SQA/SNIJIB

Training and Assessment Programme for SVQ 3 SVQ level 3 Domestic Plumbing and Heating

H98F 04: Install and test domestic plumbing and heating systems

H98G 04: Service and maintain domestic plumbing and heating systems

H98H 04: Inspect and pre-commission domestic plumbing and heating systems

H98J 04: Commission domestic plumbing and heating systems

H98K 04: Decommission domestic plumbing and heating systems

Section: Central Heating Section

Stage 1: Syllabus Codes CH 1.1–CH 1.4

Stage 2: Syllabus Codes CH 2.1–3.2

Learning and delivery guidance

This Unit covers all aspects of central heating installations: from initial theory input to practical installations. Delivering this Unit to a group of learners will involve many teaching and learning techniques and approaches.

It is recommended that teaching and learning take place in an environment where learners experience simulated full-scale working central heating systems. The use of modern teaching and learning aids, eg 'smart' boards, and proprietary interactive teaching materials would also greatly enhance the learning experience.

The syllabus document is set out in a manner to allow the lecturer to determine the areas of work to be covered within a certain time frame. It is envisaged that this Unit will be offered over the first two years of 'off the job' training. It is presented in three syllabus sections with each section concluding with a summative assessment.

The programme structure, see 'The Introduction', outlines the progress of the Unit and its integration with the other Units of the qualification.

Assessment

A holistic approach has been adopted for the formative and summative aspects of the practical installation part of this Unit. This is in conjunction with:

H98F 04 Install and Test Domestic Plumbing and Heating Systems.
H98G 04 Service and Maintain Domestic Plumbing and Heating Systems.
H98H 04 Inspect and Pre-commission Domestic Plumbing and Heating Systems.
H98J 04 Commission Domestic Plumbing and Heating Systems
H98K 04 Decommission Domestic Plumbing and Heating Systems.

This pack contains practical tests for both formative assessment (Pipework exercises for Year 1) and summative assessment (H98L 04 Install Sheet Weather Protection Year 1 and 2 and Installation Practice Year 2).

Assessments other than practical assessments will be undertaken using the SOLAR e-assessment method. This process is completed entirely online and randomly selects the assessment questions from a bank of questions which cover the Unit content. In this Unit there are three assessments over the two years of the Unit's duration. (Refer to the programme structure in the Introduction.)

Assignment

This Unit has an assignment which is intended to bring together aspects of central heating installation and design practices. The assignment should commence midway through Year 2 of the Unit with a completion date being stipulated nearer to the completion date of the Unit.

Learners should be introduced to the assignment as part of the induction to the Unit — to give direction and motivate learning.

Syllabus

CH1.1 — Layouts of open vented heating systems incorporating domestic hot water

Assessment method: SOLAR e-assessment

- One- and two-pipe systems
- Mini- and micro-bore systems
- Pumped heating only system.
- Gravity hot water and pumped heating.
- Fully pumped with 2 x two port valves.
- Fully pumped with a mid-position valve.
- Fully pumped with multi-zoning arrangements
- Combination boiler with pumped heating

Appreciation of Linked fuel system arrangements, eg gas high efficiency boiler and a biomass boiler

CH1.2 — The functions of the main components, pipework and controls used in open vented heating systems incorporating domestic hot water

Assessment method: SOLAR e-assessment

- Pumped and gravity primaries (when to use); cold feed, vent (point of connections)
- Combined feed and vent applications
- Flow and return pipework for boiler and radiator circuits
- Terminology, location of components and points of connections in all system layouts
- Pump positioning in relation to cold feed and vent
- Heat emitters, radiators, convectors, towel rails, LST panels
- Feed and expansion cistern
- Flow and return pipework
- By-pass valve
- Feed and vent pipes
- Manual and automatic air release valves
- Air separators
- Recommended insulation thicknesses for selected outside diameter pipework
- Insulation requirements for pipework in unheated areas required by the Water Byelaws

CH1.3 — Heat emitters and associated controls for use in domestic heating systems

