water. The type of waste discharged is in the form of soapy or oily water.

## **1. Soil appliances**

### **a) WC (Water Closet)**

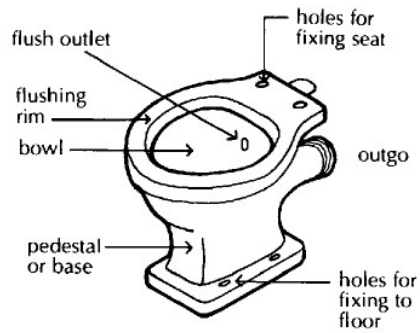
They include the WC (Water closet) and the urinal. The WC is a small room in which the early soiled water pans were enclosed when they replaced the original earth closets. A WC pan is a ceramic or metal bowl to take solid and liquid excrement, with an inlet for flushing and a trapped outlet. The seat is usually a plastic ring secured to the back of the pan. The usual flushing appliance is a cistern designed to discharge water rapidly into the pan through a flush pipe for cleaning and disposal of contents

### **Types of WC**

#### **i. Pedestal WC**

The pan is secured to the floor with screws through holes in the pedestal base to timber plugs in solid floors. The flushing rim is designed to spread the water which discharges through the flush outlet around the pan to wash down the side of the bowl. Spigot end connections for the waste pipe are moulded integrally with the pan.

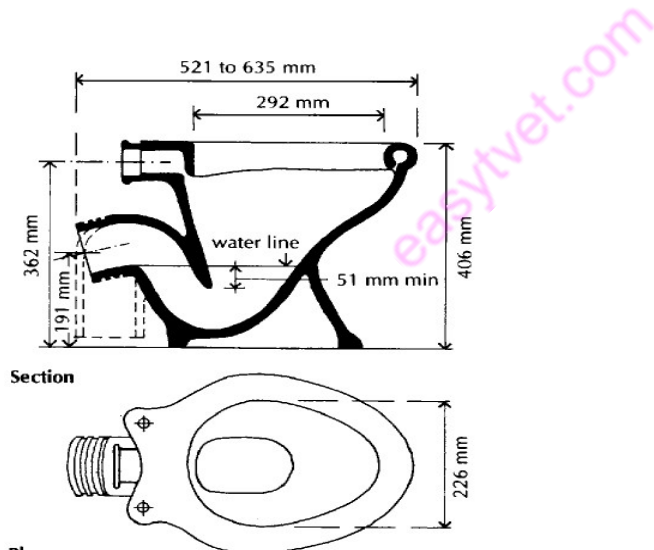
#### ***Pedestal WC***



## ii. Washdown WC

The flush water runs around the rim to wash down the bowl and then overturns the water seal to discharge the contents.

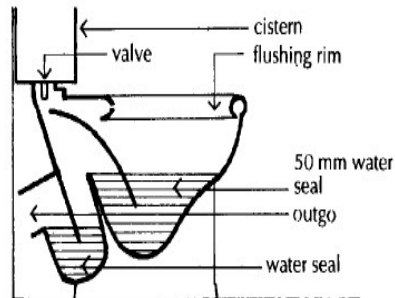
### *Washdown WC*



## iii. Siphonic WC

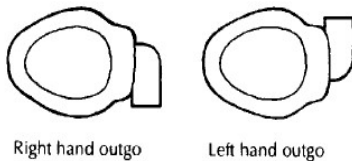
The flush water washes the sides of the bowl and causes a water trap or traps to overturn and create a siphonic action which discharges the contents. The purpose of this arrangement is to effect a comparatively quiet flush and discharge of contents. The trap is the 51 mm minimum projection of the pan into the water lying in the base of the pan to seal against any foul smells that might rise from the drains.

## *Siphonic WC*



Majority of WC have discharge outgo that is near horizontal with a small slope down and is a standard arrangement used for simplicity in production and consequent economy.

### *discharge outgo*



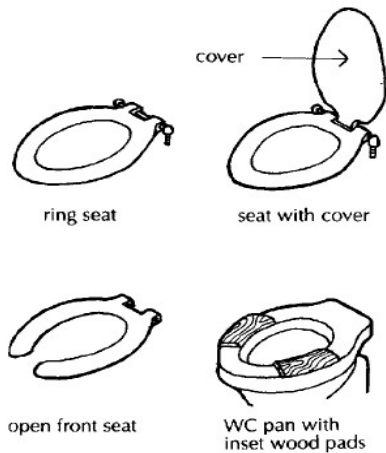
WC have seats in the form of a moulded plastic ring that fits the top of the WC pan. The back of the seat is bolted to pillars and a rod so that the seat is secured in position and can be lifted. They include;

The ring seats and lift up covers – they are moulded from plastic and finished in a small range of colors.

The open fronted lift up seat is used in male toilets to minimize fouling.

The inset wood pads fixed to one WC pan have been used in communal toilets to avoid damage that occurs to lift-up seats in general use

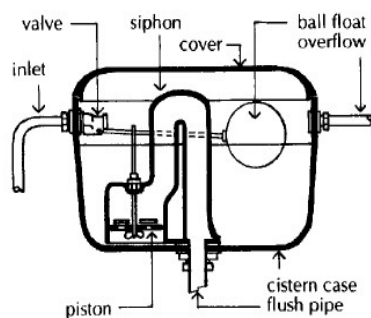
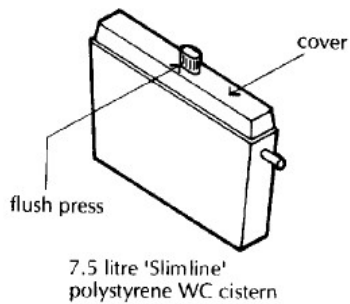
### *WC seats*



### **Flushing WC cisterns**

Flushing cisterns are made of enameled or galvanized pressed steel or plastics or vitreous china. The cistern is used for low level WC suites and is made into two pieces: the body and a lift-up cover or lid for access to the flush apparatus inside. Perforations for water supply, overflow pipe, operating lever or push and flush pipe are provided. These cisterns discharge water in one operation through a flush pipe or directly to the pan by a siphonic action. The cistern is filled through a valve operated by a ball float and arm. An air gap exists between the highest level of water in the cistern and the outlet of the float valve. The plastic siphon is operated by a lever which raises a piston to force water over the siphon bend and the siphonic action causes the water in the cistern to follow through perforations in the piston.

### *WC cistern*



## b) Urinals

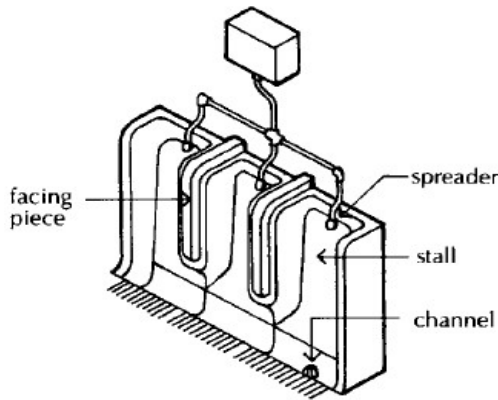
There are three types namely; Stall, Slab and Bowl.

### i. Stall urinal.

Consists of heavy, individual stoneware stalls with either a salt glazed finish, each stall having its own integral channel. The stalls are set in place on a solid floor against a wall. The junction between individual stalls is covered with salt glazed or white glazed rolls or facing pieces to serve as a finish to the joint between the stalls and afford some privacy to the users.

#### *Stall urinal*

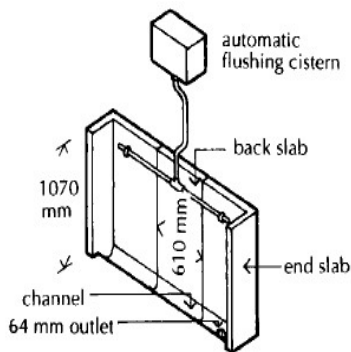




**ii. Slab urinal.**

Are less heavy constructions largely taken over from stall urinals for use in public lavatories. Consist of flat white glazed ceramic slab and white glazed ceramic channels bedded in cement and sand against the wall with projecting end slabs to each side.

