# At your services

## What to expect during commissioning

Guide

NHBC Foundation
Housing research & guidance

BSRIA

NF84

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## Acknowledgments

This guide was written by David Bleicher of BSRIA in collaboration with the NHBC Foundation.

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Published by the NHBC Foundation
ISBN 978-1-9995997-3-7

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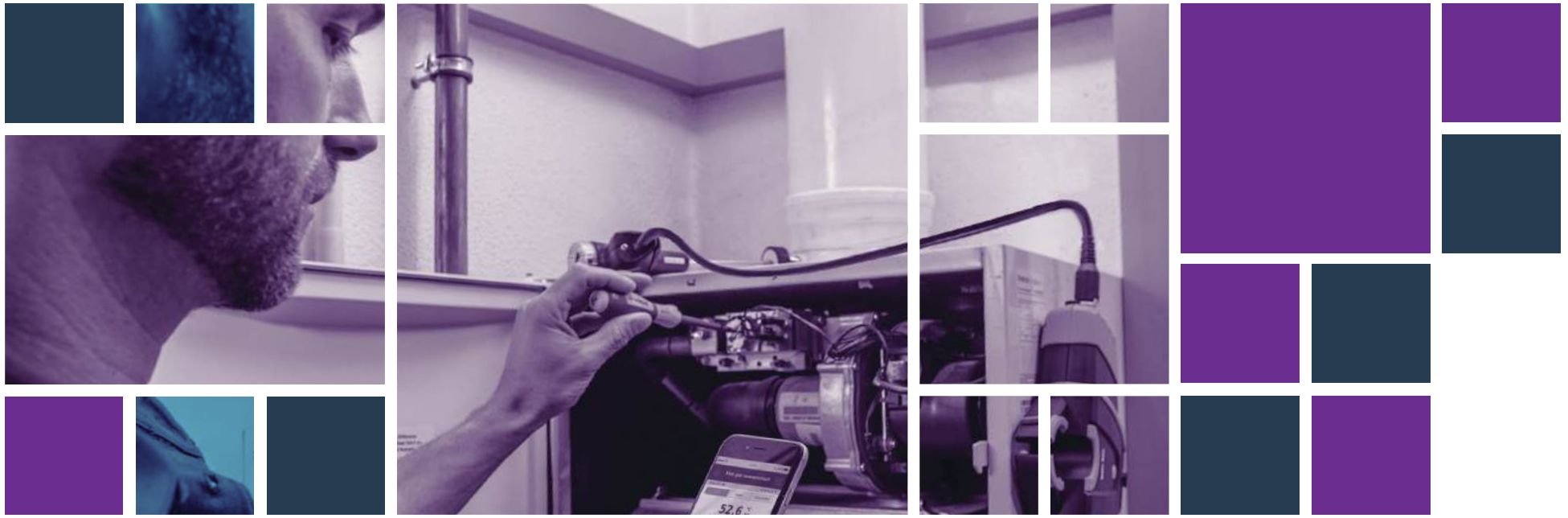

Guide

May 2019

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# Contents



# Welcome

During construction, site managers need every reassurance that the services in their newly-built homes will perform safely, reliably and efficiently. Good commissioning should provide the confidence that all is well as the build proceeds, and that any shortcomings have been fixed at the right time, avoiding often costly and disruptive remedial work before or after handover.

However, the reality is that many site managers today feel distant from the commissioning checks and balances that are so crucial. This is partly because of the sheer scope of commissioning, which has grown to cover new families of services, such as solar technologies, heat pumps and whole-house ventilation systems. In addition, commissioning in general has become much more technical and exacting, with processes and language which are not easy for non-specialists to understand. This is not good for the success of commissioning which ultimately depends on a good understanding between the site manager and any specialist installers and commissioning experts involved.

I therefore welcome this latest guide from the NHBC Foundation, which encourages site managers to reconnect with the world of commissioning and to develop a good eye for the tests and measurements that should be taking place on the services in the homes they are building. We are grateful to BSRIA for their excellent work in summarising detailed commissioning literature into this practical guide.

Neil Jefferson
Chief Operating Officer, NHBC

# Introduction

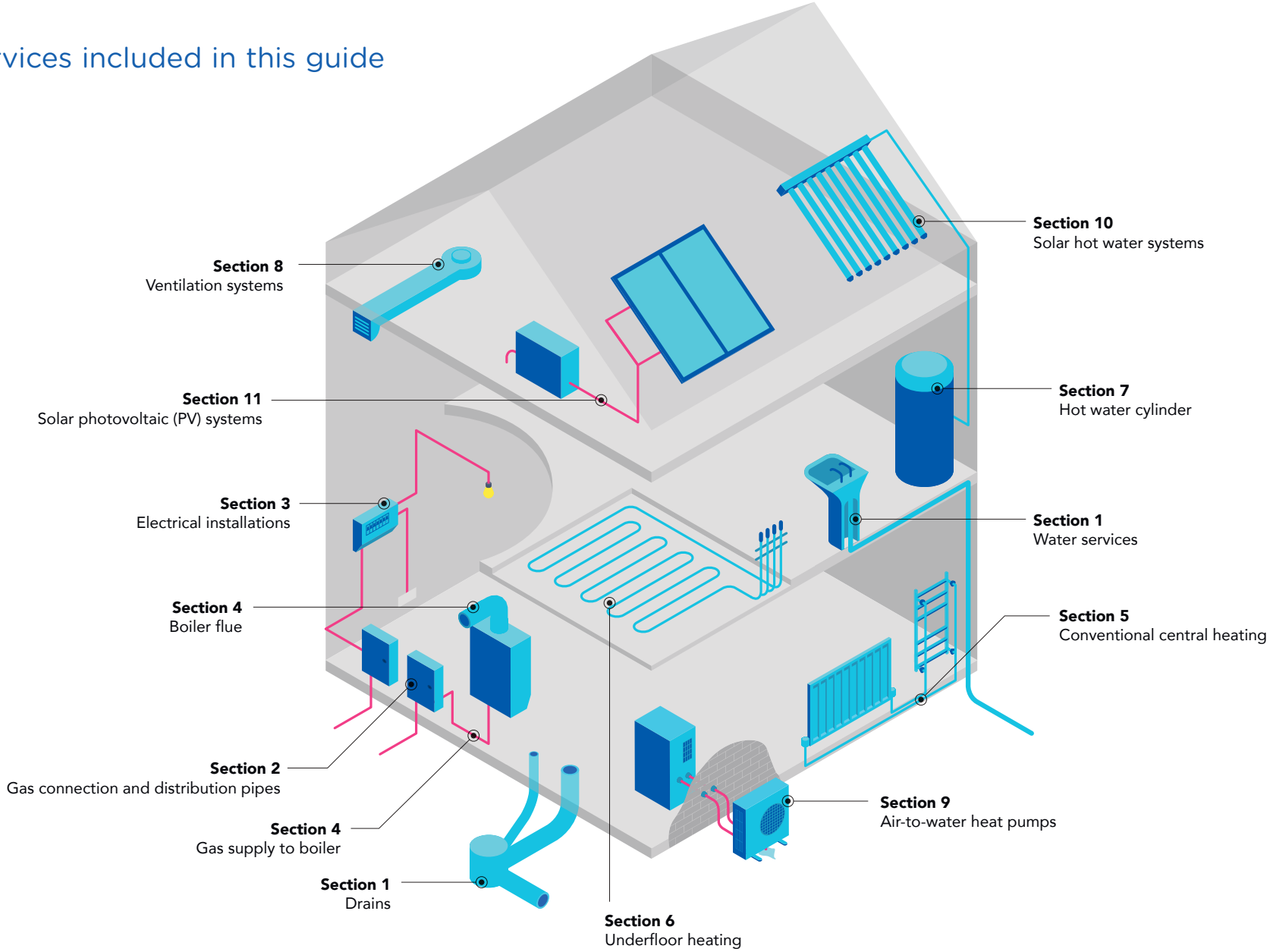
## The commissioning specialism

Site managers will want to make sure that their new homes are safe, efficient and give years of comfortable, trouble-free operation. Getting the commissioning of the services right is essential, but the diversity and complexity of modern domestic services means that many detailed and technical procedures are required to ensure everything is working as it should. The process of commissioning has become an area of considerable specialism, supported by its own professional bodies. Commissioning is often a legal requirement, for reasons of safety, and quite rightly a task that should only be undertaken by suitably qualified people. In practice, this increased specialism has led to site managers becoming more distant from the commissioning activities that are pivotal to the successful operation of the homes they build.

## Role of site managers – being vigilant

Investigations by the NHBC Foundation and others highlight that commissioning may not always be identifying the adjustments and deficiencies that it is designed to detect. This guide, developed collaboratively with BSRIA, aims to give site managers sufficient insight to be inquisitive about the commissioning activities that they should expect to see on their sites. If the site manager can constructively intervene by asking the right question at the right time during construction, this could improve the reliability and long-term performance of services. This in turn will reduce short and medium-term call-back costs, and improve occupant satisfaction ratings.

# Services included in this guide



## Sequence of work

As with all aspects of construction, correct sequencing of commissioning works is vital – many commissioning tasks can't just be left to the last minute, as it takes time to do them properly, and sometimes remedial actions are required before the build can move on. Also, some work needs to be checked before it's covered up, while other work can't be checked until the entire system is complete and energised. It will be slightly different on every project, and although this guide doesn't directly address sequencing, the guidance is presented in the order tasks are typically carried out. The systems covered are shown in the summary diagram opposite.

## Documentation

During commissioning, expert installers and technicians are required to record details of the checks and tests they have carried out in a number of documents. These documents, which may include specific requirements from manufacturers, need to be retained securely by the site manager along with product literature. Together, these documents form part of the Home User Guide (HUG) which is handed over at completion to the new home owner.

For heating systems, for example, a key document is the Benchmark Commissioning Checklist, which needs to be followed to ensure safe and efficient long-term operation, and compliance with Part L of the Building Regulations. Other documents are used to record the commissioning activities required for other services. These documents are your reassurance that proper attention has been given to commissioning. They provide important evidence if any problem arises in the future, and ongoing guidance for home owners on the correct use and maintenance of their services.