Assessment method: SOLAR e-assessment

- Column, panel radiators, low surface temperature radiators, towel rail, skirting heaters, compact radiators
- Natural and fan-assisted convectors, wall hung and kickspace
- The effect of convection fans on heat emission from fan-assisted emitters
- Underfloor pipework emissions
- Flow and return points of connection to heat emitters
- Function and location of wheel-head, lock shield, twin entry/exit and thermostatic radiator valves; radiator and remote sensor thermostat, and air release devices
- Motorised and thermostatic valves including Bidirectional types
- Full programmers time switches and Multi-zoning programmers
- Programmable room thermostats
- Functions and operation of controls and compatibility of control systems
- Factors affecting location of electrical, mechanical and wireless (RF) controls
- Select heat emitters for high efficiency condensing boiler installations
- Select multi-type heat emitters for linked fuel type installation

CH1.4 — Boilers of approved design suitable for use in open vented central heating systems incorporating domestic hot water

Assessment method: SOLAR e-assessment

- Back boilers, free-standing, wall-mounted, low water content, high efficiency condensing types
- Boilers for use with electricity, oil, natural and liquefied petroleum gases.
- Boilers for use with solid fuel, wood and biomass appliances

CH2.1 — Layouts of sealed heating systems incorporating domestic hot water

Assessment method: SOLAR e-assessment

- Sealed system layouts (refer CH1.1)
- Underfloor heating layouts, floor construction and finishes

CH2.2 — Boilers of approved design suitable for use in sealed systems of central heating systems incorporating domestic hot water

Assessment method: SOLAR e-assessment

- Combination boilers, storage
- Combined primary storage units and their operation for heating and hot water modes
- Biomass, ground- and air-source heat pumps (an appreciation for this section)
- Solar provision for domestic hot water (an appreciation for this section)
- Thermal store (an appreciation for this section)
- Appreciation of Multi-Fuel/Dual fuel type boiler installations
- Appreciation of a CHP combined heat and power type unit

To include; ASHP, GSHP, Biomass to buffer tank, unvented cylinder, and heating systems, UFH and radiators systems, thermal store for heating.

CH2.3 — Controls for use in sealed domestic heating systems incorporating domestic hot water

Assessment method: SOLAR e-assessment

- Pressure relief valve
- Expansion vessel
- Pressure gauge
- Filling loop
- Boiler thermostat
- High energy cut-out
- Temperature and pressure relief valve
- Electrical, non-electrical, mechanical
- Wireless (RF) control systems, to include: room, cylinder, boiler, frost, pipe thermostats,
- Programmable room thermostats, multi-zoning programmers
- Minimum control system for a basic central heating system
- Minimum controls for an existing semi gravity heating system
- Minimum controls for a fully pumped one heating zone heating system
- Minimum controls for a fully pumped two heating zone system
- Minimum controls for a combination boiler heating system
- Use of enhanced controls, weather compensation, delayed start function,
- Optimum start, temperature differential thermostats
- Discharge pipework, safe and visible positioning

CH2.4 — Outline the possible causes and methods of preventing corrosion in domestic open vented and sealed central heating systems

Assessment method: SOLAR e-assessment

- Effect of oxygen in water and its effect on a variety of materials in heating systems, cast iron, steel, aluminium, copper, brass
- Electrolytic corrosion, de-zincification
- Poorly designed systems, air intake
- Effect of condensate on metallic waste systems
- Effects of pluming from condensing boilers in contact with other building materials and preventative measures (plume management)

CH2.5 — Methods of preventing or minimising the effects of corrosion

Assessment method: SOLAR e-assessment

To include:

- Corrosion inhibitors
- Material selection, compatibility of materials
- Oxygen barriers in plastic pipes
- Cathodic and galvanic protection, electrically operated anti-corrosion systems
- Inhibitor selection for various metals
- Insulation from corrosive materials, painting, protective wrapping, sleeving through a variety of building materials
- Brick, block, plasterboard, atmospheric protection, underfloor conditions
- Good system design
- Provision for the safe disposal of condensate from condensing boilers, plume management systems

CH2.6 — Identify and/or diagnose faults in heating systems and recommend remedial action

Assessment method: SOLAR e-assessment/Practical

- Visual inspection and identification of wear and tear in the malfunction of controls motorised valves, thermostats, valves, pumps, programmers, time clocks, for the effective operation of a heating system (simple system operational check of control system)
- Prevention methods of reversed circulation in wrongly installed fully pumped pipework installations
- Prevention of unwanted gravity circulation in wrongly installed pipework installations
- System discharge through relief valves from sealed heating systems

CH3.1 — Calculate the heat design requirements and plan the pipework layout for a given situation

