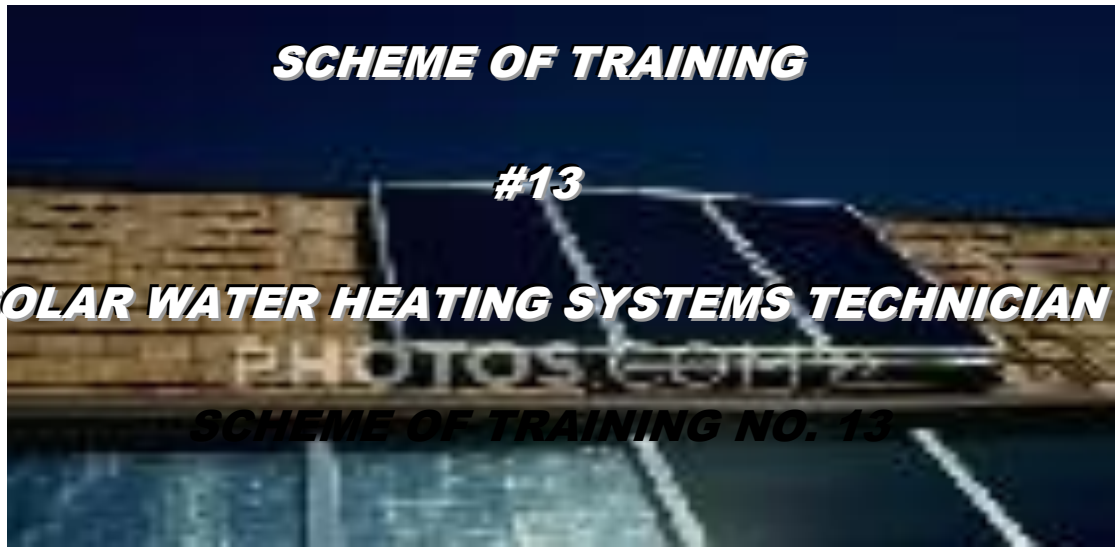

BARBADOS VOCATIONAL
TRAINING BOARD
INITIATIVE
AND INTEGRITY

# BARBADOS VOCATIONAL TRAINING BOARD




***REVISED: 2006***

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## BOARD MEMBERS

| | | |
|---|---|---|
| Mrs. Ann Hewitt | - | Chairman |
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| Mr. Anthony Grant | - | Member |
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| Mr. Peter Miller<br>Nominee Barbados Manufacturers' Association | - | Member |
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| Mr. Wendell Cozier<br>Principal, Samuel Jackman Prescod Polytechnic | - | Member |
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| The Executive Director<br>Technical and Vocational Education and Training (TVET) Council | - | Member |

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Director of Training

Miss Merna E. Jordan B. Sc., M.Sc.
Assistant Director - Operations

Mrs. Rhonda Howell, B. Sc.
Assistant Director – Administration

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

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## SECTION C:

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## INTRODUCTION

The Barbados Vocational Training Board is responsible for the coordination of various schemes of training under the Occupational Training Act Cap 42. These schemes of training regulate the training of apprentices and trainees in various skills and occupations and training is given through an integrated system of Modular Instructions. All training schemes include provision for practical on-the-job training, theoretical instruction, related studies, skills testing and certification.

The purpose of all training schemes is to provide a sound knowledge of the basic principles and techniques relevant to a particular trade or occupation and to equip all apprentices and trainees with employable skills in the world of work. In addition to this objective, all training schemes are expected to inculcate in the apprentice or trainee such fundamental traits as safe work habits, discipline, punctuality, honesty, integrity, a responsible work attitude and pride in the skills of the particular occupation, all of which are fundamental to personal development and success.

The necessity for amending the schemes of training has given the Board the opportunity to offer the schemes in modular form, and update the various topics presented in earlier schemes. Attention has also been given to new topics of Health and Safety and Orientation.

### Orientation

The orientation process will assist young apprentices/trainees beginning their training as craft persons to comprehend fully the basic principles underlying the components of the training schemes and their relation to the world of work. It will also establish a good employer/employee relationship, serve as an early motivating factor to the apprentices/trainees and help everyone concerned to fully understand their responsibilities.

### Health and Safety

The Board is acutely aware of the need for good health and safety standards in a work environment. Good health and the avoidance of injury are fundamental to personal development as well as to progress. Time lost through illness or injury which could have been avoided is counter-productive and costly both to the individual as well as the employer.

For the reasons stated above, the Board considers it to be most important that all schemes of training must include a section on health and safety pertaining to each particular trade or occupation and this must be mandatory for apprentices and trainees.

It is recognised that all risks can never be eliminated entirely, but if the particular risks of each trade or occupation could be identified and highlighted, this could go a long way to eliminate injury and inculcate safe working habits to the benefit of all.

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## THE OCCUPATIONAL TRAINING ACT, CAP 42

## SCHEME OF TRAINING NO: 13

## SOLAR HEATING INSTALLATION & SERVICE PERSONNEL

**In this Scheme:**

1. a) "Certified trade" means the trade/occupation of Solar Water Heating Technician.

b) Apprentice/trainee has the same meaning as is stated in the Act.

c) Solar Heating Installation & Service Personnel means a person who undertakes a course of training or apprenticeship in the following, over a period of time:

**Section A: Vocational Skills**

| | |
|---|---|
| A 100 | Orientation |
| A 200 | Safety on Site and in the Workshop |
| A 300 | Trade Tools and Practices |
| A 400 | Pipe Fitting and Pipe Welding |
| A 500 | Solar Heater Construction and Installation |
| A 600 | Maintenance of Plumbing Fixtures and Fittings |
| A 700 | Maintenance of Pipes |

## SECTION B: RELATED STUDIES

B 100 Communication - English

B 200 Calculation

B 300 Science

## SECTION C: GLOSSARY

2. No person shall become a apprentice/trainee in a certified trade (Solar Heating Installation & Service Personnel) unless he/she has completed:

a) the Barbados Secondary School Certificate Stage 1; or

b) not less than nine (9) years of formal education to the satisfaction of the Director.

3. An apprentice/training programme for the certified trade (Solar Heating Installation & Service Personnel) is established and shall consist of:

a) Training and instruction in full-time/part-time educational courses at an approved Educational Institution, in classes that in the opinion of the Director are relevant and satisfactory, including Occupational Safety and Health; and

b) Practical training and instruction provided by an employer of the apprentice in subjects contained in Schedules 1 and 2 of this scheme.

4. A programme of training and instruction under this scheme shall be conducted in the following manner:

a) Two (2) years full time study in an approved technical/ educational institution, plus one (1) year of practical work experience after successful completion of training in Schedule 2; or

b) A sandwich course of less than three (3) years, consisting of two (2) days release or the equivalent per week to a technical/educational institution, plus not less than three (3) days per week of practical training in an approved work place.

c) Every apprentice/trainee on the satisfactory completion of the specified period of apprenticeship/training shall be required to pass such tests as the Barbados Vocational Training Board may prescribe before he/she may be certified as a Solar Heating Installation Technician.

d) The Barbados Vocational Training Board may accept successful completion of an examination conducted by an approved body as satisfactory evidence that part of the Board's standards have been achieved.

e) The Barbados Vocational Training Board will conduct tests periodically in cooperation with Educational Institutions and the actual work place, to ensure that apprentices/trainees are making satisfactory progress.

Apprentices will be required to work in the normal manner, eight (8) hours per day, forty (40) hours per week with an interval or intervals for refreshment totalling not less than one (1) hour in accordance with the opening and closing hours of each work place. The regular daily hours of training and instruction of an apprentice/trainee shall not begin sooner or end later in each day than the regular daily working hours of the work force of the employer with whom the apprentice/trainee is working.

5. (1) The minimum rate of wages for an apprentice in the certified trade (Solar Heating Installation and Service Personnel) whether for his regular daily hours or for hours in excess of his regular daily hours shall not be less than:

**for the three (3) year programme**

**45% in the first year of training and instruction**

**55% in the second year of training and instruction**

**75% in the third year of training and instruction**

of the rate of wages for a workman employed by the employer in that trade, or where the employer is the only workman, of the rate paid to a workman in the occupation in Barbados.