**Fig 2.2 : Slab urinal**

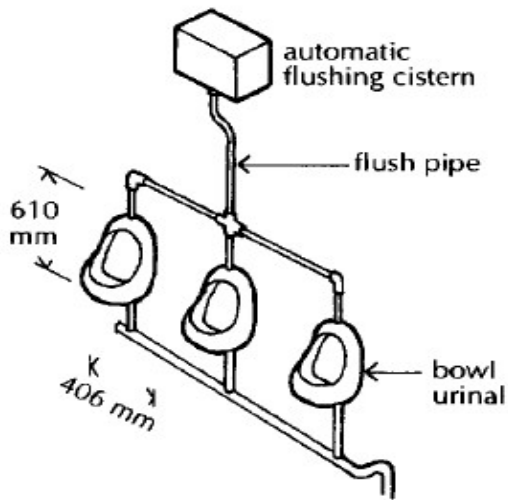


**iii. Bowl urinals**

Are individual white glazed ceramic bowl urinals fixed to a wall. They are easy to clean and offer privacy to the user. They are bolted to the wall or support and bedded in cement and sand and joints finished with silicone sealing compounds.

Urinals are flushed by automatic flushing cisterns fixed above the urinal and discharging through a flush pipe, spreaders or sparge pipe.

**Bowl urinal**



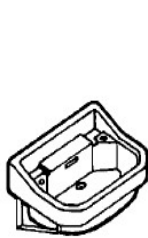
## 2. Waste Water Appliances.

Include basins, baths, sinks and bidets.

### a) Wash basins

Designed for washing the upper part of the body supported by wall brackets or by pedestal secured to the floor. Usually made of vitreous china

#### *Wash basin*



Wash basin fixed on wall brackets

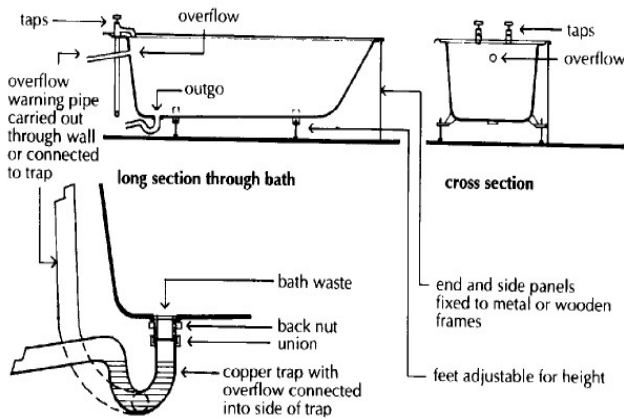


Wash basin on pedestal

### b) Baths

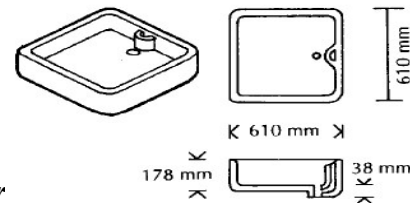
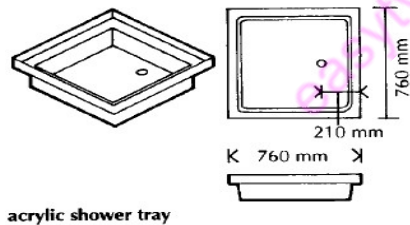
The most used is the standard Magna square ended bath. They are made of porcelain-enameled cast iron or enameled pressed sheet steel or plastic. They are used for body washing.

#### *Bath*



### c) Shower

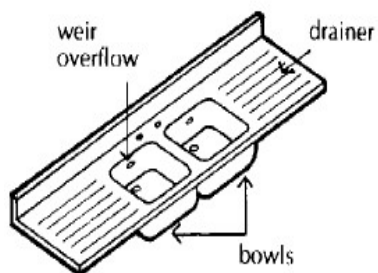
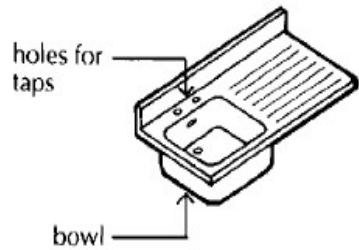
Consists of a shower tray or receiver of glazed ceramic, enameled cast iron or plastic to collect and discharge water with a fixed or hand-held shower head or rose and a valve. Showers are either fixed in a wall recess or may be free standing with enameled metal or plastic sides. The walls around fixed showers are lined with some impermeable materials such as tiles and an open side fitted with a waterproof curtain.



### d) Sinks

Is a stainless steel appliance designed to fit into the kitchen unit made with a single bowl and drainer or double bowl and double drainer. They are finished in the natural colour of stainless steel from which they are pressed.

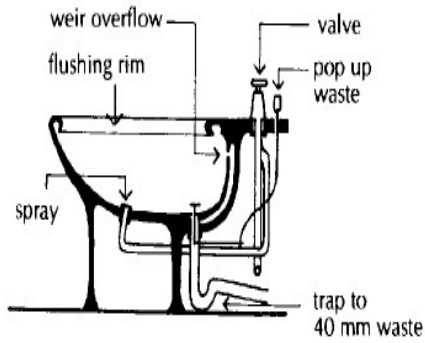
## *Sink*



## e) **Bidet**

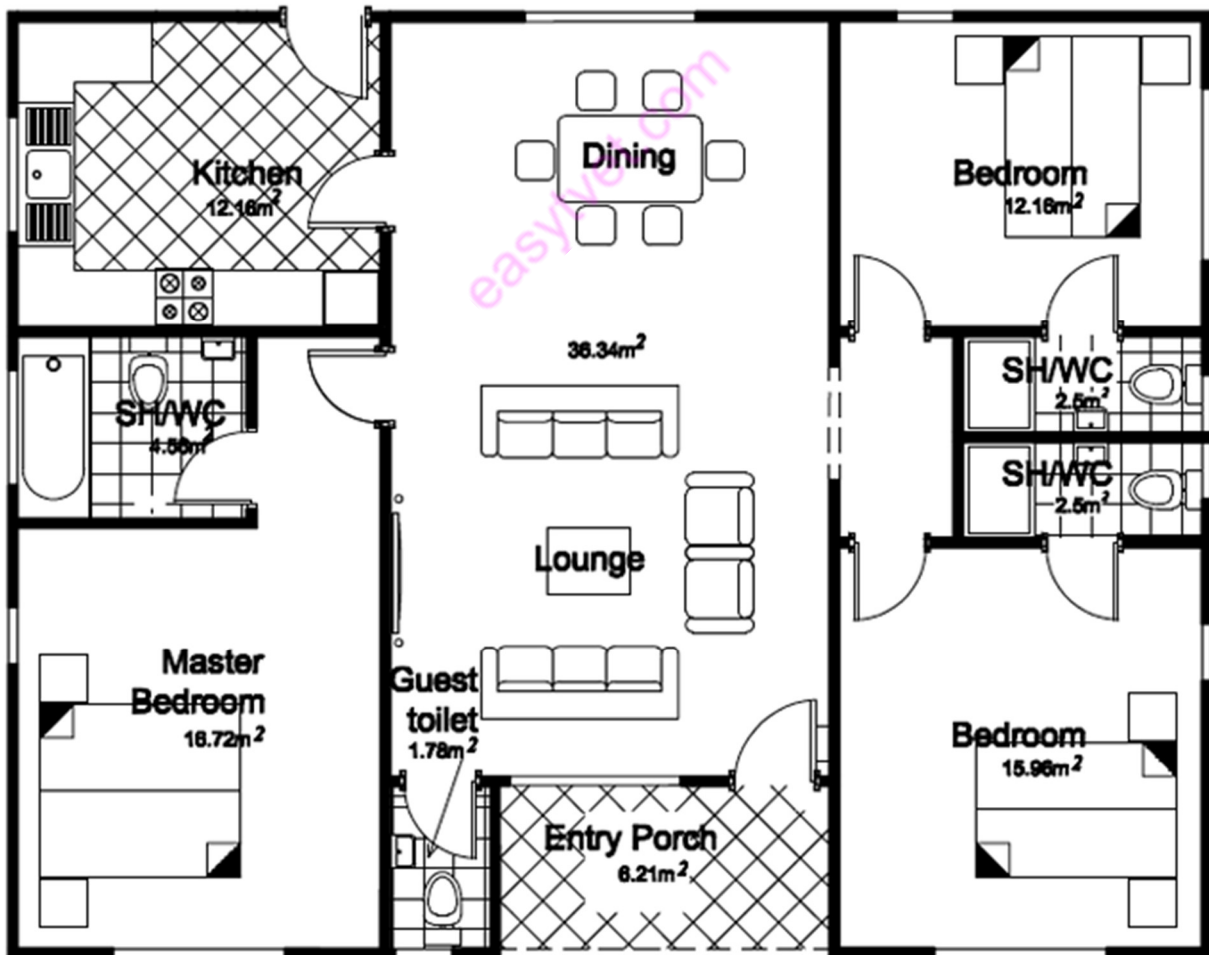
These are appliances used for washing excretory organs. It consists of a glazed ceramic pedestal bowl which is secured to the floor usually backing on to a wall or partition. May be white glazed or finished in a limited range of pastel colours to match other bathroom appliances.

