Thermal Imaging

LETCHWORTH GARDEN SHED
A LIBRARY OF THINGS

How Thermal Imaging works

The Flir E6 Camera

Building Diagnostics

The software

Borrowing the Camera

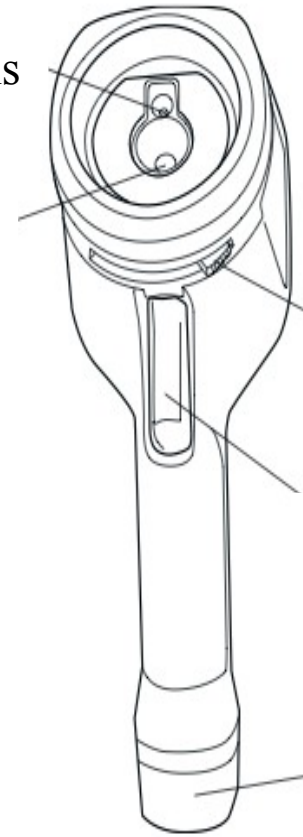
Source: FLIR

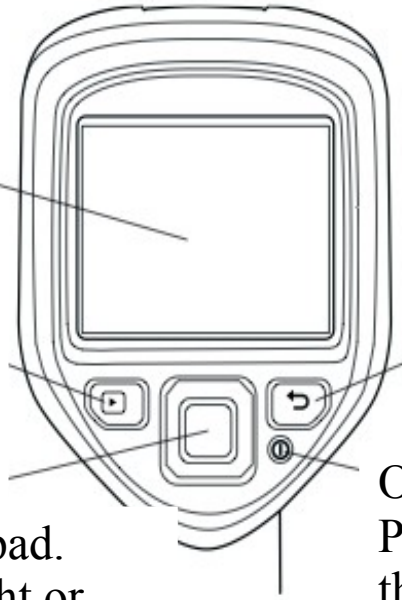
heritage foundation
Letchworth Garden City

The community thermal imaging service has been funded by a grant from the Letchworth Garden City Heritage Foundation

The Flir E6 Camera

To get started:
Push the On/off button to turn on the camera.
Open the lens cap by pushing the lens cap lever!





The camera is focus free (focus is set and cannot be changed). **(Keep at least 0.5 metres from object to focus)**

Up to 500 images can be saved.
Image names will be the next in the xxxx sequence of FLIRxxxx.jpg

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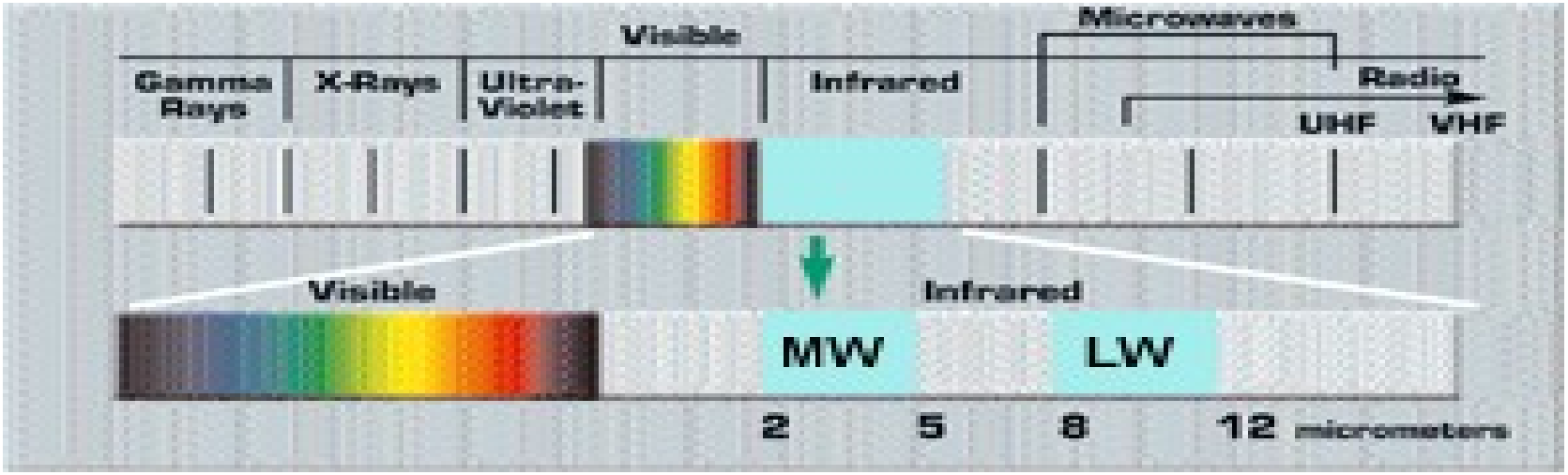
The Electro-magnetic Spectrum