5. (2) The Barbados Vocational Training Board currently refunds to the employer

**50% of the wages paid in the first year**

**40% of the wages paid in the second year**

**25% of the wages paid in the third year**

but these percentages are subject to review from time to time.

6. Credits as the Director determines, may be granted to an apprentice/trainee for:

a) the successful completion of a course of study or training;

b) for work performed or experience gained in the trade prior to an application for apprenticeship or training;

c) modules completed in the Skills Training Programme.

7. No credits will be given unless satisfactory evidence is given to the Director as proof of the above.

8. No apprentice or trainee under eighteen (18) years of age, shall be allowed to work overtime. Any hours of overtime worked by an

apprentice/trainee in excess of his regular daily hours of practical training and instruction shall not be included in calculating the hours spent in training and instruction unless otherwise prescribed or approved by the Director.

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## GENERAL OBJECTIVES

On completion of Apprenticeship in Plumbing, the apprentice should be capable of:

(a) Demonstrating safe working habits;

(b) Interpreting drawings;

(c) Planning and laying out pipe work and fittings;

(d) Constructing and installing solar heating units.

(e) Repairing, maintaining and servicing solar heating systems.

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## MODULE: A 100

## ORIENTATION

## OBJECTIVE:

As a result of experiencing the orientation process, the trainee will be able to perform the following:

1. State the reception of the workplace.

2. State the nature of the Apprenticeship Training as conducted by the Barbados
   Vocational Training Board with regard to the:

   (a) Responsibility of the Board;

   (b) Contract of Training;

   (c) Rights and responsibilities of the trainee;

   (d) Conduct of the training;

   (e) Training schedules;

   (f) Rights and responsibilities of the employers.

3. List the career pattern and progression of the trade.

4. Identify protective clothing and their use.

5. Outline a brief history of the employer's policy, procedures and operations.

6. Explain the Organisational Chart.

7. Identify emergency facilities and procedures.

8. Identify the location of workers' facilities – rest rooms, sickbay.

## MODULE A 100 CONT'D

9. State the working conditions with reference to the following:

    a. hours of work – start/end of duty;

    b. attendance records;

    c. leave days, benefit – pensions;

    d. absenteeism reports;

    e. punctuality;

    f. conduct;

    g. sanctions.

10. List previously acquired transferable skills;

11. List values of ethics and responsibility of the solar heating trade.

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## MODULE: A 200

## SAFETY ON SITE AND IN THE WORKSHOP

## OBJECTIVE:

Under practical workshop and site conditions or in a simulated situation, the trainee will be able to observe the relevant safety rules and practices and perform the following

| SCHEDULE 1<br><br>TASKS | SCHEDULE 11<br><br>THEORY AND TECHNICAL INFORMATION CONTENT |
|---|---|
| State the general requirements of the Factories Act 1982-1983-17. | State the law in regard to health and safety at work. |
| Identify and avoid potential hazards in scaffolding. | Describe potential hazards in scaffolds and explain how these may be avoided.<br><br>State the safety recommendations relating to mobile scaffolds.<br><br>State the recommended methods of caring for and using ladders. |
| Erect ladders (against building) on building sites. | Emphasis should be placed on the angle and security of ladder in order to protect life, limb and property. |
| Select and use protective clothing and footwear. | State the rules for manual handling of material with regard to stance, loading of the spine, balance etc. |
| Demonstrate correct posture when lifting and handling equipment. | |
| List potential hazards relating to the use of powered tools. | State the correct methods of using and caring powered tools. |

## MODULE: A 200 CONT'D

## SAFETY ON SITE AND IN THE WORKSHOP

| SCHEDULE 1<br><br>TASKS | SCHEDULE 11<br><br>THEORY AND TECHNICAL INFORMATION CONTENT |
|---|---|
| Identify and list common defects in hand tools. | List the common defects in hand tools. |
| Recognise potential fire hazards. | List methods of fire protection, precaution and prevention.<br><br>State the conditions required for combustion and extinction of fire. |
| Carry out safety checks and inspection of equipment, cables, leads plugs. | List procedures for checking and inspection of equipment, cable, leads and plugs. |
| Demonstrate safe use of electrical equipment. | State the need for safe handling of electrical equipment. |
| Identify and select appropriate types of fire extinguishers. | State the procedure for fire drills and the use of fire fighting equipment. |
| State the procedure for removal of a shock victim from contact area. | |
| Describe the safety procedure of protecting and caring skin, eyes, hands and limbs – use protective goggles and gloves. | State the importance of personal, site and workshop hygiene; skin protection and care, also seeking qualified assistance. |

## MODULE: A 200 CONT'D

## SAFETY ON SITE AND IN THE WORKSHOP

| SCHEDULE 1<br><br>TASKS | SCHEDULE 11<br><br>THEORY AND TECHNICAL INFORMATION CONTENT |
|---|---|
| Identify flammable material. | List the use and classification of the various types of fire extinguishers. |
| Recognise potential hazards when working on building sites. | List the potential hazards relating to scaffolds, ladders, roof work, openings and trenches when plumbers are working on building sites. |
| | State the basic safety principles relating to the use of simple levers and pulleys. |
| Plan and carry out work with due consideration of safe working procedures and safety precautions. | Describe means of controlling adverse conditions, e.g. safe uses of materials and processes, adequate ventilation, fumes and dust control, the use of eye and face protectors and respirators, cutting and handling dangerous substances. |
| Describe methods of first aid application to the following conditions:<br>- Electric shock<br>- Eye injury<br>- Bleeding<br>- Burns<br>- Choking<br>- Fainting<br>- Unconsciousness<br>- Fracture<br>- Poisoning<br>- Drowning | List the basic requirements of a first aid kit.<br><br>Describe the methods of artificial respiration.<br><br>Explain the system of accident reporting, applicable to a particular organisation. |
| Protect hands and prevent metal cutting falling onto shoes. | |

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## MODULE: A 200 CONT'D

## SAFETY ON SITE AND IN THE WORKSHOP

| SCHEDULE 1<br><br>TASKS | SCHEDULE 11<br><br>THEORY AND TECHNICAL INFORMATION CONTENT |
|---|---|
| Protect eyes from flying particles when using chisels. | Explain how to remove nicks or distortions from heads of chisels. |
| Avoid the use of chisels with flattened or burred heads. | Explain why the use of chisels with flattened or burred heads should be avoided. |
| | Explain safety precautions to be taken when using chisels |
| Pressurize blow lamp tanks safety. | State the effects of over pressurizing blow lamp tank. |
| Protect blow lamp tanks from intense sunlight and fire. | State how the risk of an explosion can be avoided when using a torch. |
| Avoid muriatic acid coming into contact with the skin when soldering. | State the effects of muriatic acid coming into contact with the skin. |
| Prepare zinc chloride in an open flask safely. | Describe how "overheating" the cutting edge of a chisel can be avoided during sharpening. |
| Identify the procedure and conditions, which can cause a build-up of carbon monoxide (CO). | |

## MODULE: A 200 CONT'D

## SAFETY ON SITE AND IN THE WORKSHOP

**SCHEDULE 1**

**TASKS**

Observe safety precautions, in handling storage and use of welding gases.

State and describe the dangers of using files without handles.

Demonstrate how the following items are used:

i) float glass;
ii) tempered glass
iii) FRP;
iv) plastic glazing.

**SCHEDULE 11**

**THEORY AND TECHNICAL INFORMATION CONTENT**

List methods of avoiding build up of carbon monoxide (CO).

State and describe the dangers of using files without handles.

List the advantages, disadvantages and safety considerations when using:

i) float glass;
ii) tempered glass;
iii) FRP;
iv) Plastic glazing.