## *Bidet*



### Estimation of Sanitary Appliances

Before the fixing of appliances is done, the plumber must first identify the type and number of appliances to be installed. This is clearly visible from the Plumbing working drawings (House Plans).



The type and Number of appliances are then identified from the drawing and the information presented in a tabular form.

NO	DESCRIPTION	QUANTITY
1	Single sink, Double Drain (Stainless Steel)	1
2	Bath-Tub	1
3	Water Closets (Ceramic)	4
4	Shower Heads	2
5	Shower Trays	2
6	Wash Hand Basin	4

The Schedule of materials will then be used to order for the appliances. The cost of purchase will depend on the specifications of the appliance, quality and the manufacturer.

NO	DESCRIPTION	QUANTITY	@
1	Single sink, Double Drain (Stainless Steel)	1	
2	Bath-Tub	1	
3	Water Closets (Ceramic)	4	
4	Shower Heads	2	
5	Shower Trays	2	
6	Wash Hand Basin	4	
<b>TOTAL</b>			

The sum total cost of installation will be inclusive of cost of purchase of materials, cost of labor, cost of profits and cost of overheads. These are charged as a percentage of the cost of appliances.

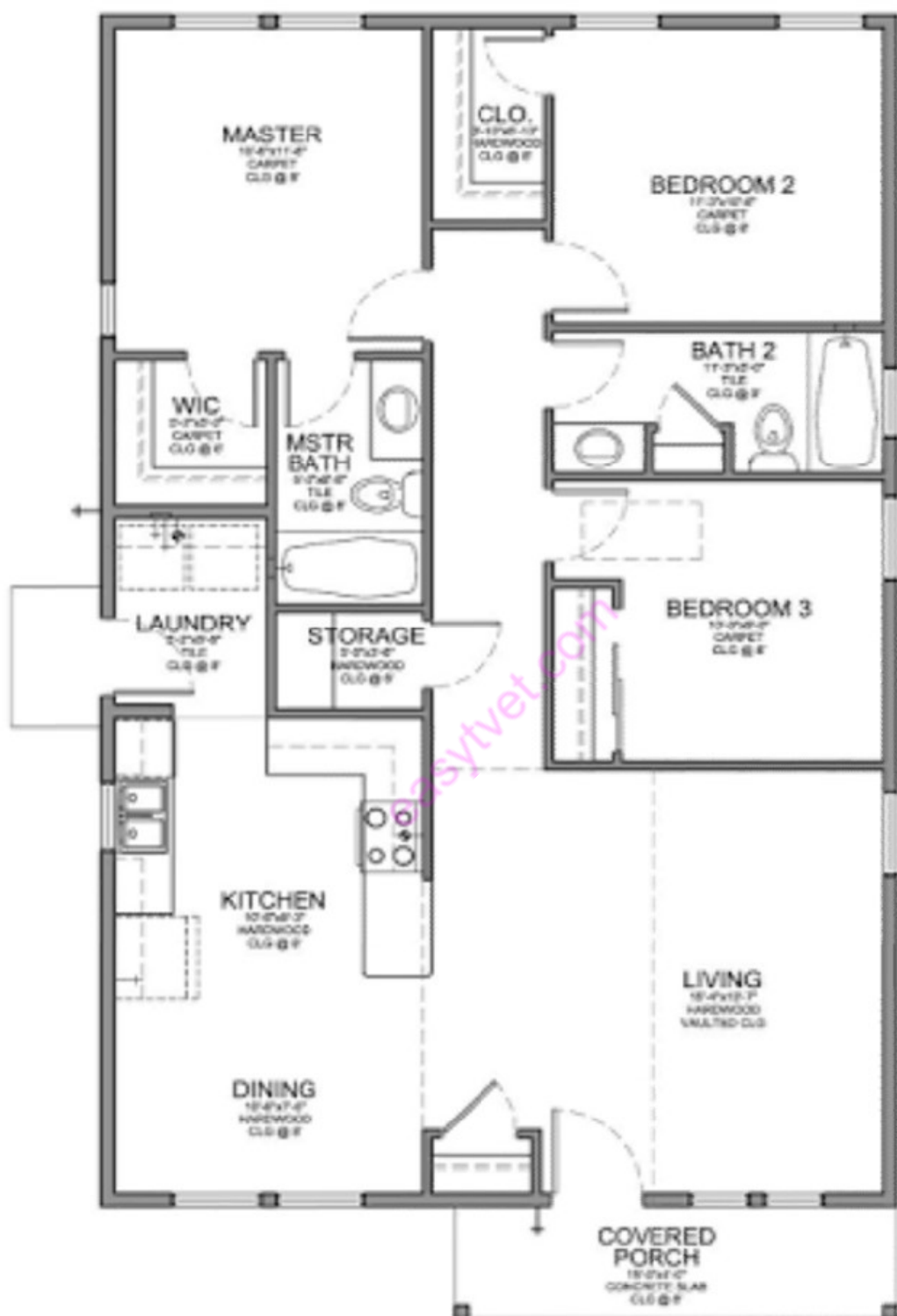
#### **4.2.2.4.Learning Activities**

##### **Practical activity**

###### Task 1

Identify the correct type and number of appliances shown on the plan

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#### **4.2.2.5.Self-Assessment**

Prepare a schedule of materials that will be used to order for the supplies for the plan given in the practical activity

#### **4.2.2.6.Tools, Equipment, Supplies and Materials**

- Pipe wrench.
- Simple water storage system
- Pipe threading equipment.
- Pipe cutter.
- Hacksaw.
- Steel rule.
- PPE
- Sink auger
- Toilet auger
- Flange plunger
- Cup plunger
- Teflon tape
- Screws.
- Adhesives.
- Pipes.
- Traps.
- Caulking materials.
- Fittings.
- Water

#### **4.2.2.7.References**

P. S. Gahlot., 2006, Building repair and maintenance management, first edition.

Antonio Curado et al., New materials and technologies in building water piping systems. India.

S. M. Patil, 2004. Building services.

Deolalikar, S. G., 2013, Plumbing design and practice. 21<sup>st</sup> reprint. New Delhi.

#### 4.2.2.8. MODEL ANSWERS

Schedule of materials

NO	DESCRIPTION	QUANTITY	@	TOTAL
1	Bath Tub	2		
2	Double sink double drain kitchen sink	1		
3	Wash Hand basins	2		
4	Water Closets	2		
TOTAL				

#### 4.2.3 Learning Outcome 3: Fix sanitary appliances

##### 4.2.3.1. Introduction to the learning outcome

This learning outcome specifies on the the procedures followed when carrying out installation works for sanitary appliances and the tools used for the operation. It also outlines the protective gear that should be worn during such operations.