## Wider design issues impacting on services

This guide does not cover the wider design issues that could inadvertently impact on the performance of a system or its future maintenance. These could include:

- ☐ Limited space for installation of pipes, cables, ducts or controls
- ☐ Over-complex routing of ventilation ductwork
- ☐ Inadequate space for installation or accessibility of equipment
- ☐ An undersized boiler or fan unit
- ☐ Incorrect sizing of pipes or ductwork

Any of these, and other similar design deficiencies, may mean that the required performance cannot be achieved during commissioning, even when adjustment is made to the limits of a particular system. Sometimes a site solution (often costly and disruptive) may be possible to address a shortfall in performance, though there will be instances where a differently sized component or system is necessary. Site managers should flag up either situation with their design teams so that similar problems are avoided on future builds.

## Limits of this guidance

This guide is not intended to give you detailed guidance on commissioning procedures themselves, only a summary of what you should see taking place and important documents you should be asking for. The people carrying out the commissioning will be adhering to current industry standards that set out the procedures in detail. The services systems most commonly found in new homes are covered, but you may sometimes come across systems that are unusual, innovative or of larger scale, such as those used in larger houses or apartment blocks. These are not addressed in this guide. Finally, many manufacturers provide their own detailed commissioning procedures. The installer or tester must follow these and sometimes this may require a process different from that summarised in this guide.

# 1 Water and drainage installations

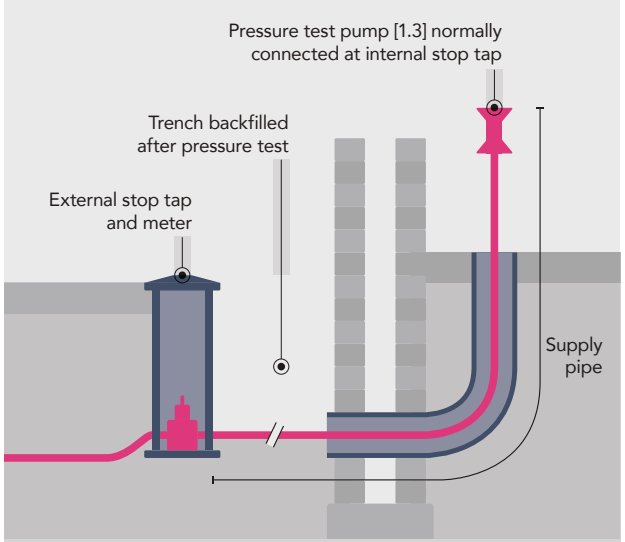
To avoid serious damage to homes from leaks, the Water Regulations require hot and cold water pipes to be flushed and pressure tested, and the Building Regulations require watertightness testing for all drains.

## Step 1

**Pressure testing the water supply pipe** (checks watertightness between the meter and the internal stop tap [1.1])

Expect to see the plumber doing the following before the trench is backfilled:

- ☐ Filling the pipe with water and pressure testing it [1.3]
- ☐ If there is a loss of pressure, locating any leaks, fixing them and retesting.




1.1 Water supply pipe

## Step 2

**Pressure testing all foul and surface water drains** (checks watertightness)

Expect to see the drainage specialist doing the following on all drains before trenches are backfilled:

- ☐ Fitting bungs into open ends of drain pipes
- ☐ Pressurising the pipe using either air [1.2] or water
- ☐ For an air test, measuring the pressure over a period of time. For a water test, measuring the amount of top-up water used over a period of time
- ☐ If test indicates a leak, locating any leaks, fixing them and retesting.

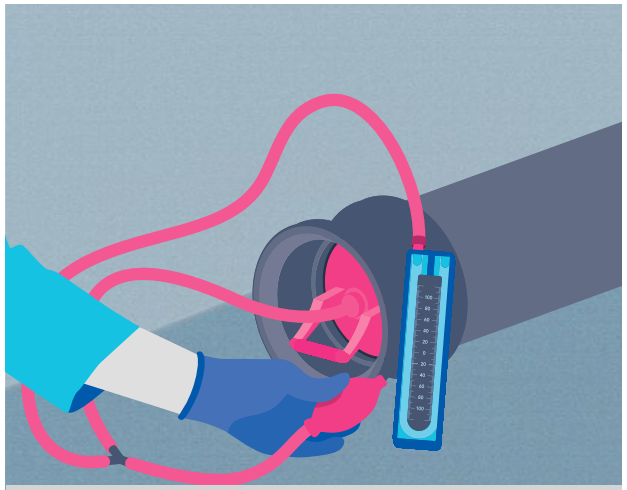
Drain tests should be observed by a building control officer, who will also check that drains have been laid to the correct falls. If drains are not connected to the mains (eg to a cess pit) additional commissioning activities may be carried out.

## Step 3

**Pressure testing the hot and cold water pipes and flushing** (checks watertightness and removes debris that could contaminate the water)

Expect to see the plumber doing the following:

- ☐ Inspecting, filling and pressure testing [1.3] the pipework
- ☐ If there is a loss of pressure, locating any leaks, fixing them and retesting
- ☐ Once watertight, flushing the pipework.



1.2 An air test being carried out on a drain

## Additional checks the plumber should do:

### Internal stop tap

- Closing the internal stop tap, opening a tap and taking a note of the meter reading
- Keeping the internal stop tap closed and reading the meter again after one hour. A difference between the two readings could indicate that the internal stop tap is letting by and needs to be fixed or replaced.

### Home pipework leak test

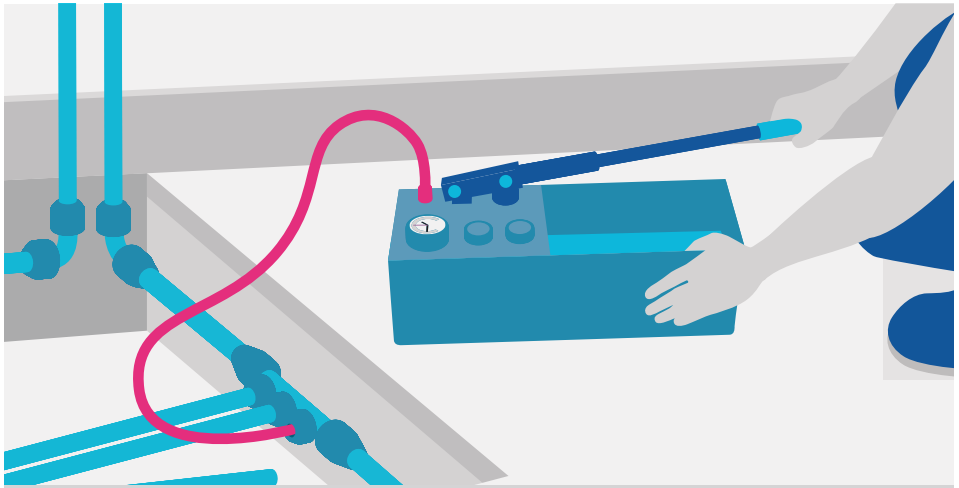
- Taking a meter reading with all taps closed and the internal stop tap open
- Waiting for 15 minutes and then checking the water meter. If the meter dial has moved, there could be a leak
- Any leaks to be investigated, fixed and the pipework retested and reflushed.

### Once all other checks are complete

- Checking that taps operate easily and provide adequate flow of cold water (from cold taps) and hot water (from hot taps)
- Checking that water goes down each waste pipe rapidly
- Checking that toilet cisterns flush and refill properly and don't leak.

### Notes

1. Pressure testing of hot and cold water pipes (**Step 3**) may need to be carried out in stages as parts of the installation are completed.
2. In homes with indirect hot water cylinders (those connected to the boiler or other heat source), the hot water cylinder should not be filled until after the central heating system has been pressure tested.
3. After **Step 3**, hot and cold water systems must be disinfected and flushed if there is a long lag between commissioning and occupation of a home. Seek advice from your plumber on the timing and frequency of this health and safety requirement.



1.3 Hot and cold water pipes being tested using a manual pressure test pump (Step 3). The same pump can be used to test the supply pipe (Step 1)

# 2 Gas connection and distribution pipes

The following tests are carried out to ensure the gas installation is safe. Depending on the size of the installation, additional tests may be required. All tests must be carried out by a gas engineer who is on the Gas Safe Register. Ask to see their credentials.

## Step 1

**Emergency control valve let-by test** (checks if the emergency control valve can fully shut off the gas supply in an emergency or when maintenance is required)

Expect to see the gas engineer doing the following:

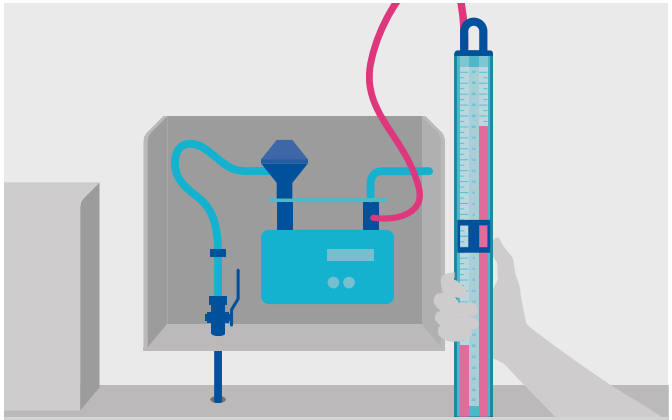
- ☐ Closing the emergency control valve (normally in the meter box)
- ☐ Switching off all gas appliances and opening their isolation valves
- ☐ Connecting a u-tube manometer [2.1] or electronic pressure gauge [2.3] to a pressure test point
- ☐ Taking pressure measurements and using leak detection fluid to see if the emergency control valve is letting by [2.2]
- ☐ If the emergency control valve is letting by, immediately notifying the National Gas Emergency Service and reporting it to you.