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## MODULE: A 300

## TRADE TOOLS AND PROCEDURES

## OBJECTIVE:

Under practical workshop and site conditions or in a simulated situation, the trainee will be able to identify, select and use the common tools used by the plumber.

| SCHEDULE 1 | SCHEDULE 11 |
|---|---|
| **TASKS** | **THEORY AND TECHNICAL INFORMATION CONTENT** |
| Demonstrate the safe and proper use of each tool. | Recognise and name common tools used by the solar water heating technician. |
| | State the composition of steels used in the manufacture solar water heating tools. |
| Identify faults in hand tools. | List possible defects in hand tools and describe how these can be rectified. |
| State the planned maintenance requirements for hand tools. | Explain the procedure for adjustments and use of hand tools. |
| Select and list appropriate tools for a particular job. | Describe methods of grinding and sharpening tools. |
| State workshop and site safety rules. | State the industrial safety regulations – Factories Act, 1982. |
| Distinguish between correct and incorrect trade procedures and practices. | |

## MODULE: A 300 CONT'D

## TRADE TOOLS AND PROCEDURES

| SCHEDULE 1<br><br>TASKS | SCHEDULE 11<br><br>THEORY AND TECHNICAL INFORMATION CONTENT |
|---|---|
| Measure, cut and prepare pipe and tubing. | Explain methods of caring and storing non-powered and powered tools, equipment and measuring devises. |
| Interpret drawings to determine layout for solar water heating requirements and specifications. | List methods and communicate technical information in standard form. |
| Follow or adhere to relevant building codes, regulations and specifications. BNSI CP 16 (Part 1) 1981. | State the relevant sections of the National Building Code BNSI. CP 16 (Part 1) 1981. |
| Shape pipe and tubing bar stock and lead sheeting, by bending and forming. | Describe the application of force in bending and forming pipe and tubing, bar stock and lead sheet. |
| Join pipe and tubing by:<br>(a) reaming and threading;<br>(b) soft soldering, hard soldering, autogenous brazing and welding, caulking, cementing and wiping joints, flanged and compression fittings. | Stating the purpose and procedures of soft soldering and hard soldering. Also the requirements of soldered and brazed joints. |
| State the safety precautions in relation to soldering and brazing. | State the safety precautions in relation to soldering and brazing.<br><br>List and describe the range of joining processes for pipe and tubing. |

## MODULE: A 300 CONT'D

## TRADE TOOLS AND PROCEDURES

| SCHEDULE 1<br><br>TASKS | SCHEDULE 11<br><br>THEORY AND TECHNICAL INFORMATION CONTENT |
|---|---|
| Select and use the appropriate joining process for a particular task. | List the equipment and consumables used in making joints. |
| List and describe the safe working procedure in relation to power tools. | State and describe the dangers of using defective and damaged hand tools, portable powered tools, and gas heating equipment. |
| List the main powered workshop equipment used by the solar water heating technician. Explain the procedure for its use. | |
| **CARE AND USE OF VEHICLES:** | |
| Carry out visual checking of vehicle. | Practical exercises on visual inspection of vehicle. |
| Remove radiator cap, check coolant level and top up as required. | State the safety precautions necessary when removing radiator caps. |
| Select oil for specific application. | Define the term "multi-grade" with respect to oils. |
| Check engine oil level and top up as required. | State the need for correct water level in battery cells. |
| Check battery cells and top up with distilled water as required. | State the procedure for removing and installing battery, including identification of terminals. |
| Remove and install battery. | List the safety factors to be observed. |

## MODULE: A 300 CONT'D

## TRADE TOOLS AND PROCEDURES

| SCHEDULE 1 | SCHEDULE 11 |
|---|---|
| **TASKS** | **THEORY AND TECHNICAL INFORMATION CONTENT** |
| | List methods used to neutralise acid contact with:<br>- human skin;<br>- eyes;<br>- clothing;<br>- vehicle. |
| Check operation of lighting system. | List the procedure for checking lighting system including direction indicators and brake lights. |
| Identify jacking points in vehicle and remove and replace wheel. | State the safety precautions to be observed when changing vehicle wheels. |
| List and report defects found on vehicle to the supervisor or foreman. | State the importance of observing manufacturer's specifications for tyre pressures and oil filter change. |

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## MODULE: A 400

Under practical workshop and site conditions or in a simulated situation in Solar Water Heating the trainee must be able to identify, prepare and select materials and fittings for solar water heating technician.

## PIPE FITTING AND WELDING

| SCHEDULE 1<br><br>TASKS | SCHEDULE 11<br><br>THEORY AND TECHNICAL INFORMATION CONTENT |
|---|---|
| Follow, adhere to relevant building codes, regulations and specifications BNSI, CP 16 (part 1) Reg. 4.1. | List the relevant building codes regulations and specifications. Water Services Regulations 1982. |
| Prepare working areas with regard to safety hazards and safety practices. | Identify hazardous working areas. |
| Interpret solar water heating requirements from site and working drawings. | Sketch and draw working and site plans to indicate solar water heating requirements and information on location of all pipes. |
| Identify and select materials and fittings to specifications. Reg. 4.1. | Identify and select pipes and fittings with regard to materials, grade, thickness size and applications CP 16 Reg. 4.1 (part 1). |
| Measure and cut pipe – galvanised, P.V.C., lead and copper to specified length. | Describe the assembly of pipe work systems and methods of sealing.<br><br>List the standard pipe lengths and sizes commonly available. |

## MODULE: A 400 CONT'D

## PIPE FITTING AND WELDING

| SCHEDULE 1<br><br>TASKS | SCHEDULE 11<br><br>THEORY AND TECHNICAL INFORMATION CONTENT |
|---|---|
| Select the appropriate types of joints for various grades of light gauge tubes. | Calculate pipe and tubing lengths including allowances for threads, bending fittings and joints. |
| Demonstrate the use of measuring and levelling instruments. | Be aware of toxic and flammable properties of cleaning fluid and adhesive. |
| Prepare pipe ends for jointing. | Describe hacksaw blades, types, sizes and uses. |
| Set up piping with suitable gradient (slope) for surface or underground applications (roughin). | Compare the relative difference between taper and parallel threads, also types of stocks and dies available. |
| Secure pipes of various materials to the building structure. | Explain the procedure for cutting threads. |
| Thread various (ID) galvanised iron pipe using stocks and dies. | Describe the methods of bending light gauge copper tube of various outside diameters (OD). |
| Measure and cut copper tubing, using tube cutter and hacksaw. | Explain the process of tinning and soft soldering, also the purpose of soldering flux. |
| Bend and form pipe and tubing. | List the apparatus used for soldering and welding. |

## MODULE: A 400 CONT'D

## PIPE FITTING AND WELDING

| SCHEDULE 1<br><br>TASKS | SCHEDULE 11<br><br>THEORY AND TECHNICAL INFORMATION CONTENT |
|---|---|
| Assemble and test oxyacetylene, propane and butane heating equipment. | Be aware of possible carbon monoxide (CO) in closed areas. |
| Demonstrate the different types and shapes of blowpipe flame. | State the effect of work hardening, heat treatment, annealing on materials. |
| Demonstrate the principle of joining pipe and tubing by:<br>- Fusion welding;<br>- Braze welding Reg. 4.4.4. | State the methods of fastening pipes to various backgrounds.<br>Describe types and methods of fitting flanges to pipes.<br>Describe the procedure for testing pipe work. |
| Identify and correctly name various types of valves and their applications. | Explain and illustrate the construction of various types of valves. |
| Install various types of valves and stopcocks. | Identify appropriate spacing and correct method of fastening for strapping of pipes when surface mounted. |
| Install pipe work with spaces supports and brackets to various types of background Reg. 2.10. | State the main causes of corrosion of metal pipes. |
| Gas welds low carbon steel to form pipe brackets and support. | Describe the basic principles of making bends in various pipe work materials. |