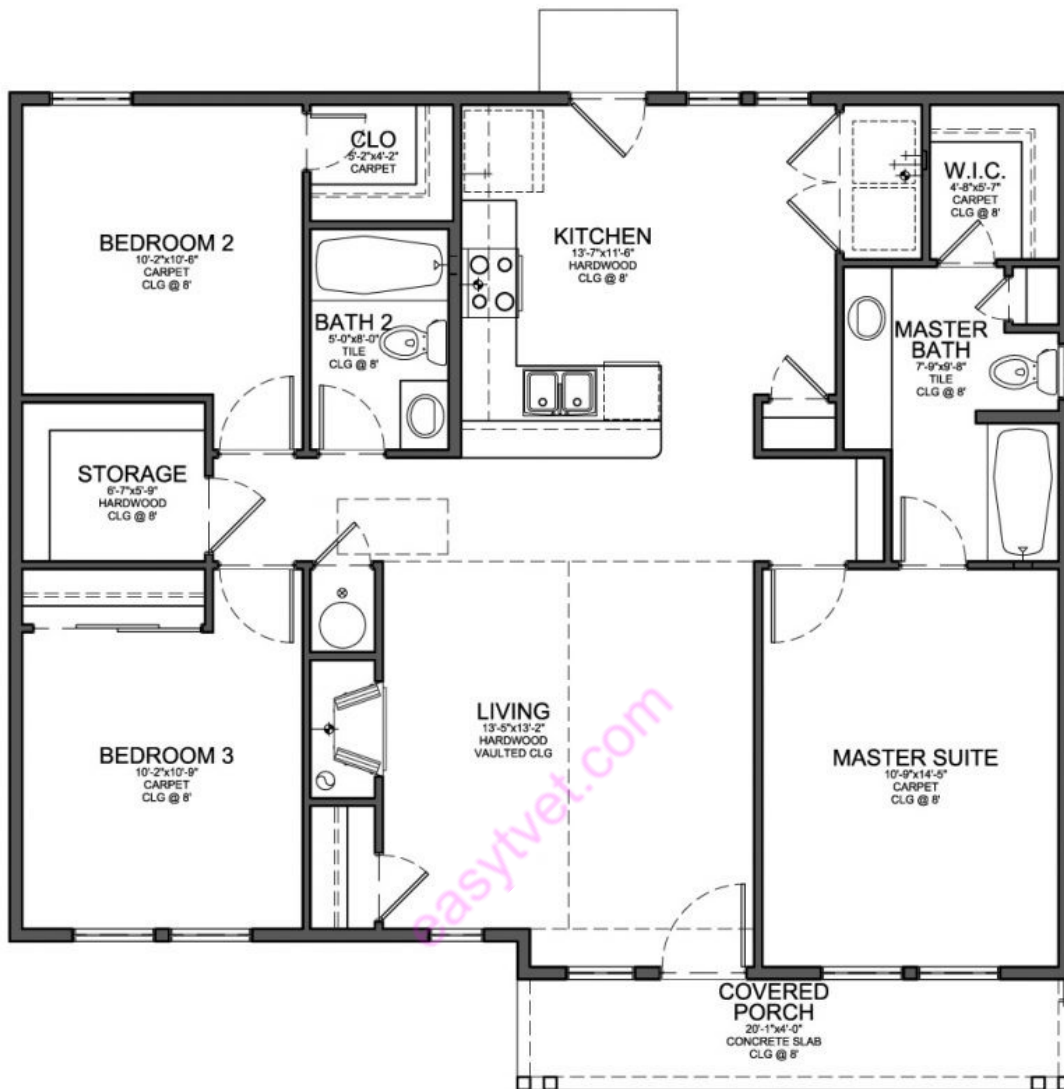
##### 4.2.3.2. Performance Standard

1. Tools and equipment needed for fixing appliances are identified based on the type of sanitary appliance.
2. Appliance positioning is determined based on working drawings.
3. Tools and equipment are used based on best practices.
4. Support for sanitary appliances is put in place based on manufacturers' instructions.

5. Sanitary appliances are mounted based on best practices.
6. Parameter checks are done in accordance to industry standards.
7. Housekeeping is conducted based on best practice.
8. Personal Protective Equipment is used in line with occupational safety and health regulations.
9. Safety and health practices are observed based on OSHA.

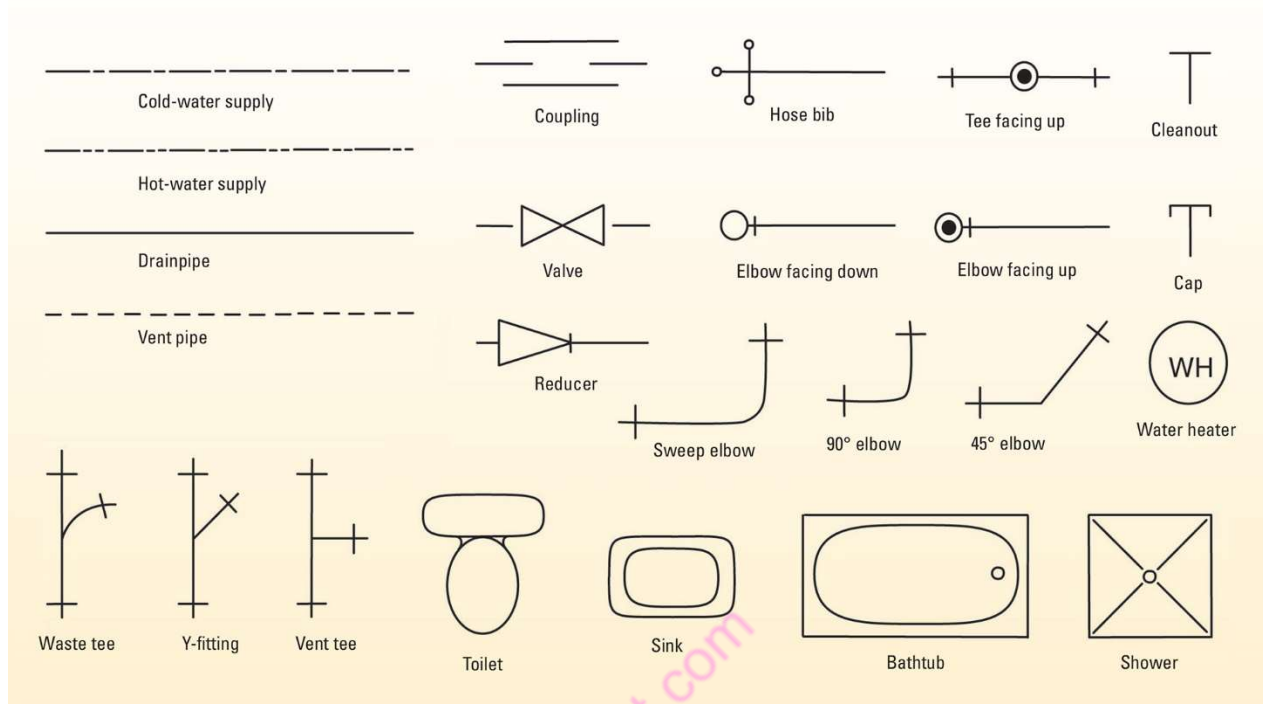
#### **4.2.3.3.Information Sheet**

Before installation of sanitary appliances begins, one is first supposed to identify the type and number of appliances from the architectural and plumbing working drawings.



This can be correctly identified if there is prior knowledge on the Plumbing symbols  
 Sample of Plumbing Symbols

## Plumbing symbols



## PROCEDURE FOR INSTALLATION OF APPLIANCES

### WC INSTALLATION

#### AN OLD WC

##### Disconnect the Supply Line

After turning off the water at the shutoff, flush the toilet to remove most of the water from the tank and bowl. A little water will be left in the bowl. Use a force-cup plunger to force it down the drain line. Remove the remaining water from the tank with a sponge and a bucket.

Disconnect the supply line from the base of the tank.

##### Remove the Old Toilet

To remove the old toilet, pop off the trim caps at the base of the toilet. Next, loosen and remove the nuts and washers on the closet bolts securing the bowl to the floor. If the nuts are rusted, you may need to cut them off with a hacksaw.

##### Install a New Wax Seal

Use a putty knife to pry up and remove the old wax seal

Inspect the flange beneath the seal to make sure it's not cracked. Once you've inspected the flange, remove the rag from the hole.

### **Attach the Tank and Bowl**

With the closet bolts and seal in place, you can attach the tank and bowl to assemble the new toilet. Slide the tank bolts through the opening in the bottom of the tank. Line up the shank of the bolts with the holes in the bowl, and drop the tank into place. Secure the tank to the bowl by tightening a nut onto each tank bolt. Evenly tighten all the nuts until the tank rests firmly on the bowl.