Assessment method: SOLAR e-assessment/Assignment

- Up to date notional external temperatures, 'U' values for design purposes, exposure rating of the building, room design temperatures, room air changes, effects of extraction fans in rooms, total floor area for zoning purposes (keep below 150 m^2).
- Selection of insulation material for heat loss reduction in installation cylinder and pipework, for maximum efficiency of the system, small bore, micro-bore and underfloor (one room only) design applications.
- Appreciation of 'new build' and 'existing properties' design applications (differing 'U' values).
- Appreciation of Pre 1919 traditional/historic Buildings (differing 'U' values).
- Sedbuk ratings, SAP terminology in application of design considerations for energy efficiency recommendations, specific heat capacity of air, air to water, temperature difference, flow and return design temperature, calculation of heat emitters using computer program and standard 'U' values selection, draw comparisons of both design applications.
- Select radiators from manufacturers' catalogues.
- Calculate pipe diameters using resistance/flow rate tables able to identify the index circuit and calculate the pump duty, awareness of modulating pumps.
- Methods of system balancing using practical and equipment methods, flow and return temperature recording and air temperature monitoring for full system balance.
- Design one room using Underfloor Heating Design procedures (an appreciation).
- Design considerations temperature recommendations for the elderly or infirm.

CH3.2 — Outline procedures for commissioning, decommissioning and maintenance of central heating systems

Commissioning

Assessment method: SOLAR e-assessment

- Visual inspection, test for leaks, pressure testing.
- System cleansing, cold/ hot flushing, dynamic flushing, (ensuring there is no biological burden in the process).
- System cleanser and corrosion inhibitor application, venting the system, balance the system, customer hand over.

Decommissioning

Assessment method: SOLAR e-assessment

- Isolation of system from other services
- Application of notices during procedures
- Safe disposal of substances, inhibitors
- Safe and effective removal of system pipework, appliance/s and components

Maintenance

Assessment method: SOLAR e-assessment/Practical

- Procedures for annual servicing of appliance/s
- Checking of controls, components
- Correct procedures for flushing existing systems
- Safe disposal of all waters used in the cleansing and flushing process

Assignment

Information for assessors

CH3.1 — Calculate the heat design requirements and plan the pipework layout for a given situation

Performance Criteria

Each learner will have to successfully complete the following:

(a) Calculate the heat requirements for a given situation.
(b) Select and locate combined heating and hot water controls for the given situation.
(c) Calculate the heat design requirements and plan the pipework layout for a given situation.
(d) Calculate the heat loss requirement for underfloor heating for the lounge.

Aims of the assignment

The aim of the assignment is to introduce the learners to the planning and design aspects of central heating and domestic hot water supply. It further develops skills already gained within the first two years of the SVQ programme.

Assignment overview

The assignment focuses on the central heating requirements of a two storey domestic dwelling. Plan and elevation views are given to provide information about the dwelling. Plans, design guides and tables are provided to enable the learner to refer to.

The learner will be asked to design a central heating system incorporating domestic hot water system. One design is of a traditional low pressure open vented and low pressure central heating system and references should be made to sealed heating systems and mains fed unvented hot water on the advantages / disadvantages of each type of system.

The drawing plans are to be increased to A3 size and a scale of 1:50 should be used for the assignment.

The learner will be asked to specify major components/controls for the system and report on their choices.

The central heating design is to carry out different methods of heat loss calculations and drawing comparisons of each for two rooms. Planning and designing of the pipework installation with various controls which can be used for the effective and safe operation of the heating systems.

The learner will be asked to pipe size the central heating installation, calculate the boiler power, pump duty, and identify the index circuit to give an indication on the importance on the performance of the system to meet all design requirements.

The learner will design one room for underfloor heating.

Centres to produce standard answers

Information for learners

CH3.1 — Calculate the heat design requirements and plan the pipework layout for a given situation — Assignment

This is an open-book assignment where you will be able to use central heating design guides, building standards, textbooks, manufacturers' instructions, and internet access if required, to assist with the knowledge and understanding requirements for central heating design, controls and installation practice.

During the research and the application that will be required, your tutor/assessor will set out guidelines and support to assist in the development of this assignment.