## MODULE: A 400 CONT'D

## PIPE FITTING AND WELDING

| SCHEDULE 1 | SCHEDULE 11 |
|---|---|
| **TASKS** | **THEORY AND TECHNICAL INFORMATION CONTENT** |
| Use a range of gases and burner equipment. | Describe the correct method of jointing different types of plastic pipe work. |
| Cap and test roughed-in pipe work. Reg. 2.11.8. | Describe the various methods of jointing low carbon steel pipes. |
| Apply anti-corrosive treatment to metal pipes. | Recognise possible dangers in connection with hot water supplies. |
| | List the main causes of accidents in relation to gas heating equipment and describe how such accidents can be avoided. |

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## MODULE: A 500

## SOLAR WATER HEATER CONSTRUCTION AND INSTALLATION

## OBJECTIVE:

Under practical workshop and site conditions or in a simulated situation in Solar Water Heating Construction and Installation, the trainee will be able to:

| SCHEDULE 1 | SCHEDULE 11 |
|---|---|
| **TASKS** | **THEORY AND TECHNICAL INFORMATION CONTENT** |
| Follow or adhere to relevant building codes, regulations and specifications. | List the tools used and methods of constructing solar heating panels. |
| Interpret site and working drawings and specifications. | Sketch and describe the basic pipe work scheme employed with solar heating systems. |
| Identify and select materials as per relevant specifications. | Calculate the tank capacity and collector area/capacity required to supply a given quantity of heated water (e.g. family size, occupancy appliance, etc.) |
| | Produce sketches and working drawings to specifications. (Pump-assisted and thermosyphon systems). |
| . | Identify and select materials as per relevant specifications. |

## MODULE: A 500 CONT'D

## SOLAR WATER HEATER CONSTRUCTION AND INSTALLATION

| SCHEDULE 1<br><br>TASKS | SCHEDULE 11<br><br>THEORY AND TECHNICAL INFORMATION CONTENT |
|---|---|
| Identify and select tools and equipment and jointing techniques for particular applications. | |
| Measure, cut, bend, joint and fix pipe work to heating panel. | |
| Prepare and solder pipe joints using portable heating equipment. | Determine appropriate tools, equipment and jointing process for particular applications. |
| Assemble, check and correctly use portable heating equipment. | Distinguish between types of solder. |
| Install thermal insulation in heating panel. | State the purpose and distinguish between types of flux. |
| Fit glass and glaze collector cover. | List the advantages, disadvantages and safety aspects of various types of glass and glazing material. |
| Inspect and test welded joints. | State the safety precautions specific to soldering and welding. |
| Bronze weld light gauge copper tube up to 40 mm OD. | Describe methods of inspecting and testing joints. |

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## MODULE: A 500 CONT'D

## SOLAR WATER HEATER CONSTRUCTION AND INSTALLATION

| SCHEDULE 1 | SCHEDULE 11 |
|---|---|
| **TASKS** | **THEORY AND TECHNICAL INFORMATION CONTENT** |
| Construct a joint of light gauge copper tube up to 28 mm OD, using low melting point silver solder. | List the basic rules effective soldering and welding in terms of:<br>- planning and preparation;<br>- carrying out the operation;<br>- removal of flux residues. |
| Determine suitable position for heating equipment on house roof. | List the considerations which determine the position of heating equipment on house roof. |
| Fabricate thermally insulated tank. | Explain the waterproofing procedure in an element weather vs. bright sunlight. |
| Calculate structural supports required for tank and collectors. | |
| Install panel on roof (*waterproof as required).* | Methods of calculating structural supports required for tank collectors. |
| Design a roofing flange to avoid leaks. | Methods of installing equipment. Allowance for ventilation under equipment. Adequate supports etc. |
| Install tank on roof. | Prepare a list of tools required, installation and service of Solar hot water systems |
| Connect collector to storage tank. | |

## MODULE: A 500 CONT'D

## SOLAR WATER HEATER CONSTRUCTION AND INSTALLATION

| SCHEDULE 1<br><br>TASKS | SCHEDULE 11<br><br>THEORY AND TECHNICAL INFORMATION CONTENT |
|---|---|
| Select the appropriate fixing accessories when installing tanks and collectors to the following roofing materials:<br><br>i) Clay roofing tiles;<br>ii) Onduline sheets;<br>iii) Galvanised steel sheets;<br>iv) Aluminium sheeting;<br>v) Concrete. | Prepare a list of tools required, installation and service of Solar hot water systems:<br><br>a) spanners, adjustable spanners, torque wrenches, applications and control of torque.<br><br>b) Adjustable spanners and pipe wrenches;<br><br>c) Pliers;<br><br>d) Screwdrivers;<br><br>e) Hammers;<br><br>f) Levers and supports;<br><br>g) Die sets;<br><br>h) Portable heating equipment. |
| Connect tank to service supply lines and fixed points (insulate hot delivery lines as required).<br><br>Install pipe work and fittings.<br><br>Diagnose faults in collector panels. | Describe the effects of the use of incorrect flame settings on joints.<br><br>Explain the function an installation of the pressure control valve. |

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## MODULE: A 500 CONT'D

## SOLAR WATER HEATER CONSTRUCTION AND INSTALLATION

| SCHEDULE 1 | SCHEDULE 11 |
|---|---|
| **TASKS** | **THEORY AND TECHNICAL INFORMATION CONTENT** |
| Diagnose faults in service supply. | Describe and illustrate the operation of thermo siphon and pump-assisted circulation systems. |
| | Explain the function of the air valve. |
| Check circulation between storage tank and solar collector. | Fill up and bleed air from system:<br>a) water supply available;<br>b) water supplied by hose. |
| Check for leaks in general plumbing. | Describe the difference between forced circulation systems and gravity systems, and list the advantages of the former. |
| Check and identify supply and return lines. | Explain the transmission of heat by conduction, convection and radiation. |
| Identify and label booster switch. | Explain the procedure for filling up system. |
| Check hot water distribution lines. | Describe methods of identifying supply and return lines. |
| Pressure test hot and cold water plumbing systems. | |

## MODULE: A 500 CONT'D

## SOLAR WATER HEATER CONSTRUCTION AND INSTALLATION

| SCHEDULE 1 | SCHEDULE 11 |
|---|---|
| **TASKS** | **THEORY AND TECHNICAL INFORMATION CONTENT** |
| | Explain and demonstrate the effects of bridged lines. |
| | Explain and demonstrate the effects of bridged lines. |
| | Describe and sketch the methods of supporting and making connections to collector panels and storage tanks fitted to the roof. |

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## MODULE A 600

## INSTALLATION OF PLUMBING FIXTURES

| SCHEDULE 1 | | SCHEDULE 11 |
|---|---|---|
| **TASKS** | | **THEORY AND TECHNICAL INFORMATION CONTENT** |
| Identify, select, inspect, assemble and install the following: | | Determine suitable “head” for storage cistern. |
| Automatic flush valves | Reg. 4.2.8. | Read plan and determine heights and position of fixtures. |
| Waste outlets | Reg. 4.3.1. | |
| Strainers and outlet plugs | Reg. 4.2.19 | Explain the working principles of measuring and levelling equipment. |
| Equipment traps. | | |
| Overflow pipes | Reg. 4.2.18 | |
| Cold Water Storage Cisterns. | | |
| Bathtubs. | | Describe the assembly of fittings. |
| Water closet combinations | Reg. 4.2.3-4 | Describe the installation of fixtures to building fabric. |
| Bidets. | | |
| Showers | Reg. 4.2.12 | State the general rules for installation of fittings and fixtures. |
| Laundry traps and tubs | Reg. 4.2.11 | Describe the purpose and types of traps commonly used with sanitary appliances |
| Kitchen sinks | Reg. 4.2.2 & 4.2.10 | Describe methods of connecting fixtures to pipe work. |
| Drinking fountains | Reg. 4.2.14 | . |