### **Secure the Toilet and Finish Installation**

Set the assembled toilet onto the flange assembly, making sure that the closet bolts protruding from the floor line up with the holes in the base. Lightly press the toilet in place to form a good seal with the wax ring.

Place a couple of washers and a nut on each bolt. Secure the nuts with a small wrench, but don't over tighten them. If the bolts extend too far over the top of the washers and nuts, cut off the excess with a hacksaw.

Pop the trim caps in place to cover the ends of the bolts.

Secure the new seat and lid to the bowl with mounting bolts.

Use slip-joint pliers to reconnect the supply line to the bottom of the tank.

## **WC INSTALLATION FOR A NEW WC**

### **Installation Procedures & Details for Toilets**

**Before installing a toilet**, examine it for manufacturing defects that can cause leaks or prevent it from sealing fully to the closet flange. Occasionally the inlet where the tank connects to the bowl, or the outlet (horn) at the bottom of the bowl that seals to the closet flange, is deformed enough to cause problems.

**Also make sure the base (foot) of the toilet is flat** or it will have a tendency to rock and break the seal, leading to odors and leakage.

Next, make sure the floor framing where the toilet will be mounted is adequate. Ideally the toilet should sit between two joists set no more than 12 inches on-center, with blocking nailed on either side of the drain to reinforce the area around the closet flange. This will limit any movement in the fixture that could break the seal at the wax ring.



**Toilet rough-in dimensions** locate the toilet waste pipe and flange assembly in the building rough and finished floor so that the toilet will be spaced a proper distance from the wall. The toilet rough-in dimension shows the standard distances to the waste line center from the finished wall and side wall.

- 12" from finished wall behind toilet to center of waste line - may vary by toilet model
- 15" from center of toilet to nearest side wall
- 24" clear space in front of the toilet (or more)

- 6" from flushometer to highest fixture part (for flush-o-meter toilets)

**The hole in the subfloor cut to fit the toilet waste line** should be just a bit larger than the drain. Also, it is best if the toilet sits on top of the finished flooring rather than having a dirt-trapping joint where the finished floor abuts the fixture.

**Next, install the closet flange and secure it to the subfloor** with brass or stainless-steel screws. With vinyl flooring, the flange can sit directly on the subfloor. With tile, use a plywood spacer to raise the flange to the height of the tile.

### **NB**

To insure longevity, use brass closet bolts, nuts, and washers rather than the plated steel that is often packaged with the toilet.

**Toilet Setting Tips :** Some plumbers use two wax rings. The first is pushed onto the bottom of the toilet bowl around its drain opening, pushing the wax ring thoroughly into recesses and making sure that the stick wax seals thoroughly to the bowl bottom and that it does not protrude into (and thus block) the bowl drain opening.

A second, thin wax ring is then placed onto and gently pushed against the toilet flange ring on the floor. Alternatively you can buy an "extra thick" toilet base wax ring seal.

Now as the toilet is set and pushed down onto the toilet flange, rotate the toilet left and right slightly an inch or two to seal the two wax rings together. This approach can provide a more thorough seal and plenty of wax to minimize the risk of future leaks around the toilet base.

- **Gradually tighten the nuts on the closet bolts**, alternating from one side to the other until it is snug without over tightening.
- **Finally, apply a bead of silicone caulk** around the sides and front of the toilet foot, leaving the back unsealed. This will allow leaks to be spotted before serious damage develops.

### **INSTALLATION FOR A Wash Hand Basin (W.H.B)**

1. Get the necessary tools for the job. You can install a new sink with basic tools and new components that match the valves already installed in your plumbing. Make sure you have:



- Silicone caulking
- Plumbers' wrenches, either pipe wrench or slip-joint pliers
- Basin wrench
- Set of plumbing sockets

2. Turn off the water supply valves. Typically located beneath the sink, it's critical that you shut off the water supply to the sink before you remove it. If the valves are not beneath the sink, then you'll have to turn off the main water supply. This is typically located on a lower level or the basement near the water meter.

- To test, turn on the hot and cold water on your sink and make sure no water comes out before proceeding.

3. Remove the old WHB, if necessary. If you're replacing a WHB, you'll obviously need to remove the WC that's in place before installing the new one. Disconnect the supply and drain lines from the faucet, using locking pliers or a crescent wrench. A small amount of water may leak out when you do this, which is normal. Just use a bucket or a towel to handle the water that leaks out.

- Locate the large nut that connects the sink to the drain and disconnect it. This metal or plastic nut will be located either in the wall or the floor. Use your hands or locking pliers to unscrew the nut.
- Remove the current sink by sliding the edge of a putty knife around the perimeter of the bathroom sink, loosening any caulk that connects it. Pull it loose.

Measure the new sink to make sure it fits the space. All new sinks should come with a template of the mounting opening, marking the location of the faucet holes, including a cutout for the sink. You can use the template to make sure the sink fits in the desired location. If it doesn't, you may need to do some trimming or, or cut the entire opening if you're installing a sink in a house under construction.

- Most new sinks come with clips and screws that are used to hold the sink in place. If you buy a faucet, sometimes it'll come with the drain and tailpiece for the sink. If it isn't included, get one

before you start. The supply lines for the faucet need to correspond to the faucet and valves under the sink, so make sure they match before you get started.

### **MOUNTING THE NEW SINK**

1. Put the sink in place and caulk it. Put a thin bead of silicone around the bottom lip of the sink and set it into the hole. Clean up any excess silicone or smooth a line. Depending on the design of the sink and the opening where it connects to the plumbing lines, you may need to caulk in any number of different places.

- For under mount sinks, put a bead of silicone under, have someone hold the sink in place, and install the connecting clips included with the sink.
- You might have to pre-drill holes with a diamond carbide tip if you're installing the sink in a granite/stone counter.

2. Secure the sink with clips. Connective clips are often included with new sinks to help anchor the units into place, in addition to the sealing caulk. The design of this varies, and will depend on the type of sink and the design, but they usually act like a lever to hold the sink in place. Follow the instructions included with the new sink and defer to the manufacturer's guidelines.

3. Install the faucet. New faucets usually screw onto the faucet assembly in a clockwise direction. Some faucets will have a rubber gasket around the base, and screw on easily, while others will recommend using silicone sealant to secure to the sink or counter. You can anchor the faucet by reaching up underneath and using lock nuts that are included with the installation kit.

- Sometimes it may be easier to install the faucet before the sink, depending on the design of the counter and the fixtures. Make sure the space for the faucet matches the location of the sink, using the template to measure before you install anything

4. Install the tailpiece and drain kit. Drop the tailpiece through the sink and screw on the tailpiece nut from underneath. Some sinks come with gaskets that go between sink and tailpiece.

If it doesn't, use non-hardening plumbers' putty or silicone to create the seal. Install the gasket, the included cardboard washer, and the locknut to secure the tail piece

## **PPE used when carrying out during installation / fixing of appliances**

### **A. Face protection**

**Goggles and face protection** must be used when workers are at risk from flying particles, liquid chemicals, acids or caustic liquids and chemical gases. Various goggles for face protection must meet certain design criteria for safety.



### **B. Foot Protection**

**Safety shoes** with impact protection are used in work areas where heavy objects or tools could be accidentally dropped on the feet. Safety shoes with puncture protection are required when working around nails, wire tacks, scrap metals and other objects that could pierce the feet.

### C. Hand Protection

**Gloves** are required to protect the hands of workers from cuts, scrapes, punctures, burns, chemical absorption, and exhaust temperatures. It is crucial that the type of glove being used is the right one for the job.



### D. Hearing Protection

Appropriate **ear muffs or ear plugs** must be made available as a last resort if it is not possible to make the workplace less noisy. The requirement is a small part of the occupational noise exposure standard which requires employers to ensure that workers are exposed to less than 90 decibels of noise over an 8 hour period.