## Step 2

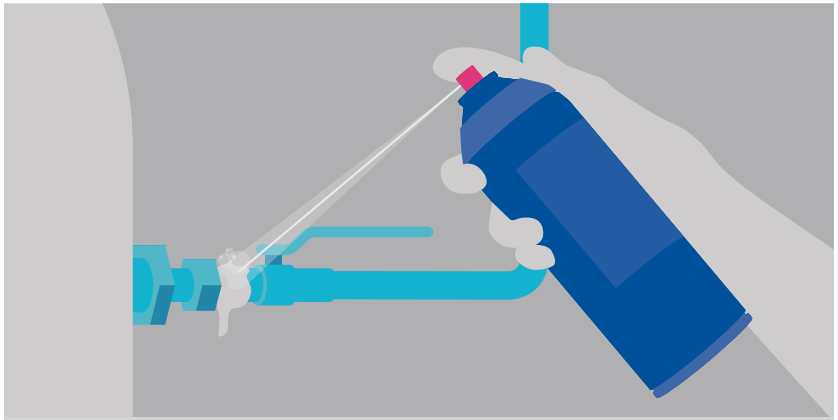
**Gas pipework tightness test** (this test, also known as a soundness test, checks that the home's pipework, meter or appliances have no gas leaks)

Expect to see the gas engineer doing the following:

- ☐ Switching off all gas appliances and opening their isolation valves
- ☐ Pressurising the system by opening the emergency control valve and then closing it again
- ☐ Monitoring the pressure in the pipework using a u-tube manometer [2.1] or electronic pressure gauge [2.3] and also using leak detection fluid
- ☐ If pressure falls, identifying any leaks, fixing them and retesting.



2.1 Using a u-tube manometer – shown connected to a pressure test point on a gas meter



2.2 Using leak detection fluid

## Step 3

**Gas pipework purging** (carried out to avoid the possibility of an explosive air/gas mixture forming in pipes, appliances or confined spaces)

Expect to see the gas engineer doing the following:

- ☐ Choosing a suitable purge point, for example the gas valve on the boiler
- ☐ Opening windows and preventing inadvertent operation of any switches, appliances or possible ignition sources in the vicinity of the purge point
- ☐ Turning on the gas supply and noting the meter reading
- ☐ Opening the purge point and confirming the presence of gas, for example with an electronic gas detector [2.4]
- ☐ Closing the purge point and testing it with leak detection fluid
- ☐ Checking that a sufficient volume of gas has passed through the meter and, if it hasn't, further purging the pipework
- ☐ Repeating test for each gas pipework branch.

2.3 An electronic pressure gauge


2.4 An electronic gas detector

**Important Documents**

On completion of testing and purging, the gas engineer should provide you with a certificate. This confirms that the entire installation has been designed, constructed, inspected and tested in accordance with the Gas Safety (Installation and Use) Regulations.

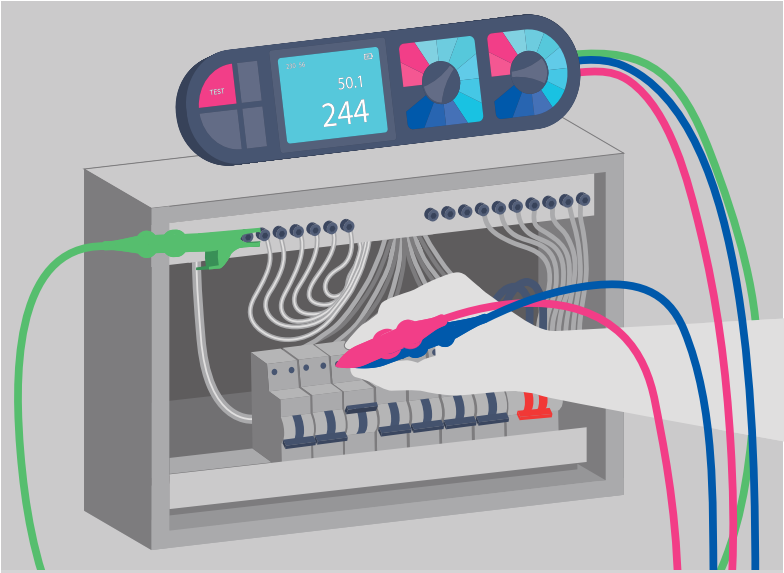
# 3 Electrical installations

By law, the electrical installation in a home must be tested to check that it is safe. Any faults can result in electrical fires and electric shocks. Electricians must be registered with one of the government's competent person schemes. Ask to see their credentials.

## Circuit testing

Expect to see the electrician doing the following:

- ☐ Testing every circuit using a multifunction installation tester or similar device [3.1]
- ☐ Identifying any faulty circuits, fixing them and retesting
- ☐ Checking that the mains power indicator is lit on all smoke detectors (and also on heat and carbon monoxide detectors, if present).




3.1 A multifunction installation tester

## Additional checks the electrician should do:

- ✓ Checking that all switch and socket covers are securely attached and that there is no exposed wiring anywhere
- ✓ Checking that every circuit breaker in the consumer unit is clearly labelled [3.2] and isolates the relevant circuit
- ✓ Checking that all switches (including two-way light switches, commonly found in hallways and stairs) operate as expected
- ✓ Checking that the means of disconnection (plug socket or isolation switch) for each built-in kitchen appliance isolates the relevant appliance
- ✓ Using a socket tester [3.3] to check that every socket is working safely and correctly
- ✓ Checking the operation of smoke detectors (and also heat and carbon monoxide detectors, if present) by activating them with the test button.


3.2 Clear and permanent labelling on a consumer unit


3.3 A socket tester

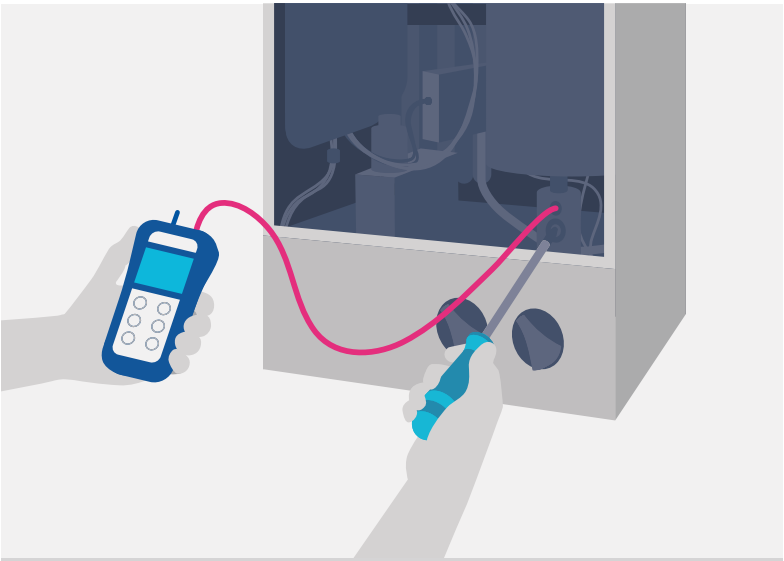
## Important Documents

On completion of the electrical installation, the electrician should provide you with a certificate. This confirms that the entire installation has been designed, constructed, inspected and tested in accordance with the IET Wiring Regulations and the Building Regulations. It should include a schedule of all the inspections carried out.

# 4 Boiler – gas supply and correct operation

Commissioning ensures that boilers (and other gas appliances) are operating safely. All tests must be carried out by a gas engineer who is on the Gas Safe Register. Ask to see their credentials.

Steps 1 to 3 are commissioning checks for a typical gas boiler. Similar tests will be carried out by the gas engineer on other gas appliances such as as ovens and hobs.



4.1 Gas inlet pressure test using a digital pressure gauge

## Step 1

**Gas inlet pressure test** (checks that there is sufficient gas pressure at the inlet of the boiler to ensure correct operation)

Expect to see the gas engineer doing the following:

- ☐ Connecting either a U-tube manometer [see 2.1] or an electronic pressure gauge [4.1] to the boiler test point
- ☐ Running the boiler at its maximum capacity
- ☐ If the gas pressure is outside the correct range for the boiler, notifying you and the gas supply company and placing a 'do not use' notification on the boiler
- ☐ Once any gas supply issues (whether related to gas supply pressure, sizing of pipes or leaks) are addressed, the gas engineer should retest the gas inlet pressure
- ☐ When satisfactory, checking the boiler test point with leak detection fluid.

## Step 2

**Gas flow rate test** (checks that the boiler is burning a sufficient amount of gas to deliver its full heat output)

Expect to see the gas engineer doing the following:

- ☐ Ensuring all gas appliances, except the boiler, are switched off
- ☐ Running the boiler at its maximum capacity
- ☐ Taking two gas meter readings two minutes apart
- ☐ Switching the boiler off
- ☐ From the readings taken, calculating the gas flow rate
- ☐ If the gas flow rate is outside the correct range for the boiler, notifying you and the boiler manufacturer.

The gas engineer will follow guidance from the manufacturer to ensure that a sufficient gas flow rate for the boiler is achieved. If it is not achieved, the manufacturer may need to provide a replacement boiler.

## Step 3

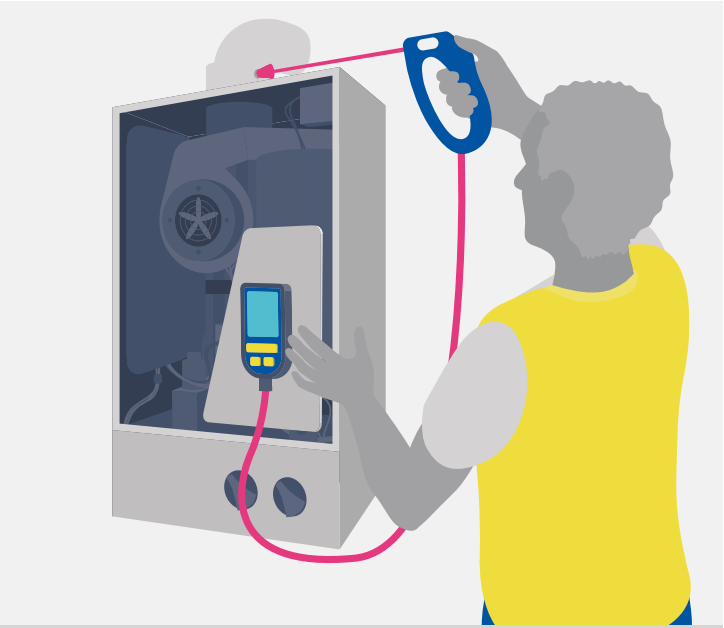
**Boiler flue integrity check – flue gas** (this checks that the boiler is burning gas efficiently and that the flue is safe, with no leaks that could lead to dangerous levels of carbon monoxide in the home)

Expect to see the gas engineer doing the following:

- ☐ Inserting the probe of a gas analyser into the air inlet test point on the flue [4.2]
- ☐ Checking levels of different combustion gases ($O_2$, $CO_2$, CO) and the combustion ratio of these gases
- ☐ If readings are within an acceptable range, recording these in the Benchmark Commissioning Checklist
- ☐ If any readings are outside the correct range, switching the boiler off, and notifying you
- ☐ Making adjustments, checking seals and repeating the flue integrity check
- ☐ If the readings remain outside the correct range, notifying you and the manufacturer (a replacement boiler may be required)
- ☐ Removing the probe, capping the test point and replacing the boiler casing.