# BARBADOS VOCATIONAL TRAINING BOARD

## SOLAR WATER HEATING STSTEMS TECHNICIAN

## MODULE A 600 CONT'D

## INSTALLATION OF PLUMBING FIXTURES

| SCHEDULE 1<br><br>TASKS | SCHEDULE 11<br><br>THEORY AND TECHNICAL INFORMATION CONTENT |
|---|---|
| Identify, select, inspect, assemble and install the following (cont'd) | |
| Urinals and urinal tanks. Reg. 4.2.6-7 | Give reasons and method of prevention of loss of seal traps Reg. 4.5.3. |
| Special fixtures Reg. 4.2.16 | |
| Floor drains Reg. 4.2.15 | |
| Check security of fittings and fixtures. | Explain "Water hammer," its causes and possible remedies. |
| Observe safety precautions – planned insulation procedures. | Describe methods of testing fixtures for stability and leaks. |
| Layout pipe work for thermo-syphon and pipe assisted domestic hot water systems. | State the need for overflow and warning pipes. |
| Join piping to existing pipe-work using correct fittings. | Examine the effects of the use of check valves in a heating system (closed system). |
| | State the relevant regulation regarding water supply to fixtures |
| Install air-bleed pipes and drain off taps. | List and state the purpose of common tools and materials used in the installation of fixtures. |

## MODULE A 600 CONT'D

## INSTALLATION OF PLUMBING FIXTURES

| SCHEDULE 1<br><br>TASKS | SCHEDULE 11<br><br>THEORY AND TECHNICAL INFORMATION CONTENT |
|---|---|
| Install water heater:<br><br>(a) Gas – single and multi-point;<br><br>(b) Electric;<br><br>(c) Solar. | Relate the components of a hot water system to the physical characteristics of the contents (e.g. temperature/pressure).<br><br>State the categories of pipe, joints suitable for hot water systems. |
| Install emersion heaters and associated thermostats. | State the reasons for planned isolation provisions. |
| Assemble pipe work for single and multi-point gas and electric water heaters. | Describe methods of allowing for expansion in pipe work. |
| Install indirect and direct hot water storage cylinders. | State the need for air release pipes and draining taps. |
| Install and adjust pressure-reducing valves. | Explain and illustrate the construction of the various types of water heaters. |
| Install and adjust pressure release valves. | Describe methods of providing hot water in dwellings, e.g. gas, electricity and solar heated. |
| Connect hot water supply to service outlets. | Explain and illustrate the construction of the various types of water heaters. |
| Apply insulating materials to flow pipes. | Explain the purpose of venting hot water systems. |

## MODULE A 600 CONT'D

## INSTALLATION OF PLUMBING FIXTURES

| SCHEDULE 1<br><br>TASKS | SCHEDULE 11<br><br>THEORY AND TECHNICAL INFORMATION CONTENT |
|---|---|
| Apply insulating materials to flow pipes.<br><br>Air-bleed systems. | Describe the construction and operation of pressure release valves. |
| Connect water supply – attach waste outlet to drains. | State reasons for the use, and operation of indirect systems. |
| Test fittings and fixtures for leaks. | Describe the symptoms and effects of air locks and noises ion hot and cold water systems. |
| Trouble shoot general plumbing systems. Isolate and test specified areas.<br><br>Rectify leaks. | Describe procedure for trouble-shooting plumbing systems including the isolation/ testing of various areas.<br><br>List the characteristics of the thermal insulation materials commonly used with hot water systems. |
| Remove air locks from hot and cold water systems.<br><br>Apply thermal insulation to hot water system as required. | Explain and illustrate the construction and working principles of:<br><br>Gas heaters;<br><br>Electric heaters;<br><br>Solar heaters. |
| Identify and name the components of the following heating systems:<br><br>- gas, heaters, electric heaters and solar heaters. | Explain and illustrate the construction and working principles of:<br><br>- Thermo syphon systems; and Pump assisted systems. |
| Identify and name the components of the following systems – thermo syphon systems and pump assisted. | |

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## MODULE A 700

## MAINTENANCE OF PLUMBING FIXTURES AND FITTINGS

## OBJECTIVE:

Under practical workshop and site conditions or in a simulated situation in the Maintenance of Fixtures and Fittings, the trainee will be able to:

| SCHEDULE 1<br><br>TASKS | SCHEDULE 11<br><br>THEORY AND TECHNICAL INFORMATION CONTENT |
|---|---|
| Follow or adhere to relevant building codes, regulations and specifications. | List the relevant building codes, regulations and specifications CP 16 (part 1) Reg. 4.2 and 3.8 Service Reg. 1982. |
| Read and interpret drawings to locate fittings and fixtures. | Explain and illustrate the construction and working principles of various valves and fixtures. |
| Turn-off appropriate water supply – isolate fixture. | Explain the working principles of measuring and levelling equipment. |
| Identify and select material and fittings to specification. | Describe the methods of assembling fittings. |
| Use measuring and levelling equipment. | Describe the installation of fixtures to building fabric. |
| Measure, cut and prepare pipe to specified length. | Describe the methods of connecting fixtures to pipe work |

## MODULE A 700 CONT'D

## MAINTENANCE OF PLUMBING FIXTURES AND FITTINGS

| SCHEDULE 1<br><br>TASKS | SCHEDULE 11<br><br>THEORY AND TECHNICAL INFORMATION CONTENT |
|---|---|
| Thread galvanise iron pipe. | Describe the methods of testing fixtures for stability and pipe work for leaks. |
| Assemble the following joints:<br>a) solvent welded;<br>b) capillary;<br>c) threaded;<br>d) compression;<br>e) flanged;<br>f) fusion and welded. | Give reasons for the provision of vents, isolation valves and traps and state the safety precautions specific to the use of soldering and welding equipment.<br><br>Describe the materials commonly used in replacing tap washers and gland packing.<br><br>Describe and illustrate the action of valve seat refacer. |
| Assemble check and light torch. | Describe the siphonic principle of a w/c cistern. |
| Demonstrate safe use of welding, and soldering equipment when assembling joints. | Explain the procedure for testing pipe work fittings and fixtures. |
| Identify and correctly name various types of valves and their applications. | Describe the procedure for removing and renewing defective sections of: |
| Repack leaking gland – stopcock or bibcock *Reg. 13 (1). | a) galvanised and cast iron pipe;<br>b) copper tubing<br>c) p.v.c. pipe. |
| Rewash pillar cocks and taps or mixer taps. | |

## MODULE A 700 CONT'D

## MAINTENANCE OF PLUMBING FIXTURES AND FITTINGS

**SCHEDULE 1**

**TASKS**

Reseat cock and taps.

Repair siphon for w/c cisterns (close coupled and low level).

Demonstrate safe work habits – handling broken fixtures.

Repair/replace leaking flush valves.

Replace copper pipe capillary joint.

Renew specific lengths of defective galvanised iron pipe.

Replace broken fixtures.

Renew specific sections of defective p.v.c. pipe.

**SCHEDULE 11**

**THEORY AND TECHNICAL INFORMATION CONTENT**

Describe the symptoms and effects of air locks and noises in hot water systems.

Explain and illustrate the construction and working principles of:

- gas heaters;
- electric heaters;
- solar heaters;
- thermosyphon systems;
- pump assisted systems.

Explain the procedure for renewing specific lengths and fittings of the following pipe work:

- p.v.c.;
- galvanise/iron;
- copper;
- lead.