You should consider the following points when researching and working on this assignment:

- Have you set aside sufficient time to do your research?
- Are you familiar with the variety of installation types and pipework arrangements that can be used?
- Are you able to understand and interpret information from the drawing details that have been supplied?
- Are you able to use the design information from the technical documents that are available?
- Can you use the skills that you have been using in the industry as a part of your own on-site training to help in the development of this assignment?
- Can you justify your choice of design practices
- Have you included all the technical data asked for in the assignment?
- Is your report legible, succinct and set out in a coherent manner?
- Is your name, class code and submission date indicated at the top of your report?

Information for learners

CH3.1 — Calculate the heat design requirements and plan the pipework layout for a given situation — Assignment

Name:		**Class:**
Result:	**Assessor:**	**Date:**

There are four parts to this assignment. You must complete all four parts (a), (b), (c) and (d).

(a) Calculate the heat requirements for a given situation

The plan layout and elevation drawings of a two-storey house for the assignment work can be found on page 14.

1 Calculate the heat loss from the lounge and Bedroom 1 using a proprietary heat-loss program.
2 Calculate the heat loss from lounge and Bedroom 1 by the use of tables.
3 Calculate the heat loss from the lounge and Bedroom 1 by the use of a patent calculator.
4 Compare the results of the above methods (1–3).
5 Select radiators for the rooms that will be capable of providing sufficient heat output and are acceptable for the space provided on the drawing.

Note: check that the drawings you have been given are A3 sizes.

Evidence of the procedures used **must** be submitted with the completed assignment:

- The computerised printout for the lounge and bedroom in the completed assignment
- Heat loss by the use of tables
- Heat loss by the use of a patent calculator
- Heat loss comparison conclusions
- Radiator sizes and positioning

Fabric heat loss

2 Heat loss calculation for Lounge using tables				
Description of fabric	**Area (m^2)**	**U-value (W/m^2)**	**Temperature difference (K)**	**Total heat loss (W)**
Total fabric losses				
Add ventilation losses				
Total heat loss for room				

Fabric heat loss

2 Heat loss calculation for Bedroom 1 using tables				
Description of fabric	**Area (m^2)**	**U-value (W/m^2)**	**Temperature difference (K)**	**Total heat loss (W)**
Total fabric losses				
Add ventilation losses				
Total heat loss for room				

(b) Select and locate combined heating and hot water controls for the given situation.

The installation is a two-pipe fully pumped small bore heating system. The positions of the boiler, radiators and hot water cylinder are shown on Drawing Number 1.

You are required to specify control systems to permit the following:

- Timed control of the central heating
- Timed control of the domestic hot water
- Temperature control of the central heating system
- Temperature of the domestic hot water
- Provisions of controls for boiler interlock
- Consideration of zoned areas