### Important Documents

On completion of boiler commissioning, the gas engineer needs to complete relevant parts of the Benchmark Commissioning Checklist. A copy of this is usually included in the boiler installation instructions. Once all parts of the Benchmark Commissioning Checklist have been completed, it should be handed to you.



4.2 Boiler flue gas and integrity check

# 5 Conventional central heating circuits with radiators

The following steps aim to ensure that the heating circuit does not leak, is protected from internal corrosion and is set up to work efficiently.

## Step 1

**Pressure/watertightness testing** (checks for any leaks in the pipework and radiators, and ensures the connections can withstand the operational water pressure)

Expect to see the heating installer doing the following (with the boiler, or other heat source, disconnected):

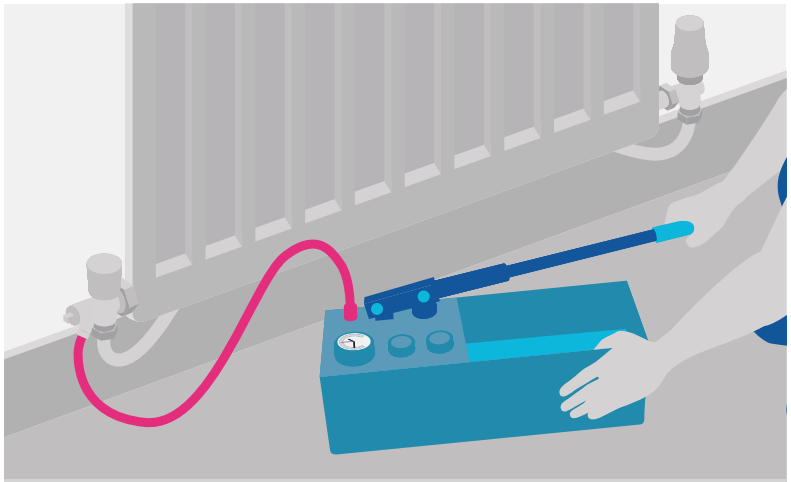
- ☐ Filling the pipework and radiator circuit with clean water
- ☐ Pressurising the circuit [5.1] and checking for loss of pressure
- ☐ If there is a loss of pressure, locating any leaks, fixing them and retesting.

## Step 2

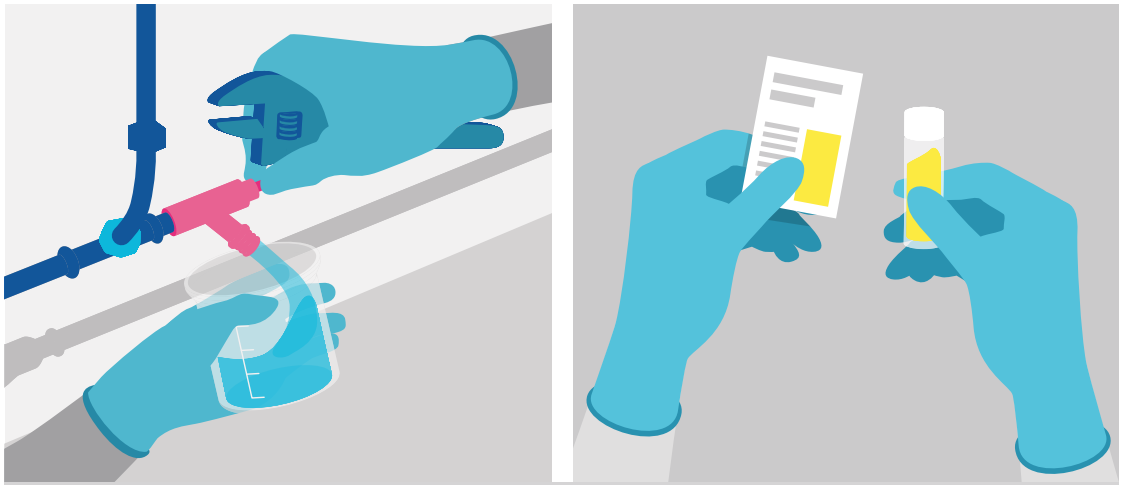
**Flushing and cleaning** (removes metal particles, solder residue and organic/biological contaminants) and **adding inhibitors and biocides** (helps prevent corrosion and bacterial growth during use)

Expect to see the heating installer doing the following:

- ☐ With the boiler, or other heat source, still disconnected, flushing the circuit with clean or chemically-treated water
- ☐ Carrying out a final flush with clean water if chemically-treated water was used
- ☐ Connecting the heating circuit to the boiler (or other heat source) and filling the entire system with clean water, mixed with a suitable inhibitor
- ☐ Performing a test [5.2] to show that the right amount of inhibitor is present in the system.



5.1 Pressure testing the circuit



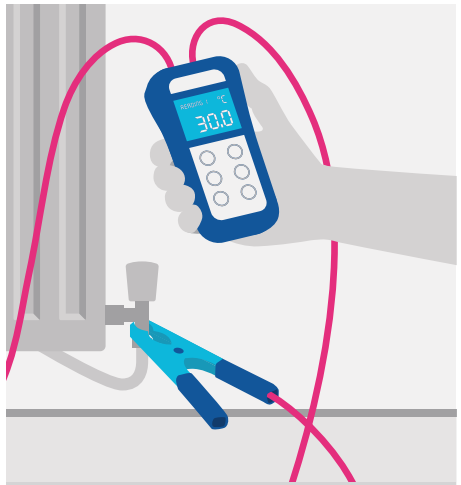
5.2 A water sample is taken and colour tested for the right concentration of inhibitor

## Step 3

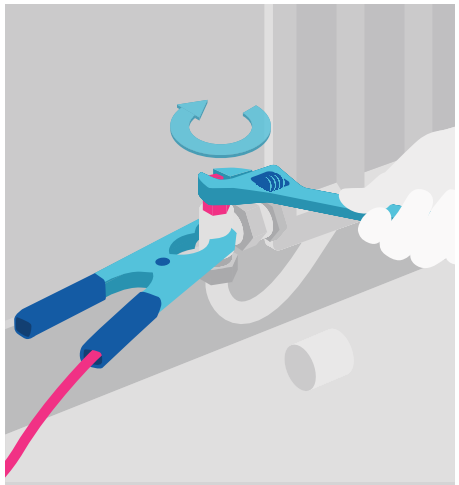
**Balancing the heating system – hydraulic balancing** (to ensure radiators deliver the design heat output in each space)

Expect to see the heating installer doing the following:

- ☐ Removing any thermostatic radiator valve (TRV) heads and opening all lockshield valves
- ☐ Running the boiler (or other heat source)
- ☐ Measuring the temperature drop across each radiator with a digital thermometer and a clamp-on (or strap-on) temperature probe [5.3]
- ☐ Adjusting the lockshield valve [5.4] to achieve the required temperature drop across each radiator in turn (typically starting at the radiator nearest the boiler or other heat source).




5.3 Digital thermometer in use



5.4 Lockshield valve adjustment

### Notes

1. Check that drain valves are provided at low points and that radiators which require thermostatic radiator valves (TRVs) are fitted with them.
2. For **Step 1** ask for a risk assessment if the installer proposes to use a gas pressure test (dry test).
3. For **Step 1**. For homes with indirectly-heated hot water cylinders (i.e. most cases), pressure testing of the central heating circuit must be carried out before the cylinder is filled.
4. For **Step 2**. The heating installer is responsible for the choice of inhibitor and ensuring it matches the specification of the boiler manufacturer. Typically, inhibitors need to be NSF approved.
5. For **Step 2**. During 2019 it is expected that a new technical requirement will be introduced to install a permanent in-line filter before the inhibitor is added.

### Important Documents

The relevant parts of the Benchmark Commissioning Checklist should be completed by the heating installer and retained by the site manager. This will include a record of the pressure testing (**Step 1**), a record of the specific chemical-treated water used for flushing and the inhibitors used (**Step 2**) and a record that the heating system has been balanced for efficient operation (**Step 3**).

# 6 Underfloor heating pipe loops and manifolds

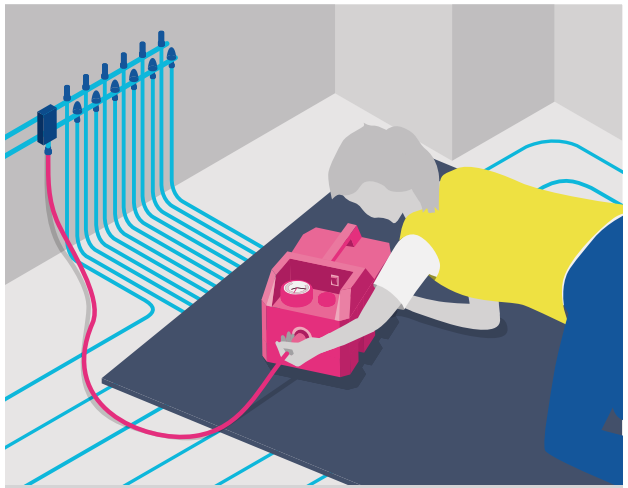
Commissioning puts particular focus on avoiding any damage and consequential leaks from the pipe loops, as repairs are very costly and hugely disruptive.