- Thermal Energy is non visible light – its wavelength is too long for the human eye to see
- Humans perceive this energy as heat,
- Everything with a temperature above absolute zero emits heat, even very cold objects like ice.
- The higher the temperature of an object the more IR radiation is emitted.
- Infrared camera's measure the radiation and produce an image of the heat of an object - they will not show air temperature.

A thermogram is a true image of radiation, it may not be an accurate measure of temperature. For building diagnostics thermal images are analysed to determine where a temperature difference exists, not exact temperature differences.

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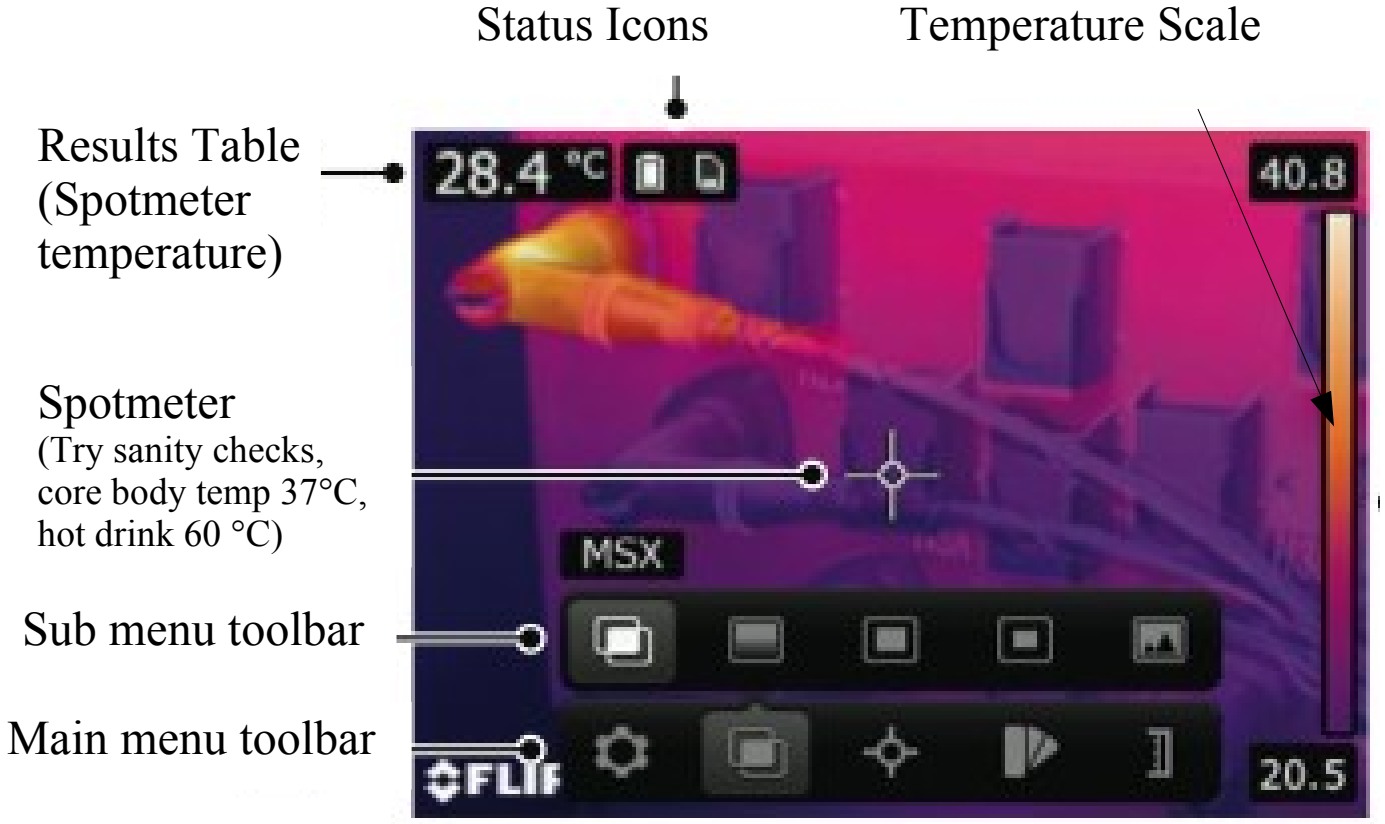
Every pixel in the radiometric image is a temperature measurement.