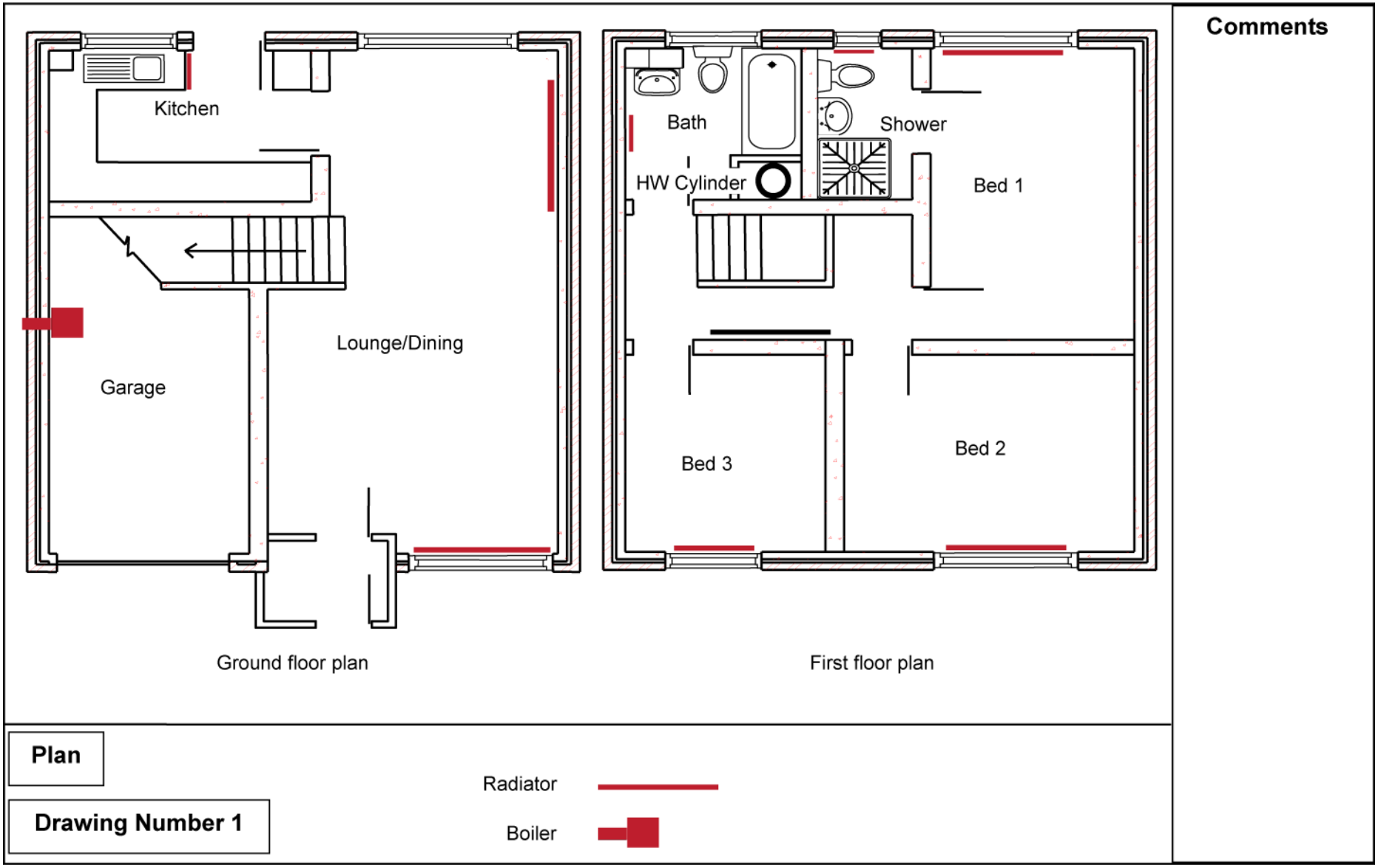
The location of all the controls that you have specified should be indicated on the drawing, together with any comments on the section provided on the drawing, eg heights of controls etc.

Consideration should be given to **all** types of system for this part of the assignment:

- Open vented cylinder
- Unvented cylinder
- Thermal store cylinder
- Open vented heating system
- Sealed heating system
- Hardwire central heating controls
- Wireless controls
- Sensor type controls
- Management systems
- Smart technology

You need to show that you have a clear and concise understanding of the advantages/ disadvantages of low pressure open vented heating and hot water systems against sealed systems of heating and mains-fed unvented hot water systems. You should give reasons for your choice of system.

The above is not exhaustive but gives an indication of what is available.



(c) Design, on plan, a heating system for a given situation.

1 Refer to the plan layout of the two-storey house. You are required to design, on plan, an open vented heating and hot water system for the house. Hot water is to be supplied from an indirect cylinder located in a cupboard off the bathroom.

Your drawing should show the layout of the pipework and the position of all control components required to make the system operate efficiently.

2 Calculate the pipe sizes for the central heating pipework.

Heat loss requirements:

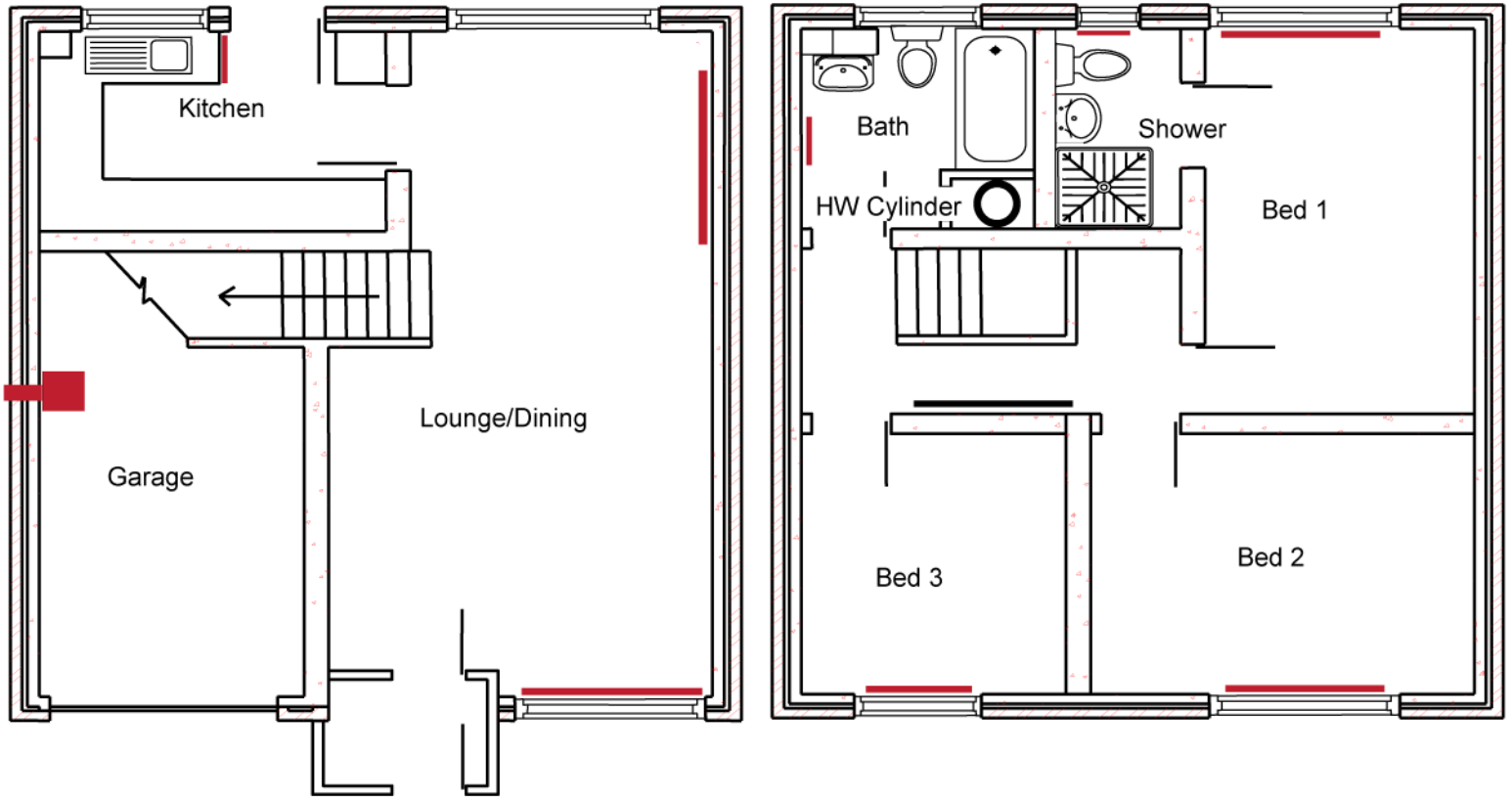
Kitchen	**1 kW**
Dining room	**1.58 kW**
Lounge	**1.58 kW**
Bedroom 1	**0.468 kW**
Bedroom 2	**0.42 kW**
Shower	**0.25 kW**
Bedroom	**3 1kW**
Hall	**0.6 kW**
Bathroom	**0.8 kW**

3 Provide a rule-assisted drawing of the pipework arrangements from the boiler to cylinder showing points of connections using BS or BS EN standard symbols for the safe and effective operation of the heating system.

4 On completion of the design procedure:

- Calculate the boiler power
- Identify the Index circuit
- Calculate the pump duty

The drawings you have been given should be A3 size.