### E. Respirators

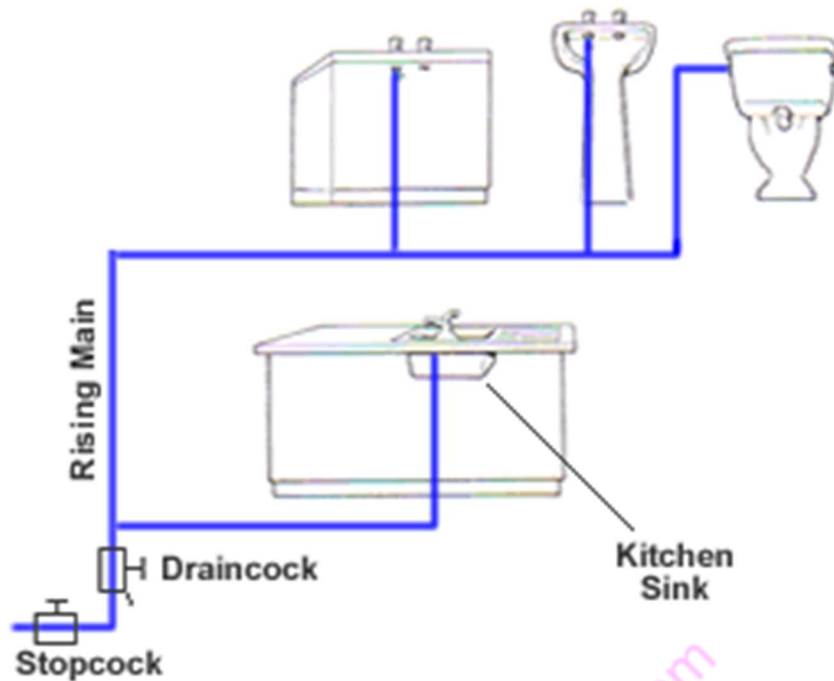
Appropriate **respirators** must be worn as a last resort if it is not possible to ventilate the work area properly.



#### 4.2.3.4. Learning Activities

##### Practical Activities

With assistance from your trainer, install the appliances as shown on the isometric drawing



#### 4.2.3.5. Self-Assessment

1. Sketch THREE types of Urinals
2. Outline the procedure to follow in installing a WC
3. Outline the procedure for installing a Wash Hand Basin

#### 4.2.3.6. Tools, Equipment, Supplies and Materials

- Simple water storage system
- Pipe threading equipment.
- Pipe cutter.
- Hacksaw.
- Vise bench.
- Files.
- Steel rule.

- PPE
- Screws.
- Adhesives.
- Pipes.
- Traps.
- Caulking materials.
- Pipe wrench.
- Fittings.
- Water

#### **4.2.3.7.References**

P. S. Gahlot., 2006, Building repair and maintenance management, first edition.

Antonio Curado et al.,.New Materials and Technologies in Building Water Piping Systems,  
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S. M. Patil,. 2004. Building servicesl, published by S.M Patil and Mrs Kavita S. Patil, Mumbai,

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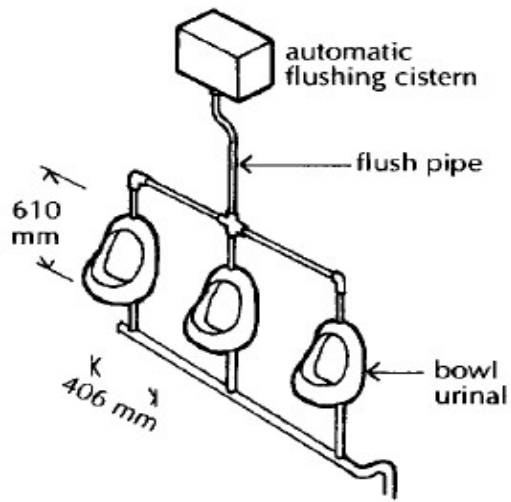
<https://www.youtube.com/watch?v=n7I6dwvVngc>

<https://www.beccavedrilling.com/storage-tank-systems.html>

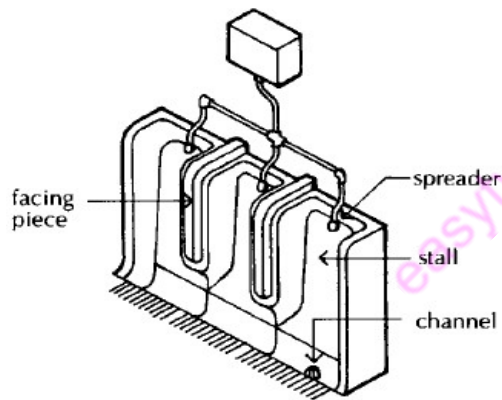
<https://www.rainharvest.com/pumps-and-controllers/pump-controllers.asp>

#### **4.2.3.8.MODEL ANSWERS**

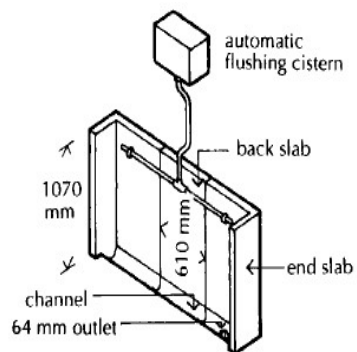
1. Bowl Urinal



Stall urinal



Slab Urinal



## 2. Outline the procedure to follow in installing a WC

Examine the WC it for any manufacturing defects that can cause leaks or prevent it from sealing fully to the closet flange.

**Check to ensure the base (foot) of the toilet is flat** or it will have a tendency to rock and break the seal, leading to odors and leakage.

**Ensure the floor framing where the toilet will be mounted is adequate.** Ideally the toilet should sit between two joists set no more than 12 inches on-center, with blocking nailed on either side of the drain to reinforce the area around the closet flange.

locate the toilet waste pipe and flange assembly in the building rough and finished floor so that the toilet will be spaced a proper distance from the wall. The toilet rough-in dimension shows the standard distances to the waste line center from the finished wall and side wall.

- 12" from finished wall behind toilet to center of waste line - may vary by toilet model
- 15" from center of toilet to nearest side wall
- 24" clear space in front of the toilet (or more)
- 6" from flushometer to highest fixture part (for flush-o-meter toilets)

**The hole in the subfloor cut to fit the toilet waste line** should be just a bit larger than the drain. Also, it is best if the toilet sits on top of the finished flooring rather than having a dirt-trapping joint where the finished floor abuts the fixture.

**Next, install the closet flange and secure it to the subfloor** with brass or stainless-steel screws. With vinyl flooring, the flange can sit directly on the subfloor. With tile, use a plywood spacer to raise the flange to the height of the tile.

**Gradually tighten the nuts on the closet bolts**, alternating from one side to the other until it is snug without over tightening.



**Apply a bead of silicone caulk** around the sides and front of the toilet foot, leaving the back unsealed. This will allow leaks to be spotted before serious damage develops.

### 3. Outline the procedure for installing a Wash Hand Basin

1. Put the sink in place and caulk it. Put a thin bead of silicone around the bottom lip of the sink and set it into the hole. Clean up any excess silicone or smooth a line. Depending on the design of the sink and the opening where it connects to the plumbing lines, you may need to caulk in any number of different places.

- For undermount sinks, put a bead of silicone under, have someone hold the sink in place, and install the connecting clips included with the sink.
- You might have to pre-drill holes with a diamond carbide tip if you're installing the sink in a granite/stone counter.

2. Secure the sink with clips. Connective clips are often included with new sinks to help anchor the units into place, in addition to the sealing caulk. The design of this varies, and will depend on the type of sink and the design, but they usually act like a lever to hold the sink in place. Follow the instructions included with the new sink and defer to the manufacturer's guidelines.

3. Install the faucet. New faucets usually screw onto the faucet assembly in a clockwise direction. Some faucets will have a rubber gasket around the base, and screw on easily, while others will recommend using silicone sealant to secure to the sink or counter. You can anchor the faucet by reaching up underneath and using lock nuts that are included with the installation kit.

- Sometimes it may be easier to install the faucet before the sink, depending on the design of the counter and the fixtures. Make sure the space for the faucet matches the location of the sink, using the template to measure before you install anything

4. Install the tailpiece and drain kit. Drop the tailpiece through the sink and screw on the tailpiece nut from underneath. Some sinks come with gaskets that go between sink and tailpiece.