Darker colour means cooler, brighter means warmer.

What can we learn from this image?

- It is Winter. Ground temperature just above 0°C
- From the image, we know it is a house - recognition.
- The heating is on, or was on (thermal inertia)
- Roof is probably insulated
- Photo was taken with sufficient light for digital camera to produce image (MSX)
- Range lock is in use (white out effect)

The Flir E6 Camera



Source: FLIR

Lock mode is good when:

- Comparing similar objects (e.g. outside walls of your house). Lock on the image with the widest temperature range and the image colours will have the same meaning.
- Taking an image which has small temperature gradients when there is a very hot or very cold point in the range. Point the camera away from the hot / cold area, lock the range and then take the image.

The camera can operate in:

Auto mode – continuously looking for the best image, brightness and contrast
Lock mode – temperature span and the temperature level are locked

Example of using navigation pad to change settings:

1) Push the centre of navigation pad and select Temperature Scale from the toolbar.
2) Select either Auto or Lock

Saved Images

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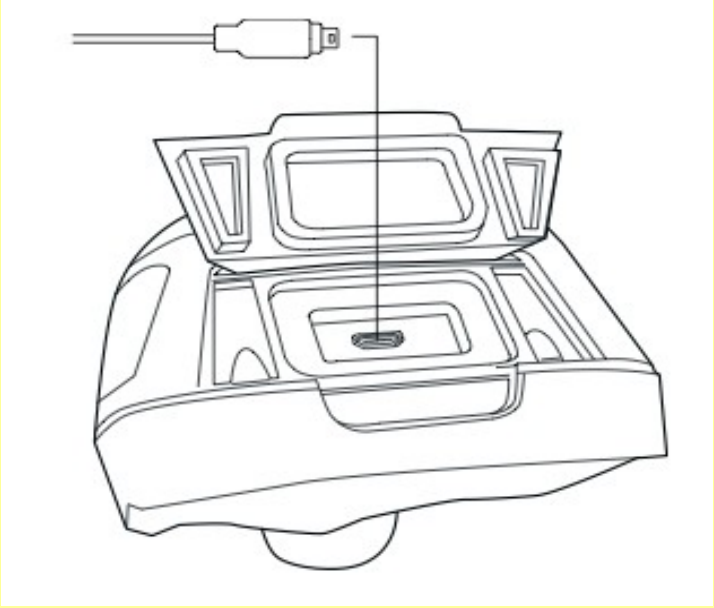
DOWNLOAD YOUR IMAGES
Download the images onto your computer.
Install FLIR Thermal Studio Free Software to see all the temperature data.
If you edit the JPG outside FLIR tools all the temperature information will be lost.

DELETE ALL YOUR IMAGES FROM THE CAMERA

- Push the centre of the navigation pad.
- On the toolbar that appears select settings.
- In the dialog box select Device Settings
- In the dialog box select Reset options
- In the dialog box select Delete all saved images.

The USB mini-B connector is used for moving images from the camera to a computer for further analysis in FLIR Tools.



For Windows PCs: Download from www.flir.co.uk/instruments/thermal-studio-plan-selection/

Surface properties / Emissions

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The **emissivity** of a material (ε) is the relative ability of its surface to emit energy by radiation compared with a black body at the same temperature (a black body has ε = 1).

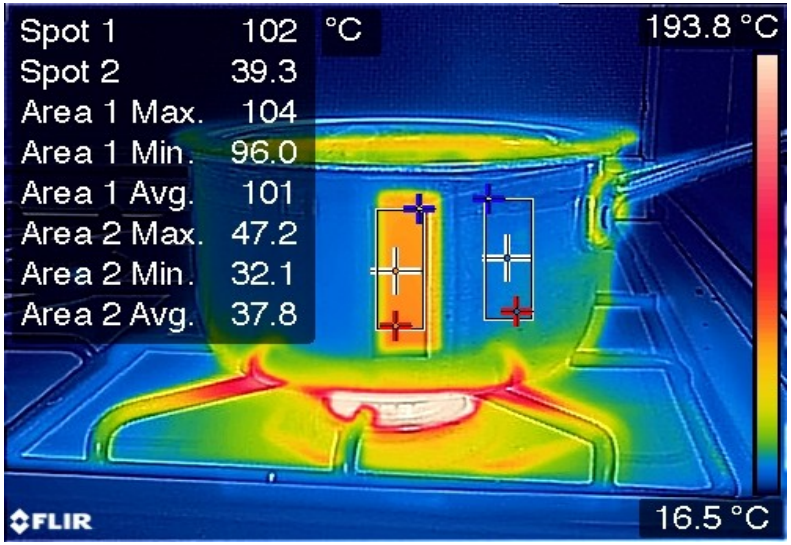
Thermal and electrical insulators have high emissivities and measurement is ok