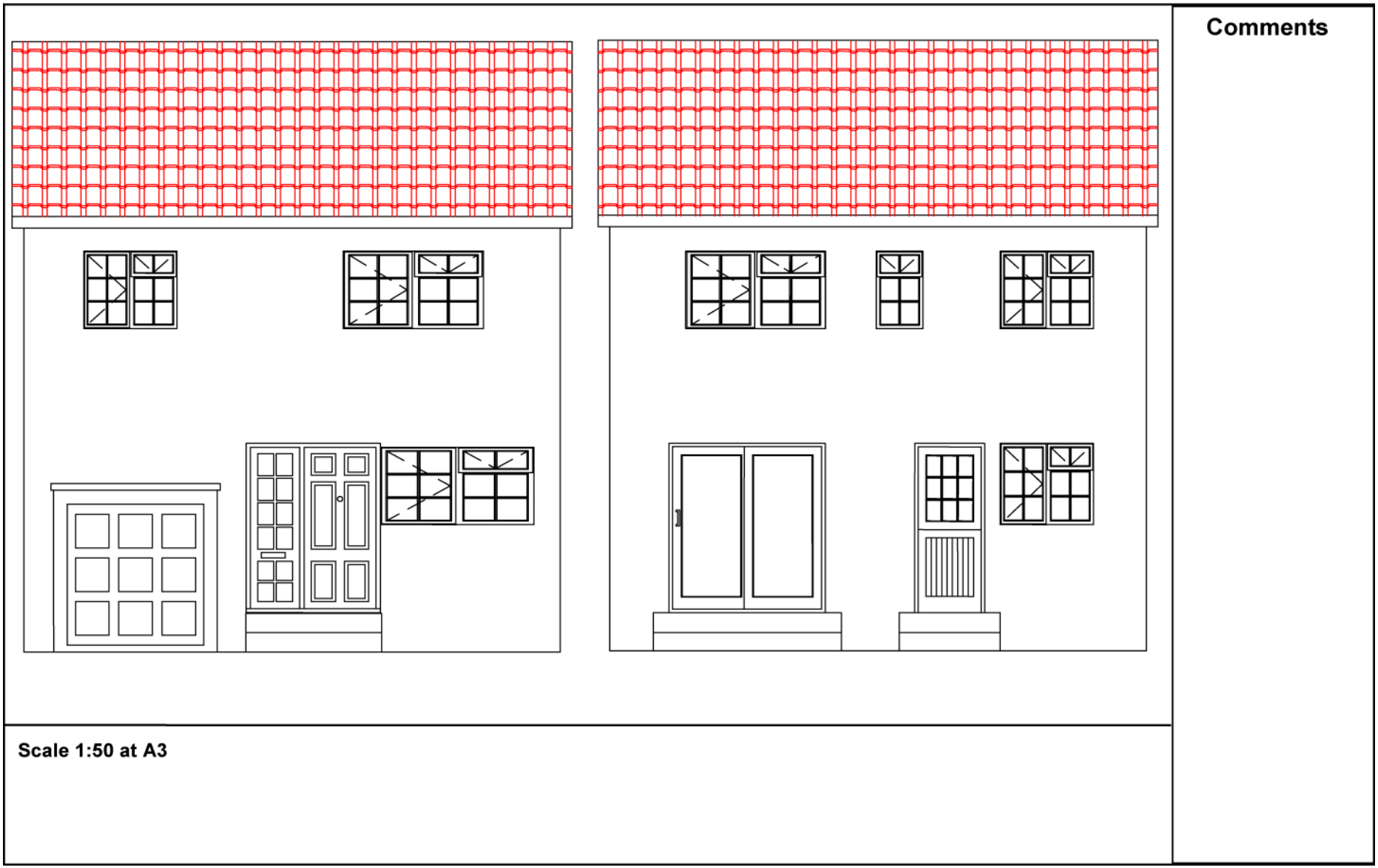
Comments

Plan; Scale 1.50 at A3

Drawing Number 2

Radiator

Boiler



Comments

Scale 1:50 at A3

Pipe sizing charts

Copy as required

Location					Pipe size selected (mm)	Pressure loss per metre run (N/m^2)