## Step 1

**Pressure/watertightness testing** (A two-step test – before and after floor covering or screed is added)

**Exposed pipe loops should be protected from damage at all times and great care taken not to damage them when screed or floor coverings are added.**

Any leaks in the loops at Step1b will require expensive and disruptive remedial work, particularly in the case of screed floors.



6.1 Pressure testing of manifolds and pipe loops. A rigid board is used to distribute weight and avoid damage to pipes

**Step 1a: Initial pressure test** (Checks for any leaks after installation of pipe loops and manifolds)

Expect to see the heating installer doing the following:

- ☐ Before they are connected to the manifolds, flushing out each pipe loop to remove debris
- ☐ Connecting the pipe loops to the supply and return manifolds. Checking visually that each pipe loop's supply and return is correctly positioned on its respective manifold and permanently labelled with the location it heats
- ☐ Filling the pipe loops and manifolds with clean water
- ☐ Pressurising [6.1] the system (pipe loops and manifolds) for at least 24 hours
- ☐ If there is a loss of pressure, locating any leaks, fixing any leaks at joints to the manifolds, replacing* any pipe loops that are leaking and retesting.

**The entire pipe loop must be replaced – pipe repair is not possible.*

**Step 1b: Final pressure test** (checks for any leaks after the floor covering or screed has been added**)

Expect to see the heating installer doing the following:

- ☐ Pressurising the manifold/pipe loop system for at least 24 hours
- ☐ If there is a loss of pressure, fixing any leaks at joints to the manifolds and retesting
- ☐ If there is still a loss of pressure, this indicates a leak in the length of one of the pipe loops. The leak must be located (requiring removal of floor covering or screed) and any leaking pipe loops completely replaced. After replacement of pipe loops, pressure testing must resume at Step 1a.

*** For screed floors, time must be allowed for the screed to cure before the final pressure test (1b). The length of time required depends on the type of screed used.*

## Step 2

**Flushing and cleaning of pipework and adding inhibitors** (removes debris and helps prevent corrosion and bacterial growth during use)

Expect to see the heating installer doing the following:

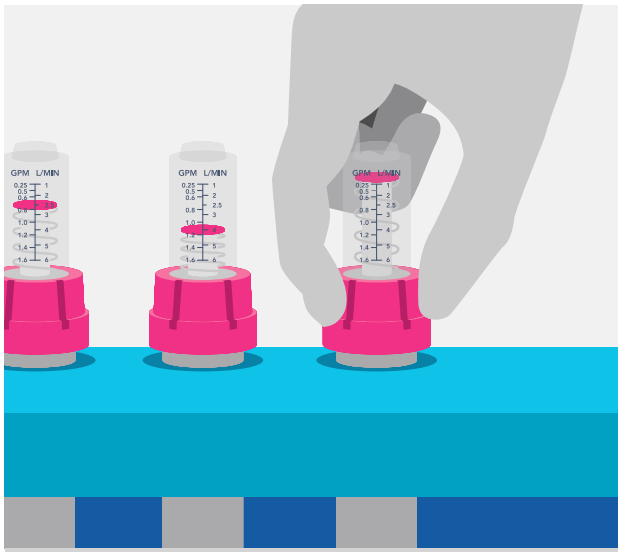
- ☐ Connecting the manifolds to the primary pipework (that serves additional heating circuits, for example to radiators) but keeping the heat source disconnected
- ☐ Flushing the system (including manifolds, pipe loops, pipework and any radiators) with clean or chemically-treated water using drain points provided
- ☐ If chemically treated water was used, flushing with clean water afterwards
- ☐ Connecting the boiler (or other heat source – for example a heat pump)
- ☐ Filling the system with clean water mixed with a suitable corrosion inhibitor and a biocide (important because bacteria can grow in water at the lower operating temperature used with underfloor heating).

## Step 3

**Balancing the heating pipe loops** (ensures water is flowing at the correct, design, rate through each pipe loop)

Expect to see the heating installer doing the following:

- ☐ Opening the valves to the heating system (primary) pipework and checking the system pressure
- ☐ Operating the underfloor heating system pumps
- ☐ Adjusting the manifold flow gauges [6.2] to achieve the design flow rate for each pipe loop. Typically, different loops will require different flow rates.




6.2 Adjusting the flow rate gauges

### Notes

1. **At end of Step 1a** The heating pipe loops must be full of water and under pressure when flooring or screed is applied.
2. **For Step 2** The heating installer is responsible for the choice of inhibitor and biocide and ensuring it matches the specification of the underfloor heating system manufacturer and the heat source manufacturer.
3. **For Step 2** The installer should perform a test to ensure that the right amount of inhibitor is in the system [see 5.2].

### Important Documents

The relevant parts of the Benchmark Commissioning Checklist should be completed by the heating installer and retained by the site manager. This will include a record of the pressure testing (**Step 1**), a record of the specific chemical-treated water used for flushing and the inhibitors used (**Step 2**) and a record that the heating system has been balanced for efficient operation (**Step 3**).

# 7 Unvented, indirect hot water cylinders*

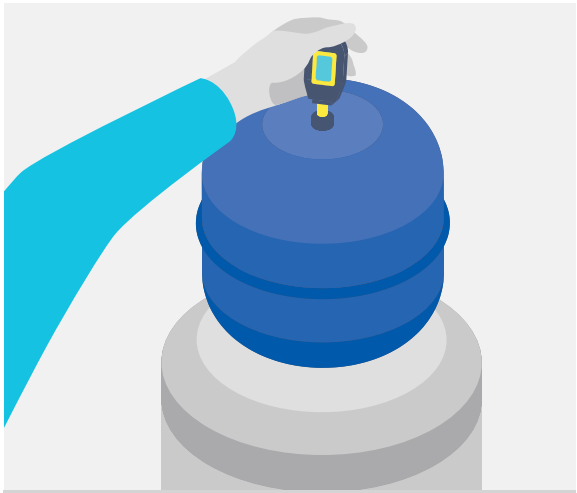
Because unvented hot water cylinders store and distribute hot water under pressure, correct commissioning is important for safe operation. They must be installed and commissioned by a competent person, for example, someone holding a City and Guilds qualification in Unvented Hot Water Systems.

## Step 1

**Checking installation and filling** (checks that the system is watertight, and the cylinder is completely filled with water)

Expect to see the installer/tester doing the following (with the central heating system already pressurised):

- ☐ Checking all pipework, valves and connections for watertightness
- ☐ Opening a hot tap and the cylinder's cold main isolation valve and allowing the cylinder to fill
- ☐ When water starts flowing from the hot tap, allowing it to run for a short while (flushing debris and purging air from the cylinder and pipework)
- ☐ Opening all hot water outlets in sequence to purge air from the pipes.



7.1 Expansion vessel pressure check for cylinders with an external expansion vessel

## Step 2

**Checking system safety and operation** (checks the safety features and correct operation with no leaks)

Expect to see the installer/tester doing the following:

- ☐ Checking for the right pressure in the external expansion vessel [7.1] if there is one
- ☐ Water discharge tests on the pressure & temperature relief valve and the separate pressure relief valve if there is one [see 7.2]
- ☐ Checking valves do not discharge water (visible at the tundish) during normal operation
- ☐ Checking that the pressure reducing valve (if included) has the correct pressure setting
- ☐ Checking that the controls activate the heat source
- ☐ Checking that the cylinder thermostat deactivates the heat source when hot water is up to temperature
- ☐ Fixing a warning label to the cylinder with all details filled in.

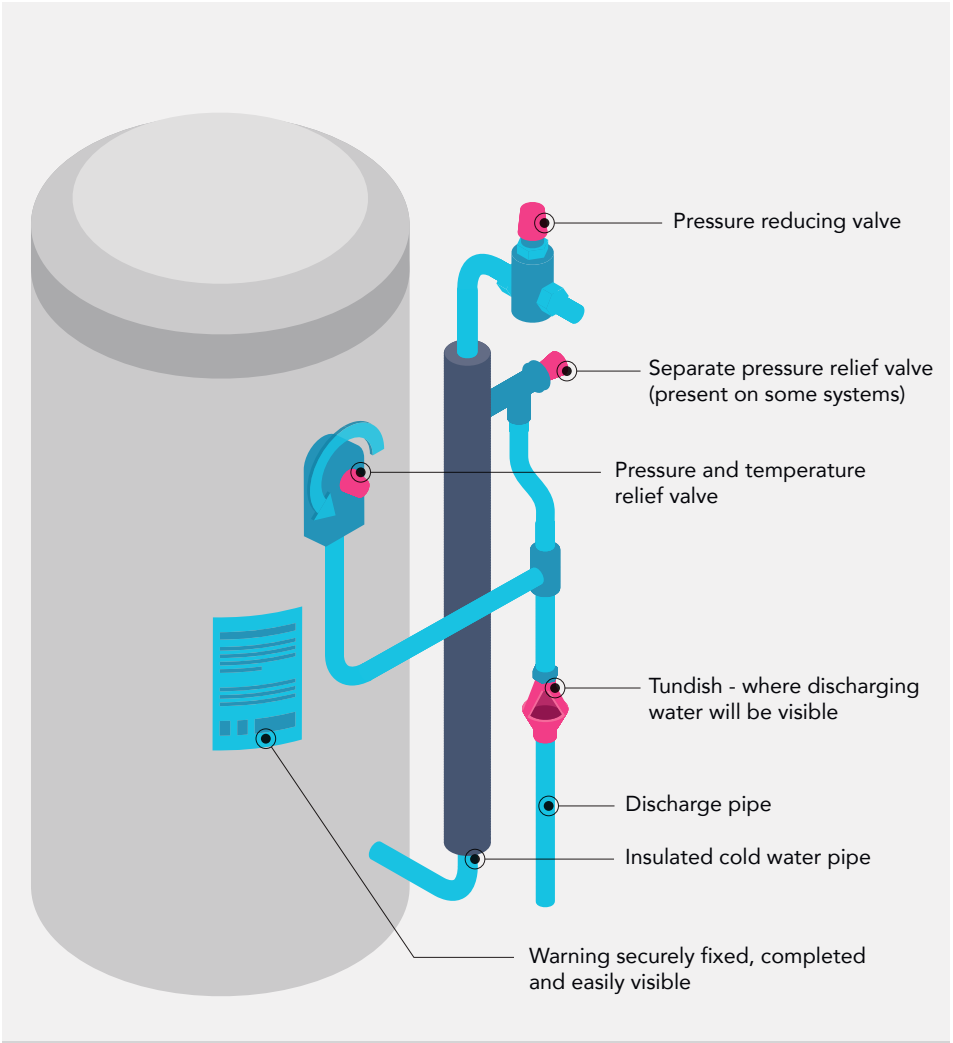
**the majority of domestic hot water cylinders are unvented (pressurised) and indirect (with the heat source, such as a boiler or a heat pump, connected by pipework to the cylinder and heating the water via a coil in the cylinder). This guidance is only for these types of cylinders.*

**Additional checks that the installer/tester should do**:

- Checking that all pipework within the cylinder cupboard is insulated, with the exception of the safety valve discharge pipes
- Checking that discharge pipes from safety valves go to a tundish, and the tundish is piped to a safe and fully-protected location outdoors
- Checking that the thermostat is set to 60°C (on some cylinders it is factory set and can only be adjusted by the installer)
- With the water in the cylinder fully heated, turning on the nearest hot tap and measuring the water temperature using a digital thermometer - it should be above 50°C within a few seconds
- Checking that hot water is available at all hot taps.