If it doesn't, use non-hardening plumbers' putty or silicone to create the seal. Install the gasket, the included cardboard washer, and the locknut to secure the tail piece

#### **4.2.4 Learning Outcome 4: Test and commission working of sanitary appliances**

##### **4.2.4.1. Introduction to the learning outcome**

This learning outcome enlightens the trainee on how to test the functionality of an installed sanitary component or system before it is commissioned for use.

##### **4.2.4.2. Performance Standard**

1. Functionality of the appliance is tested based on best practices.
2. Faults in appliance functionality are corrected based on best practices
3. The works are commissioned in accordance to job requirements

##### **4.2.4.3. Information Sheet**

### **Introduction to testing of Plumbing Systems**

#### **Definitions of terms**

- **Test** - a procedure intended to establish the quality, performance, or reliability of a system before it is taken into widespread use.
- **Functionality** - the quality of being suited to serve a purpose well
- **Fluid** - a substance, as a liquid or gas, that is capable of flowing and that changes its shape at a steady rate when acted upon by a force tending to change its shape.
- **Fault/defect** - unsatisfactory feature in a piece of work.
- **Workplace policy** - course of action adopted by an organization.
- **Leakage** - escape of liquid or gas through a hole or crack.
- **Outcome** – the end result of an operation
- **Commission** - bringing a newly constructed system into working condition

- *Waterproofing* - applying a physical barrier to pipes and appliances to prevent moisture penetration into a structure.
- *Caulking* – applying a waterproof filler and sealant building work and repairs

## **TYPES OF TESTS DONE ON PLUMBING SYSTEMS**

Plumbing tests are usually done for the purpose of ensuring correct work, free from defects arising after installation of components and systems. There are four different methods of testing the plumbing systems which include;

1. water test
2. air test
3. peppermint test
4. smoke test

Of these, the water, peppermint, and smoke tests are most commonly used. The water and air tests are chiefly used as the first test on new work. When it comes to the final test, either the peppermint or smoke test may be applied. Each is thorough when properly applied.

Before the final test is applied, all fixtures should be in position and the system entirely complete, and the traps filled with water.

### **1. WATER TEST**

Is applied on new work where any defective leaks in joints will be readily detected when the system is filled with water. The mode of applying the water test is to close up all openings in pipes, either by soldering the ends shut or by plugs with caps. These plugs are made in different forms to suit all the uses for which they may be called upon in testing a job. The water supply for testing may be connected to the end of the test plug where capped, with a stop-cock to shut off when necessary; and then the system is ready for filling. The filling should be done slowly, and any leaks found should be immediately fixed. Where a leak occurs in a lead joint which only requires a little more caulking, the water may be shut off until this is done.

*Water test*

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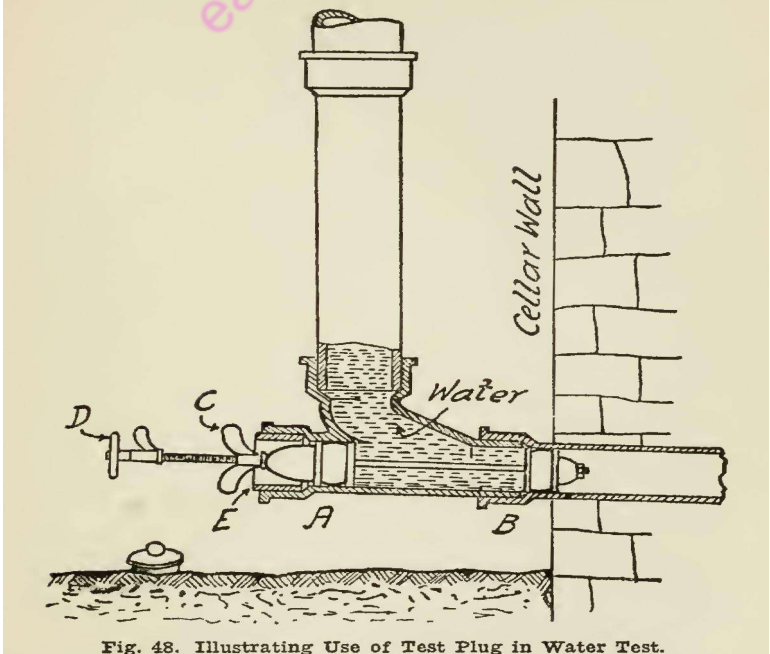


Fig. 48. Illustrating Use of Test Plug in Water Test.

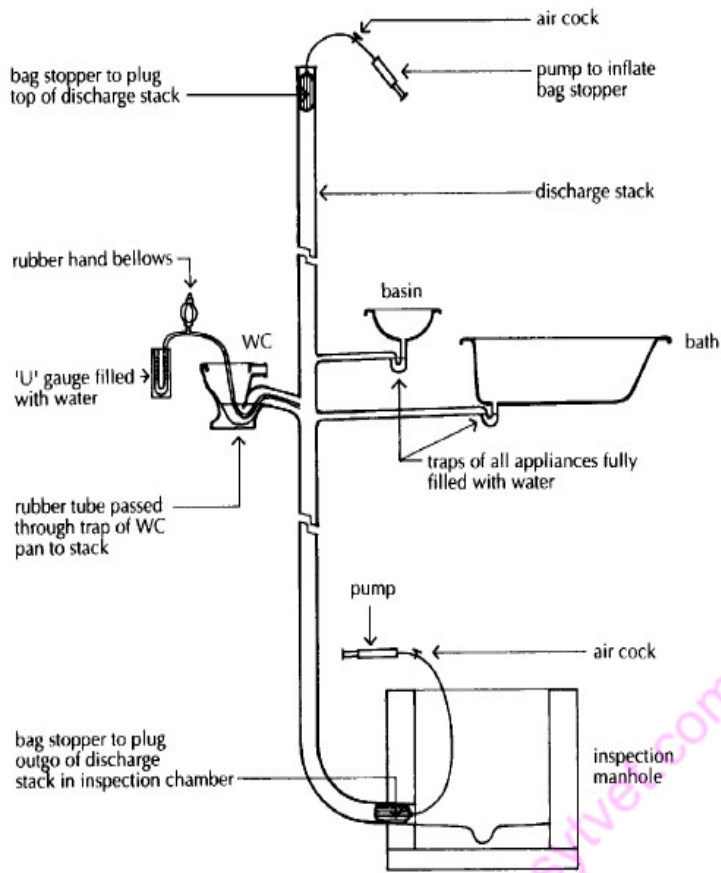
## 2. AIR TEST

The air test shall be made by attaching an air compressor testing apparatus to any suitable opening, and after closing all other inlets and outlets to the system, forcing air into the system until there is a uniform gage pressure of five (5) pounds per square inch (34.5 kPa). The pressure shall be held without introduction of additional air for a period of at least fifteen (15) minutes.

The air test subjects all parts of the system to the same uniform pressure, while the pressure in the water test varies from zero pressure at the top to a pressure at the bottom depending upon the height of the stack. In applying the air test, all openings are closed. Through any convenient plug, a gas pipe is connected, to which a mercury gauge is attached, and hose connection made to the force pump. The air pumped into the system exerts a pressure on the mercury, forcing it upward in the tube about two inches for each pound of air pressure.