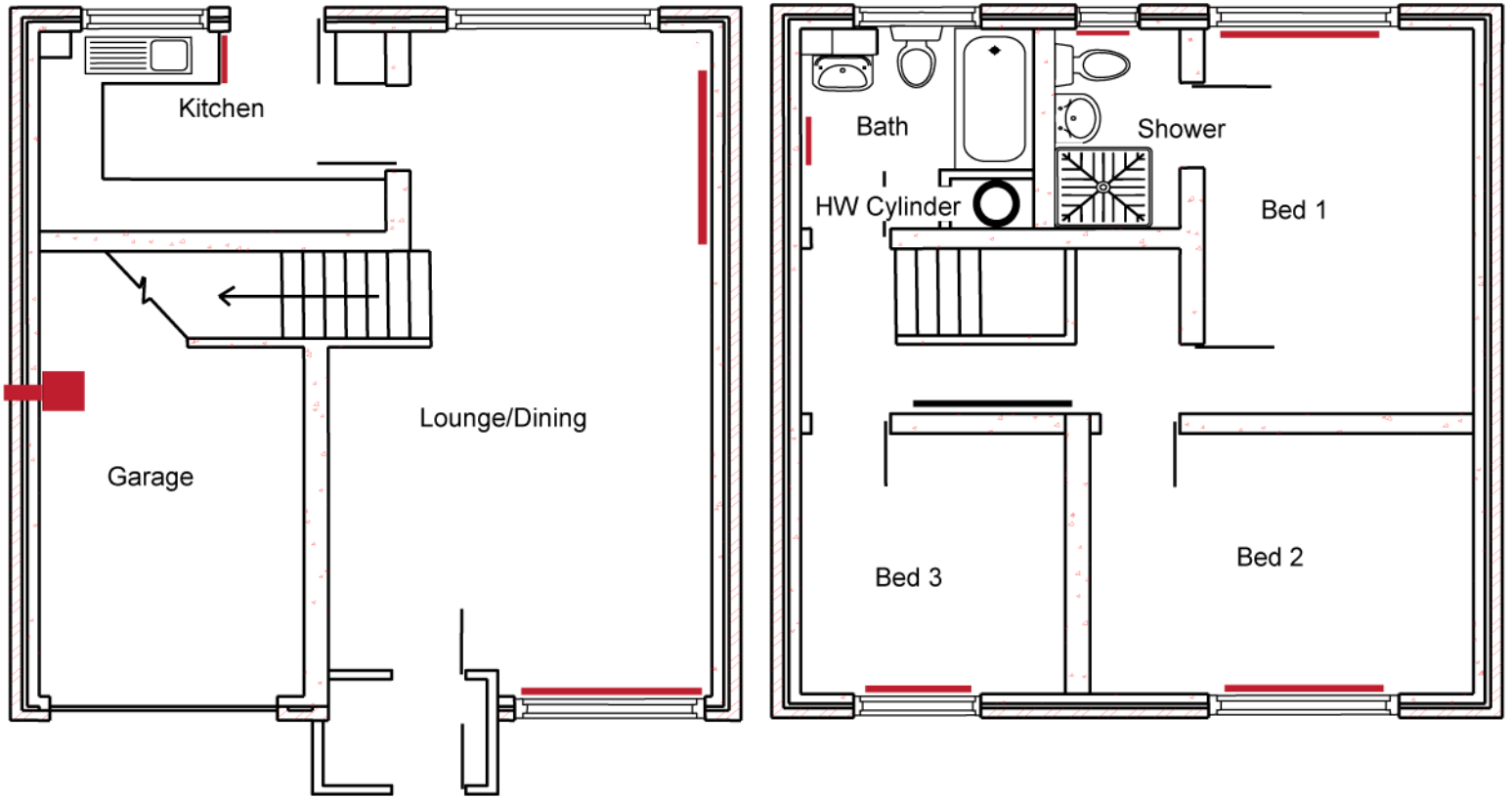
(d) The client has decided that they would prefer underfloor heating in the lounge as the two radiators selected are taking up valuable wall space. You are required to design on plan (Drawing Number 3) an underfloor heating layout for the lounge area.

Heat output:
Lounge 1.58 kW

Calculate the length of coil to complete the heating circuit.

Describe a method of controlling the water temperature to the underfloor heating zone.

Recommend a floor construction for the completed installation.



Comments

Plan

Drawing Number 3

Radiator

Boiler

Marking schedule and learner feedback

CH 3.1 — Calculate the heat design requirements and plan the pipework layout for a given situation — Assignment

Name:		**Class:**	**Date:**
Result:	**Assessor:**		**Date:**

Marking schedule	**Yes**	**No**
(a) Calculate the heat requirements for a given situation		
(b) Select and locate combined heating and hot water controls for the given situation		
(c) Calculate the heat design requirements and plan the pipework layout for a given situation		
(d) Calculate the heat loss requirement for underfloor heating for the lounge		
Learner feedback		
Learner's response		
Learner's signature		

Note to assessor: Learner feedback should relate to the marking schedule

Assessor checklist

CH3.1 — Calculate the heat design requirements and plan the pipework layout for a given situation — Assignment

Class: **Assessor:**		**Learner's name**										
Part	**Marking schedule**											
(a)	Calculate the heat requirements for a given situation											
(b)	Select and locate combined heating and hot water controls for the given situation											
(c)	Calculate the heat design requirements and plan the pipework layout for a given situation											
(d)	Calculate the heat loss requirement for underfloor heating for the lounge											