## Important Documents

The plumber/installer should record all the relevant details in the Benchmark Commissioning Checklist. A copy of this is normally included in the cylinder installation instructions.




7.2 The main safety components on an unvented hot water cylinder. These may vary depending on the manufacturer

# 8 Ventilation systems

Proper testing and commissioning is needed to ensure correctly-operating ventilation systems that deliver good indoor air quality and minimise the risk of mould and condensation. All mechanical ventilation systems must be tested for the airflow they deliver.

## 8.1 For extract fans and cooker hoods (not the re-circulating types)

### Step 1

#### Setting up for testing

Expect to see the installer/tester doing the following:

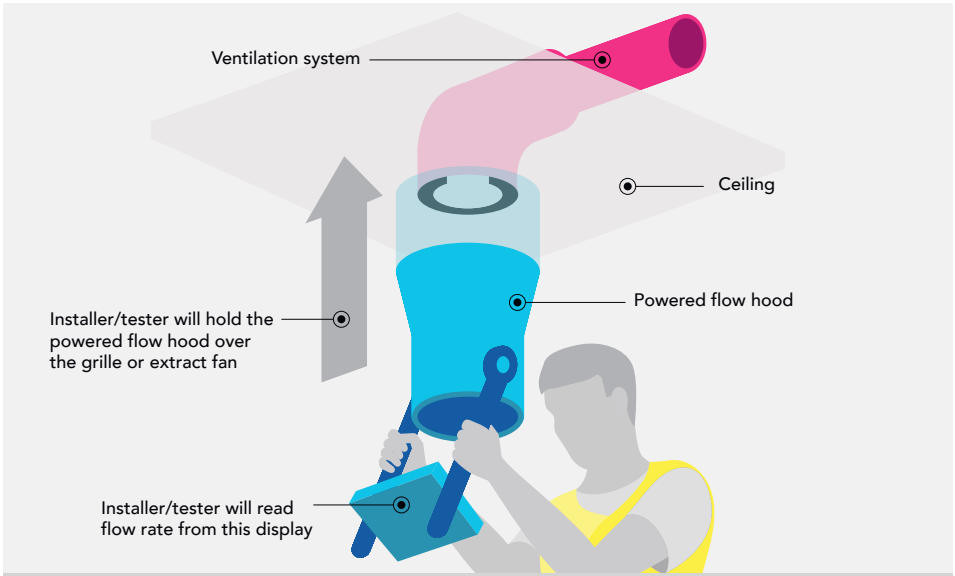
- ☐ Opening all trickle vents
- ☐ Closing all doors (internal and external) and windows

### Step 2

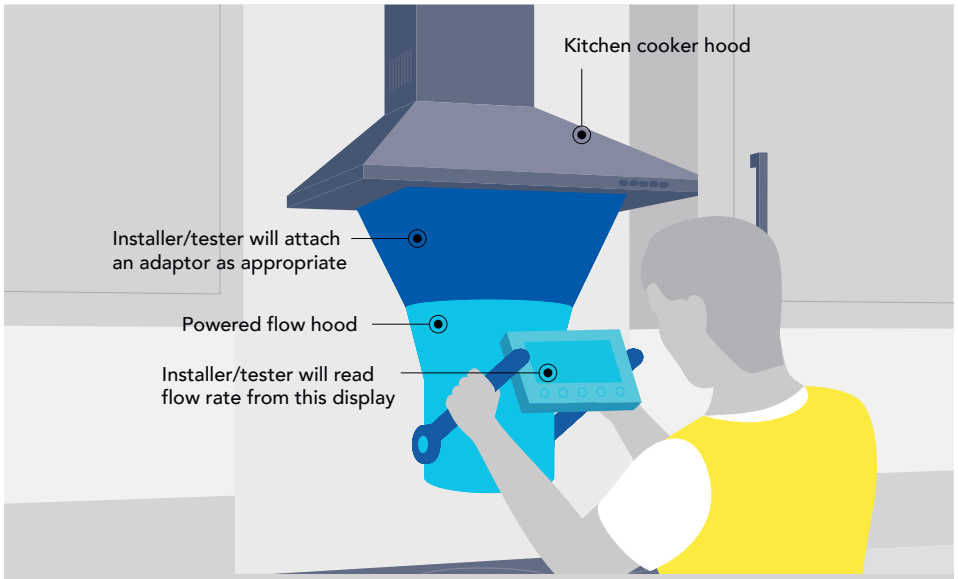
#### Testing and measuring for correct flow rate

Expect to see the installer/tester doing the following:

- ☐ Testing the flow rate of each extract fan [8.1] and the cooker hood [8.2]
- ☐ Recording the measured flow rates on the commissioning sheet
- ☐ If initially the required flow rate is not achieved, adjusting the ventilation and retesting
- ☐ Advising you if adequate air flow is unachievable.




8.1 Using a powered flow hood to test flow through a grille or extract fan




8.2 Using a powered flow hood to test flow through a cooker hood

## 8.2 For whole-house systems (such as MVHR and MEV)

These systems need to be balanced to ensure that design air flow rates are achieved in each room.

**Important Documents**

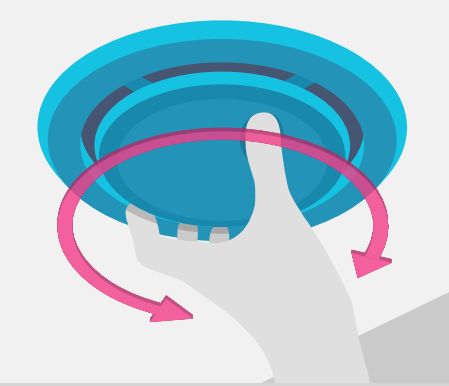
On completion of the commissioning, the installer/tester needs to provide you with a system commissioning sheet showing the equipment used and results.

## Step 1

### Setting up for testing

Expect to see the installer/tester doing the following:

- ☐ For MVHR Closing all doors (internal and external) and windows
- ☐ For MEV Closing all doors (internal and external) and windows, but ensuring the trickle vents are open.



8.3 Adjusting a grille (sometimes known as an air valve) on a whole-house ventilation system

## Step 2

### Testing and measuring for correct flow rate

Expect to see the installer/tester doing the following:

- ☐ Flow rate tests at every supply and extract grille, with the system in both low (trickle) and high (boost) modes [8.1]
- ☐ Adjusting grilles and fan speeds to achieve the correct flow rates [8.3]
- ☐ Locking grilles in their correct position
- ☐ Recording the final measured flow rates onto the commissioning sheet
- ☐ If the required flow rates cannot be achieved, informing you.

### Additional checks that the installer/tester should do:

- ✓ Ensuring that flexible ductwork is only used for lengths of 300 mm or less, is fully extended, and is fully supported, with no sags or kinks
- ✓ Ensuring that all joints are secure and airtight
- ✓ Checking that there are no visible defects in ductwork and terminals, that all packaging has been removed and fans and filters are free from debris
- ✓ Ensuring that fans work correctly when switched on or when activated through automatic controls
- ✓ Checking that fans stop running when switched off or controls are deactivated
- ✓ If there are run-on timers, ensuring that these are set to 15 minutes
- ✓ For whole-house ventilation systems, checking that the low (trickle) and high (boost) mode can be selected manually (from a control positioned in a convenient location for the occupants).

# 9 Air source (air-to-water) heat pumps

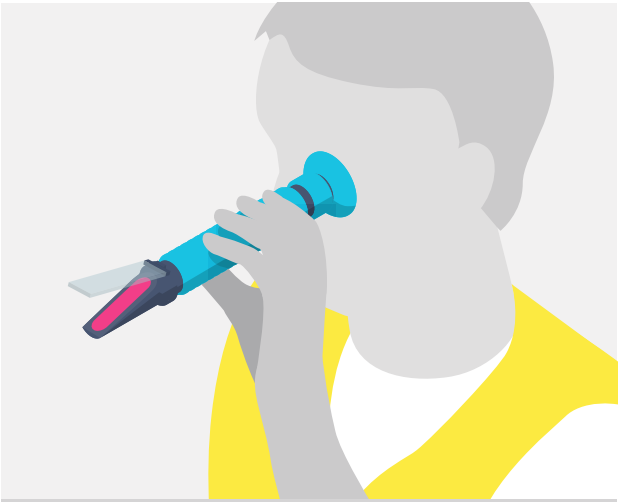
The heat pump and its integration with the home's heating system (and often the hot water cylinder) requires specialist commissioning to ensure efficient operation. Installation and commissioning should be carried out by people who are competent to do so, for example those trained in accordance with the Microgeneration Certification Scheme (MCS) installer standards. Ask to see the installer's credentials.

This guide only covers packaged (also known as monobloc) air-to-water heat pumps, the most common type encountered [9.2].