## MODULE A 700 CONT'D

## MAINTENANCE OF PLUMBING FIXTURES AND FITTINGS

| SCHEDULE 1<br><br>TASKS | SCHEDULE 11<br><br>THEORY AND TECHNICAL INFORMATION CONTENT |
|---|---|
| Repair/replace defective lead pipe. | |
| Replace bidet regulator sealing washers (vacuum breaker). | |
| Rewasher or replace ball-cock or valve for bottom feed or side feed w/c cisterns. | |
| Reseat ball cock or valve. | |
| Clean clogged drains. | |
| Dismantle, inspect and reassemble water heaters. | |
| Install and adjust pressure release valves. | |
| Test pipe work fittings and fixtures of leaks. | |
| Examine the effects of hair pin cracks in CPVC pipe with and without applied pressure. | Describe the procedure for trouble shooting plumbing systems, including the isolation/testing of specified areas. |
| Rectify leaks *Reg. 13. | |

***Water Services Regulations**.

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## MODULE A 800

## MAINTENANCE OF PIPES

## OBJECTIVE:

Under practical workshop conditions or in a simulated situation in the Maintenance of Pipes, the trainee will be able to:

| SCHEDULE 1 | SCHEDULE 11 |
|---|---|
| **TASKS** | **THEORY AND TECHNICAL INFORMATION CONTENT** |
| Follow or adhere to relevant building codes, regulations and specifications, BNSI CP 16 (part 1) Reg. 2.5 and 4. | List the relevant building codes, regulations and specifications.<br><br>Identify hazardous working area. |
| Prepare working areas with regard to safety hazards and safety practices. | Sketch and draw working and site plans to indicate plumbing systems. |
| Read and interpret relevant system details from drawings of plans. | Identify and select pipes and fittings with regard to materials, grade, thickness, size and applications. |
| Examine and test existing plumbing for faults. Reg. 2.11.3.3.3. | Describe the type of pipe suitable for each application. |
| Rectify any defects found in existing plumbing systems. | Describe the procedure of assembling pipe-work and the methods of sealing.<br><br>List the standard pipe lengths and sizes commonly available. |

## MODULE A 800 CONT'D

## MAINTENANCE OF PIPES

| SCHEDULE 1<br><br>TASKS | SCHEDULE 11<br><br>THEORY AND TECHNICAL INFORMATION CONTENT |
|---|---|
| Identify and select material and fittings to specifications. | Calculate pipe and tubing length including the necessary allowances. |
| Measure and cut pipes to specified length. | Demonstrate the use of measuring and levelling instruments. |
| Take precautions against toxic and inflammable properties of cleaning fluids, adhesive or pipe contents (isolate piping). | Describe hacksaw blades – types, sizes and uses. |
| Bend and form pipe and tubing. | Compare the relative difference between taper and parallel threads, also types of stocks and dies available. |
| Join pipe, tubing and fittings by reaming, threading, soft and hard soldering, welding caulking, flanged fittings, compression fittings, wiping joints, cementing of non-metallic and plastic joints. | Explain the procedure of cutting threads. |
| Replace various valves and stop-cocks. | Describe the procedure for bending light gauge copper tube of various outside diameters. |
| | Explain the process of tinning and soft soldering, also the purpose of soldering flux. |
| Assemble, check, and light (blow torch) portable heating equipment. | Describe the apparatus used for soldering and brazing. |

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## MODULE A 800 CONT'D

## MAINTENANCE OF PIPES

| SCHEDULE 1 | SCHEDULE 11 |
|---|---|
| | **THEORY AND TECHNICAL INFORMATION CONTENT** |
| Demonstrate proper use of a range of gases and burner equipment. | Distinguish between types of solder and their applications. |
| Identify and correctly name various types of valves and their uses. | State the safety precautions specific to soldering and brazing. |
| Test existing and repaired pipe-work Reg. 2.11.8. | State the safety precautions with regard to the handling, transportation and storage of gas cylinders. |
| | State the gases and gas mixtures used in brazing and welding. |
| Install various types of valves. | Explain the working principles of gas regulators and blowpipes. |
| Renew specified lengths of pipe work and fittings. | State the properties of different types of flames. |
| Identify and select suitable flanges. | Describe the effects of the use or incorrect flame settings or quality control of joints. |
| Apply anti-corrosion treatment to pipe work. | Assemble, test and check oxyacetylene, propane and butane heating equipment. |

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## MODULE A 800 CONT'D

## MAINTENANCE OF PIPES

| SCHEDULE 1 | SCHEDULE 11<br><br>THEORY AND TECHNICAL INFORMATION CONTENT |
|---|---|
| Fit and secure various pipes to building fabric. | State the effects of work hardening, heat treatment and annealing on materials.<br><br>Explain and illustrate the construction of various types of valves.<br><br>Describe the methods of fitting flanges to pipes.<br><br>Describe the procedure for the testing of pipe work, including methods of isolating specified sections.<br><br>Describe types of anti-corrosion treatment.<br><br>Describe the methods of securing pipes of various materials to be building structure. |

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## MODULE B 100

## RELATED SUBJECTS

## COMMUNICATION – ENGLISH

## OBJECTIVE:

To bring about a level of achievement in communication – English skills adequate to meet the demands of society.

| LEARNING OBJECTIVE | CONTENT |
|---|---|
| The trainee will be able to: | |
| Give and follow verbal instructions, pass on verbal instructions accurately, recognise the need for differences in speaking with a variety of audiences. | Practice speaking audibly and clearly, listen attentively, relate clear verbal explanation of experience/events/activities, processes to customers, employers and fellow employees. |
| Perform communication activities by telephone. | Communicate by using: |
| Make a disciplined contribution to group discussion. | Polite speech, acceptable phrases, methods of receiving and recording messages. |
| | Practice sessions of negotiating, advising, persuading, justifying, using role-playing mock interviews and ways of responding to others' views. |
| Participate and communicate as a member of a variety of groups. | Role-play as chairman, member, leader, recorder in formal and informal large and small groups. |

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## MODULE B 100 CONT'D

## COMMUNICATION – ENGLISH

| LEARNING OBJECTIVE | CONTENT |
|---|---|
| Read effectively for information, data and direction. | Peruse instructional manuals, memos, letters, notices and labels**.** |
| Read, interpret and present diagrams, maps, charts and graphs. | Extract information from diagrams, charts and maps, bar graphs, bi-graphs and line graphs. |
| Read and interpret contents of legal documents. | Observe the implications of HP contracts, guarantees, liability and rental agreements. |
| Make notes of personal use. | Apply methods of recording salient points during talks, verbal instructions, or watching a film and from books. |
| Recognise the structure of a complete sentence.<br><br>Demonstrate knowledge of the basic rules of grammar. | Practice sentence construction exercises, components of a sentence, observation and appreciation of the conventions, beginning and ending of statements, spelling, punctuation and grammar. |
| Recognise the correct use of punctuation and capital letters. | Practice the writing of application letters, brief reports, informal notes and messages. |

## MODULE B 100 CONT'D

## COMMUNICATION – ENGLISH

| LEARNING OBJECTIVES | CONTENT |
|---|---|
| Fill in forms correctly. | Practice sessions with job application forms, insurance claims, questionnaires, etc. |
| Organise ideas for writing. Write instructions and memos. Write business letters and resumes. | Explain the significance of a logical sequence, legibility and sufficient relevant information. |
| Précis texts.<br><br>Complete comprehension exercises. | Prepare a summary of speech or written work. |
| Read and understand written material, distinguish fact from opinion, identify ambiguous statements. | Read and interpret material, reproducing the gist of such material in fewer words. |

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## MODULE B 200

## CALCULATIONS

**OBJECTIVE:**

The trainee will be able to perform calculations which meet the demands of the plumbing trade.

| LEARNING OBJECTIVE | CONTENT |
|---|---|
| Add, subtract, multiply and divide whole numbers and vulgar fractions. | Complete practical exercises with simple cost calculations. |
| Identify and use the divisions on measuring instruments. | Examine fractions as rational numbers, halves, quarters, eights and sixteenths, fifths and tenths, mixed numbers, improper fractions, practical exercises with measuring instruments. |
| Add, subtract, multiply and divide decimal fractions. | Review the theory of decimals, the placement and significance of the point, decimal notation. Change of value through movement of the point, place value. |
| Convert fractions to decimals and vice versa. | Complete exercises in payroll deductions and overtime rates. |

## MODULE B 200 CONT'D

## CALCULATIONS

| LEARNING OBJECTIVES | CONTENT |
|---|---|
| Apply and interpret ratio and proportion. | Decide on quantities for preparing mixtures, wage increases, scale on drawings. |
| Apply simple formulae. Define an equation. Transpose terms and combine like terms. | Calculate the areas, substitute formulae to determine unknown, transform of formulae. |
| | Interpret plans and prepare of material in the course of a project. |
| Apply use standard units of measurements, read graduated scales. | |
| Add, subtract, multiply and divide weights in S.I. units | Convert grams to kilograms, metric tonnes, calculating weights of solder and other plumbing materials, calculating weights of specific lengths of piping. |
| Add, subtract, multiply and divide the following in S.I. units: | |
| Mass | gram |
| Capacity | litres |
| Length | metre |
| Area | square metre |
| Volume | cubic metre |
| Temperature | degrees Celsius |