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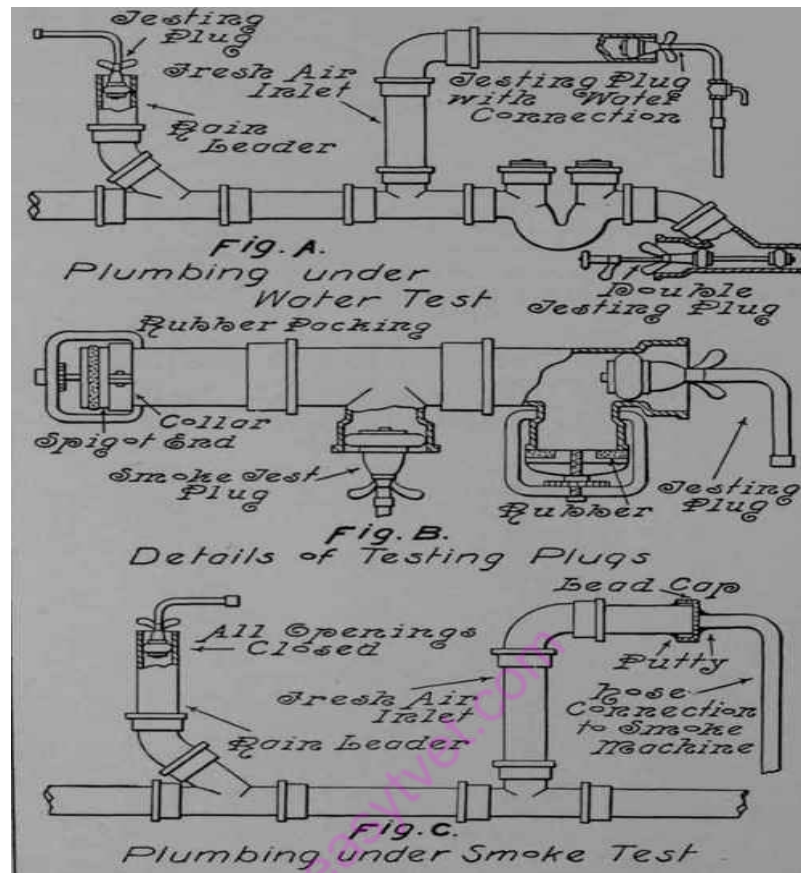
*Air test*



### 3. SMOKE TEST.

The smoke test is another test that can be applied to roughed-in new work. It is used most frequently, however, in testing old work, or in testing new work after the fixtures have been set. The manner of applying a smoke test is to close all openings, the same as for the water test, and also the openings at the roof. The testing machine, which is made especially for this purpose, is then connected to the piping system, and the smoke turned into the pipes.

## Smoke test



### 4. PEPPERMINT TEST.

The peppermint test is applied by putting about two ounces of oil of peppermint into the system at the roof, after all openings have been closed as with the other tests, and pouring about a gallon of hot water into the piping, immediately closing the opening with a plug kept at hand for the purpose. The fumes of the peppermint are supposed to travel throughout the system of piping, and to penetrate any existing leaks, the presence of which can then be detected from the characteristic smell. There being no pressure applied in this test, there is a possibility of the odor not escaping through very small leaks; and this test, therefore, is not so reliable as the water or smoke tests.

#### **4.2.4.4.Learning Activities**

##### **Practical activity**

Instruction: Assemble a sanitary water system as shown in the diagram and Test its functionality using the water test.

*Sanitary water system*

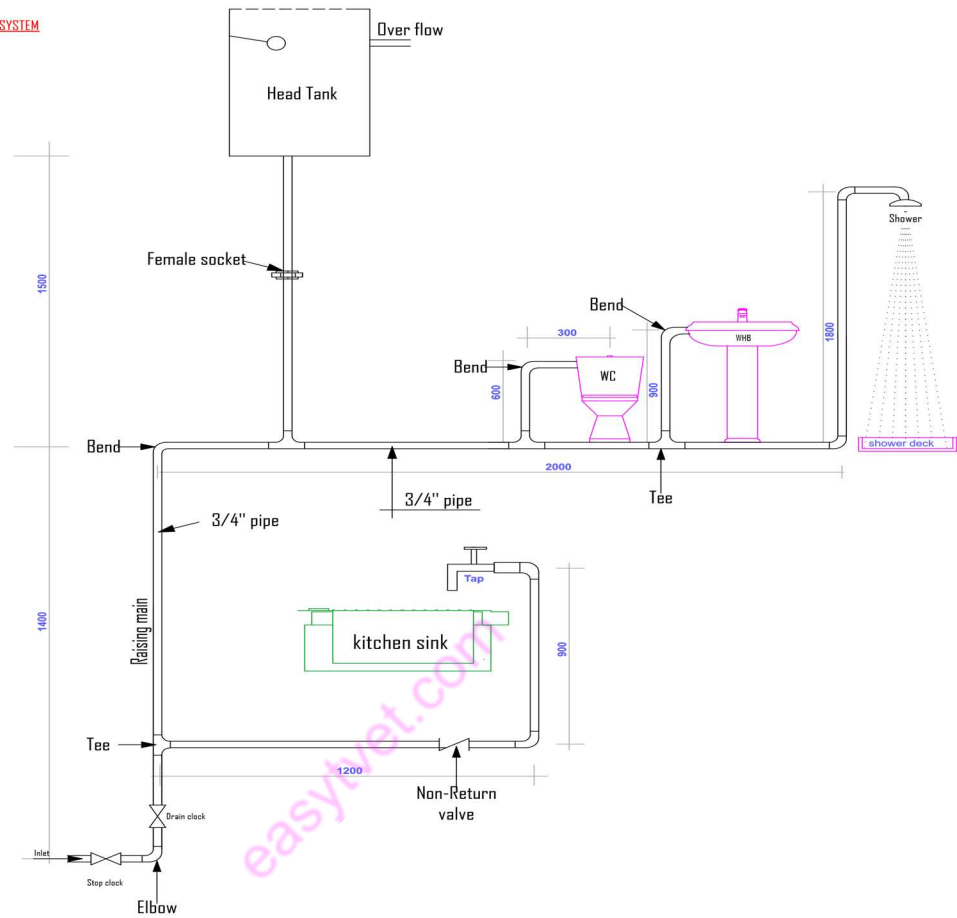
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**UNIT OF COMPETENCY: MAINTAIN PLUMBING SYSTEMS**

**UNIT CODE: CON/DS/PL/CR/D4/3/A**

**FIGURE 01-  
DIRECT WATER SYSTEM**



**Materials Required**

- Simple water storage system
- Pipe wrench
- Pipe threading equipment.
- Pipe cutter.
- Hacksaw.
- Vice bench.

- Files.
- Steel rule.
- PPE
- Screws.
- Adhesives.
- Pipes.
- Traps.
- Caulking materials.
- Fittings.
- Water

#### 1.4.3.4.1 A case study

With the assistance of your trainer, conduct a Field visit to a nearby facility with a well-established plumbing system and fill in the field visit notebook indicating the key areas listed

Visit Objective/Aim	Indicators	Special Instruction
To identify the established plumbing systems in use.	A list of plumbing systems	Must correctly identify the available plumbing systems
To identify the possible faults of the systems identified.	A list of faults	Must indicate the function possible faults for each
To assess the functionality of the plumbing systems	Functionality table	Must fill in the table for each system.

#### 4.2.4.5. Self-Assessment

1. Which four tests would you apply when testing the functionality of a plumbing system?
2. Which three waterproofing material would you use to correct a leaking elbow?
3. What are the four causes of pump failure?
4. What causes clogging in pipes?.
  
5. Why do pipes leak?

#### **4.2.4.6.Tools, Equipment, Supplies and Materials**

- 200 litre plastic tank
- 100 litre plastic tank
- PPR threaded union
- Rigid PPR pipe
- PPR bend
- Flexible PPR pipe
- Pipe threading machine
- Pipe cutter
- Pipe wrench
- Adjustable spanner
- Seal tape
- Timber
- Claw hammer
- Saw
- Spirit level
- Plumb bob
- Tape measure
- Hose pipe
- Tap

- File
- PPE (Gloves, safety boots, dust coat, goggles, helmet)
- Gate valve
- Ball valve
- Centrifugal pump

#### 4.2.4.7.References

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#### 4.2.4.8.Model Answers

1. Which four tests would you apply when testing the functionality of a plumbing system?
  - Water
  - Smoke
  - Air
  - Peppermint
2. Which three waterproofing material would you use to correct a leaking elbow?
  - Cement Waterproofing.
  - Bituminous Membrane
  - Teflon tape
  - Caulk
3. What are the four causes of pump failure?

- a) Stuck switches
  - b) An overwhelming amount of water
  - c) Clogged pipes
  - d) Improper pump installation
4. What causes clogging in pipes?

Sticky or hard substance such as a stone or other foreign body passes through pipes it causes obstruction or partially closing the valves and pipes.

5. Why do pipes leak?

- joint damage
- excessive water pressure
- cracked pipes
- incorrect pipe laying

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