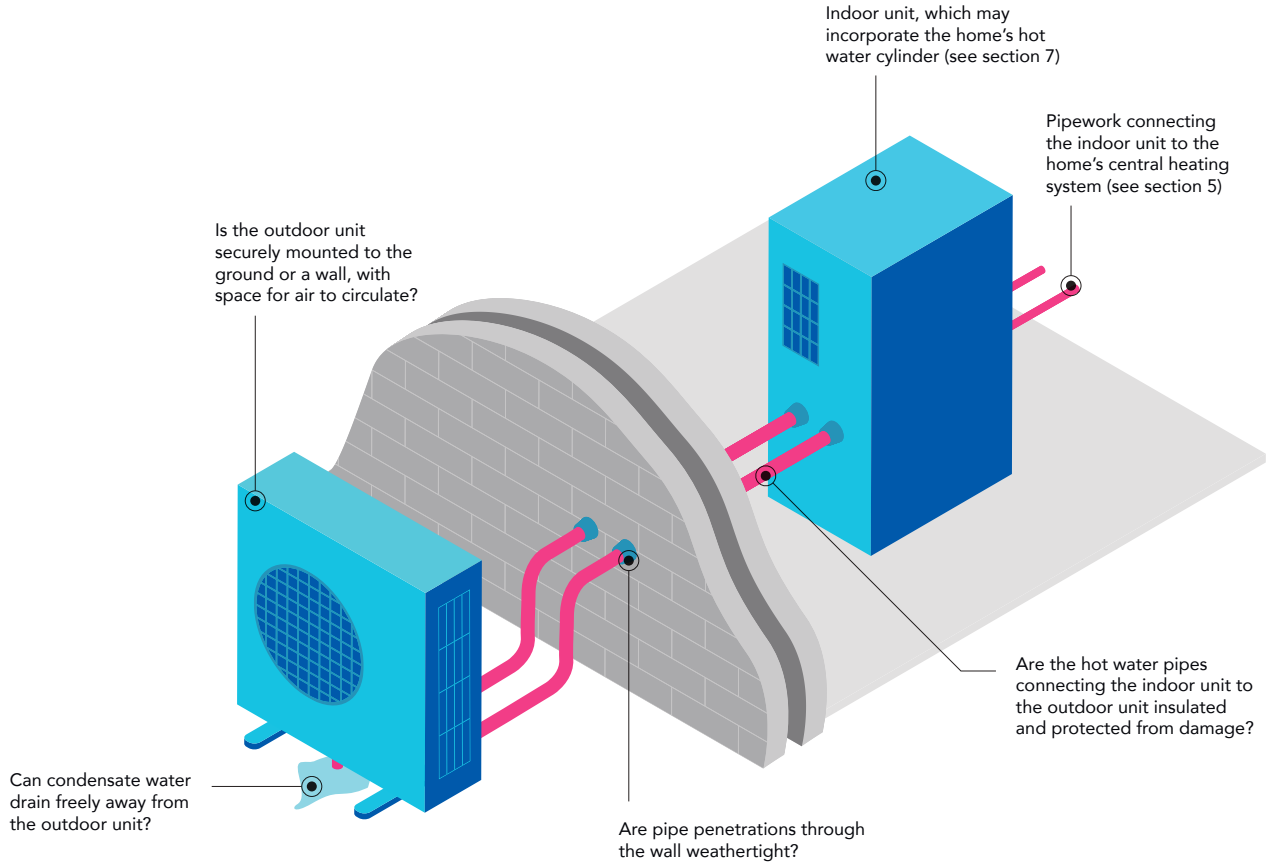
## Protection against low external temperatures

Expect to see the installer doing the following:

- ☐ Using a refractometer to check that the correct concentration of antifreeze has been achieved during system filling [9.1].



9.1 Checking the antifreeze concentration using a refractometer




9.2 Air-to-water air source heat pump

### Additional checks the installer should do:

- Checking that there is sufficient airflow around the unit
- Checking that condensate from the outdoor unit is able to drain away safely
- Checking that the pipes connecting the indoor unit to the outdoor unit are insulated and protected
- Checking that pipe penetrations through the wall have weathertight seals
- Checking that there is no undue noise or vibration inside or outside the house when the heat pump is running.

#### Split systems

A split system is a type of heat pump in which the pipes linking the outdoor and indoor units contain refrigerant, rather than water: additional checks are required for these.

### Important Documents

The installer should complete the Benchmark Commissioning Checklist. A copy of this is normally included in the heat pump installation instructions.

# 10 Solar hot water systems

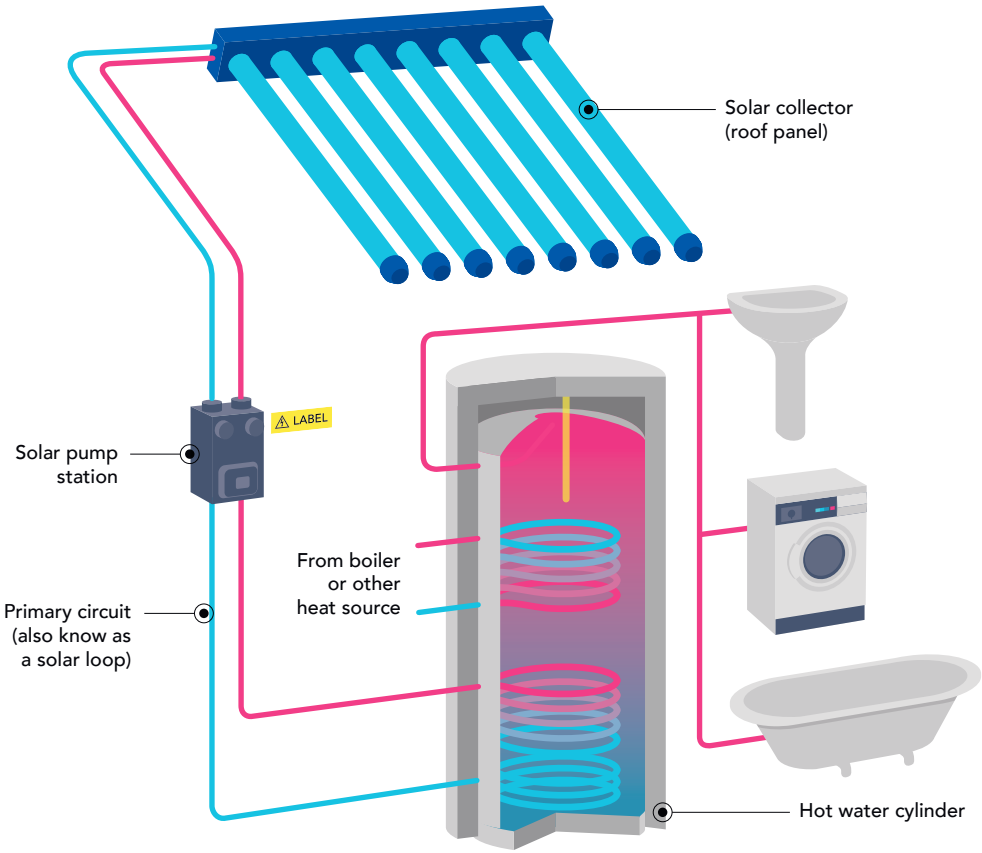
Solar hot water systems should only be installed and commissioned by those who are competent do so, for example those trained in accordance with the MCS installer standards. Ask to see the installer's credentials.

There are many types available – this guidance provides generic steps for the commissioning of a typical (indirect) system [10.1].

## Key commissioning activities

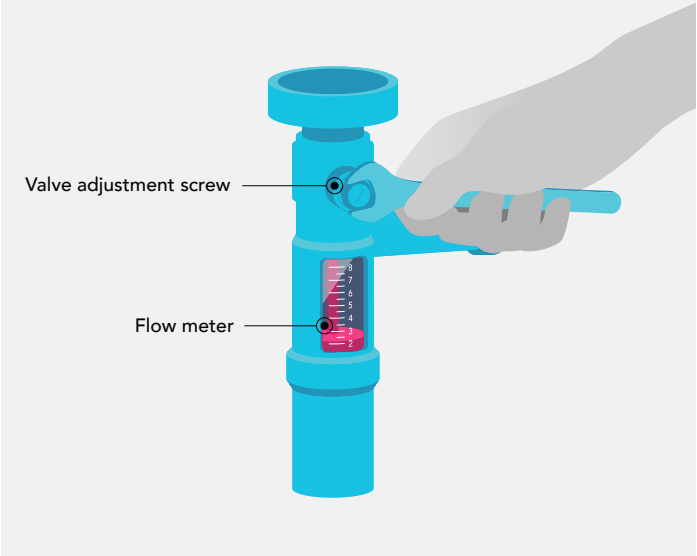
You would expect to see the installer/tester doing the following:

- ☐ Securely covering the solar collector (roof panel) so the water doesn't get heated by the sun during flushing and filling (and damage the panel)
- ☐ Before the hot water cylinder is filled, pressure testing the primary circuit, checking for leaks* and reporting any to you
- ☐ Fixing any leaks and repeating the pressure test*
- ☐ Flushing and cleaning the primary circuit*
- ☐ Filling the primary circuit with undiluted solar transfer fluid
- ☐ Checking that the pump delivers the correct flow rate and manually adjusting it if necessary [10.2]
- ☐ Checking that the pump stops running when the water in the cylinder has reached a safe maximum temperature.




10.1 Schematic of a typical solar hot water system

**similar to the processes used for central heating (Section 5)*




10.2 Checking and adjusting the flow rate at the solar pump station

## Important Documents

The installer should provide you with a certificate confirming that the system has been fully commissioned.

### Additional checks the installer should do:

- Checking that the roof panel fixings and pipe penetrations are secure and weathertight – see NHBC Foundation *Guide to installation of renewable energy systems on roofs of residential buildings* (NF30)
- Checking that the primary circuit is fully insulated
- Checking that a set of operating and maintenance instructions have been provided for the residents
- Checking that a label like the one below has been fixed adjacent to the controller.

### Caution Before Altering Settings

This system has been commissioned to run efficiently using carefully considered settings.

Alterations to these settings could invalidate the system's certificate of compliance.

Any alterations to these settings may have an adverse effect on the efficiency of the system resulting in increased running costs and as such should only be undertaken in full knowledge of the overall system design.