## MODULE B 200 CONT'D

## CALCULATIONS

| LEARNING OBJECTIVE | CONTENT |
|---|---|
| Define the base units. Read the hour clock. | Demonstrate ability to plan event an/or course of action, completing a task, estimating time. |
| Calculate powers and roots manually, using mathematical tables, or calculators.<br><br>Identify the radical sign.<br><br>Identify the square root sign. | Complete exercises in raising a number, decimal or fraction to any power, the placement and significance of the index number from/on the radical sign the "perfect" root, use of tables. Marking off into groups and additional noughts after point. The relationship between a square, rectangle and triangle. |
| Make calculations and estimations of the perimeter and area of four sided figures, circles, cylinders and triangles. | List methods of estimating quantities of materials. Standards formulae for volume of common solids. Mass as the amount of matter in a body. The standard unit of mass. The comparison of two dissimilar materials.<br><br>Read and apply conversion charts – re The conversion of litres to millilitres to cubic metres. |
| Calculate and estimate the capacity of flat end-cylinders, pipes and rectangular/square end tanks and cisterns. | Determine methods of estimating hot water requirements based on number of occupants of dwellings. |
| Calculate water storage requirements including collector capacity.<br><br>Make calculations based on the properties of the right-angles triangle. | Explain the relationship between the right angled triangle and the rectangle, measurement of angles, names and relationships between the three sides. Given length of two sides, use the formula to determine the unknown. |

## MODULE B 200 CONT'D

## CALCULATIONS

| LEARNING OBJECTIVE | CONTENT |
|---|---|
| Decide when to use calculators, tables, pencil and paper or make calculations mentally. | Practice sessions on the required techniques. |

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## RELATED STUDIES

## MODULE: B 300

## SCIENCE

### OBJECTIVE:

The trainee will be able to demonstrate an understanding of the scientific principles as they apply to the Plumbing trade.

| LEARNING OBJECTIVES | CONTENT |
|---|---|
| Identify the fulcrum, effort, resistance effort, arm and resistance arm on diagrams of first, second and third class levers. | Conduct practical exercises with simple machines, the application of levers. Moments of a turning effect. The relationship between the fulcrum, effort and resistance. Examples of hand tools. |
| Solve problems using the principle laws of levers. | Explain the principle of moments to solve unknown force. Twisting moment or torque as applied to wrenches. |
| Explain the use of a pulley system to reduce the effort or change the direction. | Identify the pulley as a machine. Describe the mechanical efficiency as the ratio of useful work done by a machine to the amount of work given to the machine. |
| Describe uses of a pulley system. | Describe the “block and tackle” as a method of lifting. |
| Describe the working principle of screw jacks. | Explain the screw jack as a machine and the theoretical advantage of jacks. Describe the principle of transmission of pressure in a liquid. |
| Define pressure as force applied to a unit area. | Show the relationship of pressure as a ratio of force and area. |

| | |
|---|---|
| | The relation between force and motion. The types of forces. Unit of force. |

**MODULE: B 300 CONT'D**

## SCIENCE

| LEARNING OBJECTIVES | CONTENT |
|---|---|
| | Describe the effects on hair pin cracks in CPVC pipe when pressure is added. |
| Explain the use of the hydrometer to determine the specific gravity of a liquid. | Conduct practical exercises in comparing the ratio of mass of any volume of substance to the mass of an equal volume of water. |
| List the specific gravity or relative density of common materials used in plumbing. | Explain simple physical properties of lead, copper, zinc, iron, steel, plastics and aluminium. |
| Explain the "flow" of electricity. | Introduce the: theory of the Electron, the measurement of current, the units or electricity and their symbols. Ohms law and its application and calculation to determine the unknown units. |
| Recognise types of electricity supply. | Identify the standard mains supply; reduce voltage supply for hand lamps and special applications. |
| Describe linear expansion of metals and plastics. | Explain expansion as a result of heat. Give examples of expansion. Describe the effects of heat on different metals. Degree (coefficient) of expansion of metals and plastics. |
| Describe expansion and contractions of liquids and solids. | Explain the principle and results of expansion and contraction. The operation of thermometers and thermostats. Types of expansion and contraction. |

| | |
|---|---|
| Explain the principle of capillarity. | Conduct practical exercises with soldering fittings. Methods of installing damp proof course materials. |

## MODULE: B 300 CONT'D

## SCIENCE

| LEARNING OBJECTIVES | CONTENT |
|---|---|
| Define atmospheric pressure. | Explain the existence of atmospheric pressure. |
| Explain siphonic action. | Examine the effects of atmospheric pressure on flow of liquids. |
| State the requirements for effective combustion of fuels. | Explain the process of combustion. The composition of the atmosphere. |
| Identify fluids as either liquid or gases. | Define temperature and heat. The relationship between temperature change and body mass of the same substance. Change of state. Measurement of temperature, the fixed points on the thermometer scale. |
| State the effects of heat on liquids and solids. | Compare the specific heat capacity of common materials. Types of heat. Heat required by mass of different substances for temperature change. Temper and hardness of steel tools. |
| Describe methods of heat transfer, its assistance and/or prevention. | Describe the process of the flow of heat. Heat gain equals heat loss. The principle of heat transfer through – radiation, conduction and convection. Practical applications to hot water systems. Good and poor conductors. |

# BARBADOS VOCATIONAL TRAINING BOARD

## SOLAR WATER HEATING STSTEMS TECHNICIAN

## MODULE: B 300 CONT'D

## SCIENCE

| LEARNING OBJECTIVES | CONTENT |
|---|---|
| Explain the terms hard and soft water. | Explain the mineral contents of hard water.<br>The process of mineral removal.<br>Permanent and temporary hardness. |
| Explain the operating principle and the use of the manometer. | Identify the scale on the dial – connecting the gauge, reading and pressure. |
| Identify corrosion and erosion in metals. | Differentiate between types of corrosion and erosion.<br>Causes of corrosive action. |
| | Explain the use of anti-corrosion treatment and chemicals. Use of dissimilar metals. |

# BARBADOS VOCATIONAL TRAINING BOARD

# SOLAR WATER HEATING STSTEMS TECHNICIAN

## MODULE: B 400

## DRAWING

## OBJECTIVE:

The trainee will be able to read and interpret building plans and produce working drawings, which meet the demands of the Plumbing trade.

| LEARNING OBJECTIVES | CONTENT |
|---|---|
| Identify, select and use standard drawing instruments and techniques. | Identify the tools at the drawing office – drawing boards, T-squares, set squares, dividers, compasses, scales and pencils.<br><br>Draw as a means of conveying design ideas to the craftsman. |
| Prepare rule-assisted sketches of craft details. | Explain the use of sketches to aid descriptive methods. Practical exercises with rule assisted sketches. Labelling of sketches. |
| Sketch views of a building. | Show views of basic plumbing details. |
| Describe systems of a linear measurement. | |
| Identify plain figures from a set of objects, pictures or names of objects. | Identify of rectangles, squares, triangles, circles, rectangular solids, cubes, pyramids, cones, cylinders, spheres and prisms. |
| Identify objects in two-dimensional forms. | Identify objects in two-dimensional forms. |

## MODULE: B 400 CONT'D

## DRAWING

| LEARNING OBJECTIVES | CONTENT |
|---|---|
| Identify objects in three-dimensional forms. | Identify objects in three dimensional forms. |
| Interpret and construct scale drawings. | Give examples of scales used to represent reduction or expansion of the actual size of an object e.g. 1:4, 6:1, 1cm = 1 metre etc. |
| Convert a scale measurement to true size given the scale. | |
| Determine actual dimensions of an object given a simple scale drawing of the object and a ruler. | Interpret working drawings. |
| Identify the sequence in which parts are put together in an assembly drawing. | Explain the importance of following a given sequence. |
| Draw to scale. | Given a basic drawing set, produce front, top and side representations of common objects. |
| Interpret and use standard symbols. | Explain the concept of a standard in communicating technical information. Symbols as a universal language for designers, technicians, craftsmen and consumers. |

## MODULE: B 400 CONT'D

## DRAWING

| LEARNING OBJECTIVES | CONTENT |
|---|---|
| Use methods of communicating technical information in standardised form. | Apply the use of standard form:<br>(a) technical drawings;<br>(b) operations sheet;<br>(c) date sheets and wall charts;<br>(d) standard/manufacturers' tables and graphs. |
| Produce figures using set squares. | Complete practical exercises with set square assisted lines and angles. |
| Produce figures using compass. | Complete practical exercises with compass assisted lines, angles and circles. |
| Interpret working and site drawings. | Interpret technical drawings. |
| Identify the link between colour coding and safety. | Identify components from drawings, diagrams and exploded views. |
| Estimate quantities of materials from drawings. | Allocate fixtures, fittings and piping. |
| Distinguish between the different types of projections. | Explain the theory and principles of projections. Identification of orthographic first and third angle projections. |

## MODULE: B 400 CONT'D

## DRAWING

| LEARNING OBJECTIVES | CONTENT |
|---|---|
| Construct orthographic figures, organise views in:<br><br>(a) first angle projection<br><br>(b) third angle projection. | 1. Orthographic, first and third angle;<br><br>2. Pictorial, isometric and oblique views. |
| Read off measurements from the drawings. | The need for essential dimensions. Placement of dimensions. Dimensions of hidden details. Practice of drawing figures to size and adding dimensions. |
| Locate position of piping and fixtures from the drawings. | Interpretation of standard symbols and conversion of scale measurements. |
| Identify and produce lines on drawings. | Identify examples and types of lines. Practice drawing with typical applications of lines. |
| Construct plain geometric figures. | Practice in the following:<br><br>Bisect a given line.<br><br>Construct a perpendicular at a point on a straight line.<br><br>Draw parallel lines.<br><br>Construct angles of various values.<br><br>Divide straight lines.<br><br>List types of triangles, polygons, hexagons and circles. |

## MODULE: B 400 CONT'D

## DRAWING

| LEARNING OBJECTIVES | CONTENT |
|---|---|
| Construct plain figures. | Practice the drawing of objects by means of plain views. |
| Construct orthographic projections. | |
| Construct isometric projections. | Isometric projection as a pictorial method of drawing.<br>Practice drawing of objects in isometric projection. |
| State the purpose of sections on drawings. | Define a section. |
| Produce drawings showing internal details through sections. | Practice the removal of sections to expose required details. |
| | Produce and locate the section plane. |
| | Compare hidden detail lines and the section plane. |
| | Identify sections. |

## SECTION C

# GLOSSARY OF TERMS
## SOLAR HEATING INSTALLATION & SERVICE PERSONNEL

Automatic flushing valve - A self flushing valve on a fixture, directly connected to the water supply pipes or to a special flush tank.

Anti-flood valve - A valve installed in a building sewer to prevent sewage from flowing back into the building.

Area Drain - A drain installed to collect surface water from an open area.

Backflow - The flow of water in pipes in a reverse direction from normally intended.

Back water valve - A device in the drainage system to prevent reversal of flow.

Bain Marie - Vessels of hot water in which cooking pans are slowly heated.

Blow-off - A discharge outlet for the release of steam, water or other fluids from a pipe line.

Bell or Hub (socket) - The portion of a pipe which, for a short distance, is sufficiently enlarged to receive the end of another pipe of the same diameter for the purpose of making a joint.

Caulking - The operation of making a joint or seam tight to withstand pressure. Performed by stuffing the joint with tow, yarn or other filling material and compressing the material inside the bell.

Check valve - A valve that permits the flow of water within a pipe in only one direction and closes automatically to prevent back flow.

**GLOSSARY CONT'D**

Chlorinator - A device which add controlled amounts of hydrochloride automatically to disinfect and destroy bacteria in the water system.

Cp 20 : 1983 - BNSI Code of Practice for Solar Heating Systems for Domestic Hot Water.

Code - BNSI Plumbing Regulations.

Core cock - A type of valve through which the flow of water is controlled by a circuit core or plug that fits closely in a machined seat. The core has a part bored through it to serve as a water passageway. Also called a plug valve.

Deep seal trap - A "p" trap with a water seal depth of more than four (4) inches.

Drum trap - A trap whose main body is a cylinder with its axis vertical. The cylinder is larger in the diameter than the inlet or outlet pipe.

Filter - A stage in a water treatment or purification plant which removes suspended matter.

Flanged fittings - An excellent method of joining large diameter pipes, both in boiler houses where easy dismantling is required and for high pressure steam and water pipes, maybe made of malleable iron of P.V.C. and maybe screwed to the ends of pipe (union secured by nuts and bolts).

Flow rate - The volume of water used by a plumbing fixture in a given amount

of time. Usually expressed in *gallons per minute* (gpm).

Grade or pitch - The fall (slope) of a line of pipe reference to a horizontal plane.

**GLOSSARY CONT'D**

| | | |
|---|---|---|
| Inserts bolts or etc. | - | Devices buried in concrete to received screws to support pipes |
| Interceptors to oil or solid | - | Any device installed in a drainage piping prevent the passage of grease, materials such as sand. |
| Invert | - | The lowest portion of the inside of any horizontal pipe. |
| Leaching systems permit into earth (also fields or leach fields). | - | Systems of underground piping which absorption of liquid waste called disposal |
| Lead burning together oxyacetylene equipment. | - | A method used to join pipes or sheets by fusion of lead using |
| Negative pressure). | - | A pressure within a pipe that is less than atmospheric pressure (minus |
| Pipe hanger | - | An iron support of a beam or pipe. |
| Potable water | - | Water which is satisfactory drinking and domestic purposes. |
| Reaming pipe cutter. | - | Removing the burr from the inside of a which has been cut with a pipe |
| Ring main a available in is often connected to trunk mains in the area. | - | A water supply system which consists of complete circuit. Water supply is either or both directions. It all or most of the |

Riser - A water supply pipe which extends vertically one full storey or more to convey water to branches or fixtures.

Rural supply system - A water system fed from privately dug wells, the water is than pumped from the well to a storage tank to be distributed to the various outlet points.

**GLOSSARY CONT'D**

Self-syphonage - The loss of the seal of a trap as a result of removing the water from the trap that is caused by the discharge of the fixture to which the trap is connected.

Sleeves - Tubes or tube-like parts fitting over or around another part. In building, a pipe used to provide openings for the installing of electrical and plumbing services used particularly in solid concrete floors through which the services must pass.

Stack - A general term used for any vertical run of the D.W.V. system.

Strainer - A perforated pipe cylinder or wire gauze or similar tube. It allows the passage of water, but large particles.

Syphonage - A suction by the flow of liquid in pipes.

BNSI 147 : 1983 - Barbados National Standard Specification for

Method of Thermal Testing of Flat Plate Solar

Collectors.

Trap - A drainage fitting which produces a water seal to prevent gas from entering the building.

Vent - A pipe installed to provide a circulation of air within a plumbing system to exhaust foul gases and to protect scales from syphonage and back pressure.

Vent (Wet) - A soil or waste pipe which also serves as a vent.

Water Conditioner - A device used to remove dissolved minerals from water. Removal of the mineral frequency improves the taste of the water and reduces the likelihood of mineral deposits building up in plumbing system.

**GLOSSARY CONT'D**

Water softener - A device which removes dissolved calcium and magnesium from the water by ion exchange.

W.C. chair carrier - A device used in the installation of hung w.c's. It supports the complete w.c. and outlet.

Three-quarter bath - A bathroom containing a water closet, a lavatory and a shower bath.

Vacuum breaker - A valve placed between the bidet and water pipe to prevent used water entering the portable water systems in the event of water supply interruption, resulting in a negative system pressure.

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