# 11 Grid-connected photovoltaic (PV) systems

PV systems must be commissioned correctly in order to work safely and efficiently and to have a long life. Electricians installing PV systems must be registered with one of the government's competent person schemes and must also demonstrate specific competency, for example registration with the Microgeneration Certification Scheme (MCS). Ask to see the installer's credentials.

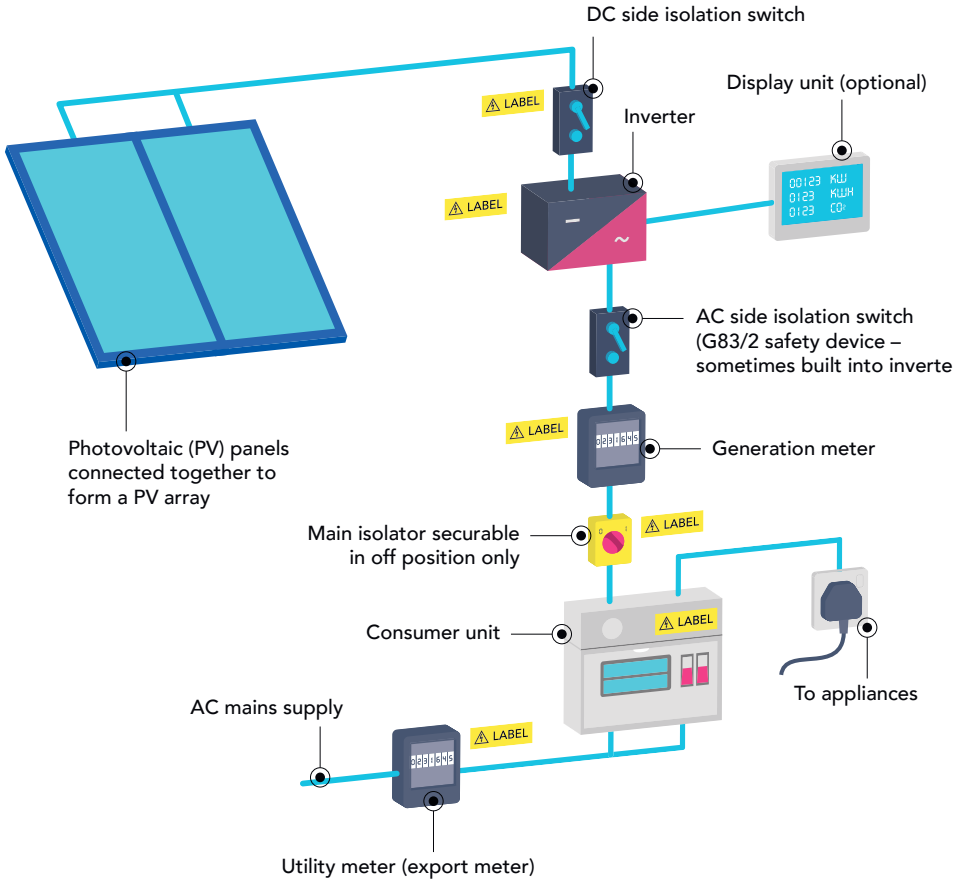
## Electrical tests of the installation

You would expect to see the installer carrying out a series of electrical tests on various parts of the installation, including components in the loft space, using equipment similar to that illustrated in 11.2. The exact tests to be carried out will vary from system to system, however, the following tests are the minimum that should be carried out:

- ☐ Continuity of earthing and/or equipotential bonding conductors, where fitted
- ☐ Polarity test
- ☐ Combiner box test
- ☐ String open circuit voltage test
- ☐ String circuit current test (short circuit or operational)
- ☐ Insulation resistance of the DC circuits
- ☐ Functional tests including the correct operation of the G83/2 Safety Device*.

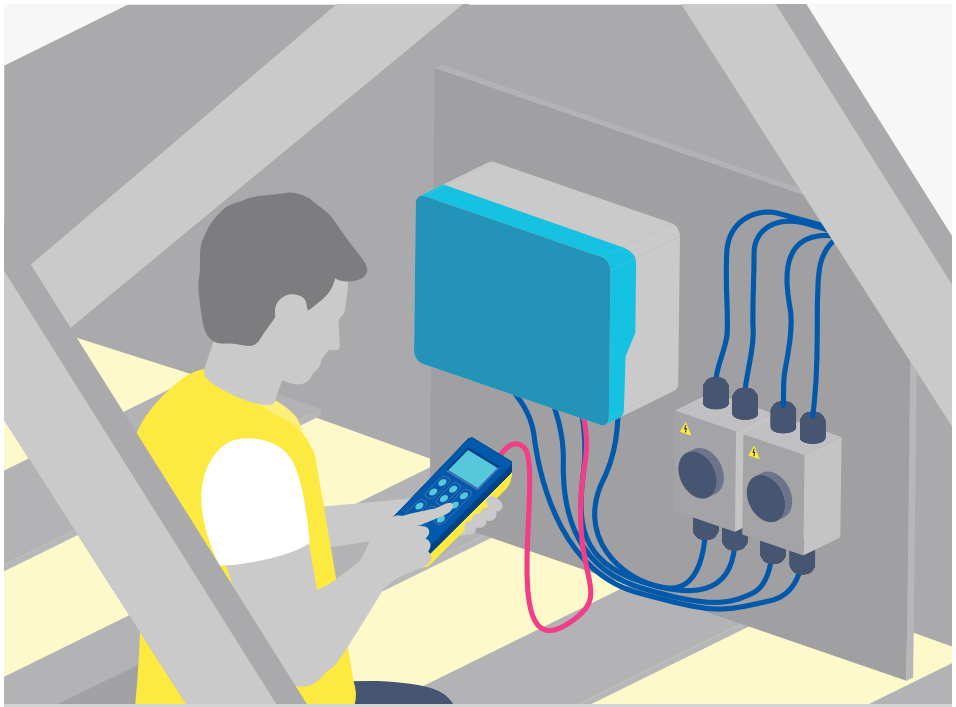
A typical installation will have several roof panels. The panels generate DC power which is converted to AC at the inverter, allowing synchronisation with the mains electricity (also AC) supplied to the home.

**In the event of a power cut, the G83/2 safety device automatically disconnects the system from the mains. It prevents power from PV systems feeding back into the mains and injuring people working to fix the power cut.*




11.1 Schematic of a typical photovoltaic (PV) system showing items that need to be labelled

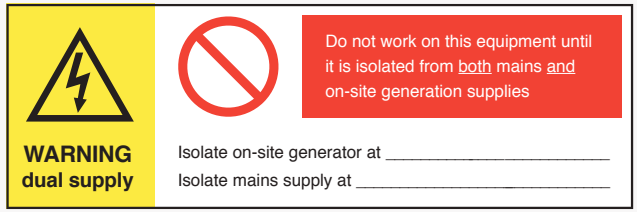
11.2 Testing equipment used on PV systems



11.3 Testing components of the PV system in the loft space

### Additional checks that the installer should do:

- Checking that the roof panel fixings are secure and that cable penetrations are properly fabricated for weathertightness – see NHBC Foundation *Guide to installation of renewable energy systems on roofs of residential buildings* (NF30)
- Checking that all safety labels are in place [11.1] and that a label like the one below has been fitted to both the meter and the consumer unit:




### Important Documents

On completion of the photovoltaic system commissioning, the electrician should provide you with the following:

- ☐ A single-line diagram showing all system components
- ☐ Manuals and data sheets for major system components such as the PV array and the inverter
- ☐ A certificate confirming that the G83/2 safety device has been fully commissioned. This certificate also needs to be submitted to the Distribution Network Operator (DNO)
- ☐ A certificate confirming that the entire installation has been designed, installed, inspected and tested in accordance with MCS requirements
- ☐ A set of operating and maintenance instructions for the residents.

# Final checks on completion

It is recommended that you perform a round of final checks once the home is complete. These checks will ensure that all systems operate correctly and haven't been affected by other works happening on site and provide an opportunity to identify and correct any shortfalls prior to handover. Some quick and easy final checks are listed below.

## Documentation

Ensure that you have:

- ☐ Collected and checked commissioning checklists and certificates for all relevant systems
- ☐ Collected together all operation manuals and other relevant documentation such as warranties
- ☐ Checked that all systems have been tested and commissioned by a competent person.

## Electrical installations

You should check that:

- ☐ There are no exposed cables
- ☐ There are no ill-fitting switches, sockets or isolators
- ☐ All switches, sockets and isolators work
- ☐ Circuit breakers work and are labelled
- ☐ Circuit breakers don't trip when lights, services and appliances are switched on
- ☐ All lighting works.

## Plumbing

You should check that:

- ☐ There are no visible signs of water leakage
- ☐ Water supply to the home is shut off when the stop tap is closed
- ☐ There are no ill-fitting taps, and they are easy to operate
- ☐ All taps work properly and don't drip when they're turned off
- ☐ Shower heads provide sufficient water pressure.

## Services

You should check that:

- ☐ Extract fans and ventilation systems work when switched on
- ☐ Controls for heating and hot water systems operate these services as intended
- ☐ Control displays are clearly visible and operate as expected
- ☐ Smoke detectors (and also heat and carbon monoxide detectors, if present) work. These should have a test button.

Handover: As part of the Home User Guide, all commissioning certificates, systems documentation and systems manuals will need to be handed over to the new owner together with Building Regulations compliance certificates. The house builder must ensure that the new owner understands how to use all services safely and efficiently, and how to maintain them correctly. It is essential that any safety-critical maintenance/replacement schedule is strongly emphasised in the Home User Guide and labelled on the relevant system as well.

## The NHBC Foundation

The NHBC Foundation, established in 2006, provides high quality research and practical guidance to support the house-building industry as it addresses the challenges of delivering 21st century new homes. To date we have published over 80 reports on a wide variety of topics, including the sustainability agenda, homeowner issues and risk management.

The NHBC Foundation is also involved in a programme of positive engagement with the government, academics and other key stakeholders, focusing on current and pressing issues relevant to house building.

To find out more about the NHBC Foundation, please visit www.nhbcfoundation.org. If you have feedback or suggestions for new areas of research, please contact info@nhbcfoundation.org.

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Published by the NHBC Foundation
ISBN 978-1-9995997-3-7