wood, plastic, soil, concrete, rubber
PVC, painted surfaces, building materials

Metals are poor emitters (ε of at best 0.25) and measurement is tricky.

copper, steel, iron, brass, nickel, chromium, zinc, lead, aluminium

Water Boiling At 100°C in Stainless Steel Pan (ε = 0.16, not 0.95 as set)



Most building materials have high emissivities (concrete 0.95, brick 0.8). Small temperature differences where building material changes may be an emissivity effect rather than heat loss differences.

Black insulation tape (high emissivity) will always show the true temperature. Area 1 is black insulation on the stainless steel pan.

Reflections

In this picture the hot spots on the roof are sun patches, if its not been dark for a while don't confuse these with heat loss.

Something always reflects. Here it is a person.

Reflection is more of an issue when emissivity is low.

If a hot or cold spot moves when you change camera position its likely to be a reflection.

Building Diagnostics

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Ideal Conditions for Use

- Building interior >10°C (15°C ideal) warmer than outside, turn up heating in advance, if necessary.
- No recent direct sun, rain or strong winds (>10 km/h)
- Two hours after sunset solar effects are minimal

GOOD PRACTICE

- Be methodical - don't miss things
- Capture the whole scene and close-ups.
  - When outside, point at the house, excluding any sky, put the camera into lock mode to get the optimum colour range.
  - Take wide angled views to see conduction losses through walls, doors, windows and roofs.
  - Look for areas of unexpected high heat loss (hot areas when outside or cold areas inside) and focus in to investigate)
- Make comparisons.
- Look for moisture, draughts and heat loss.
- Keep notes: subject, location, suspected problem,

Remember:

Inside temperature affects outside temperature. Don't assume that houses / rooms are heated to the same temperature.

Insulation

Detect thermal bridges and decide whether they can be eliminated

Cross joining bricks in an early cavity wall – external or internal insulation would reduce the problem.

Pipework – is it all necessary? Can the cross-section be reduced?

Thermal bridges show as cold spots on the inside and warm spot on the outside. They occur when a highly conductive or non-insulating material passes through an insulating layer which separates the interior and exterior of a building.

Detect missing or defective Insulation

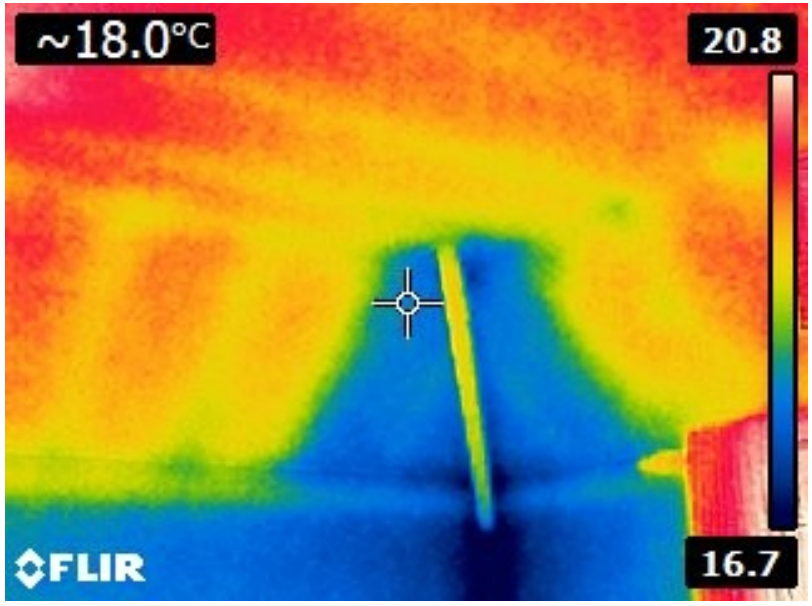
Does injected cavity wall insulation reach the corners, floor and roof?

Is interior insulation sealed properly?

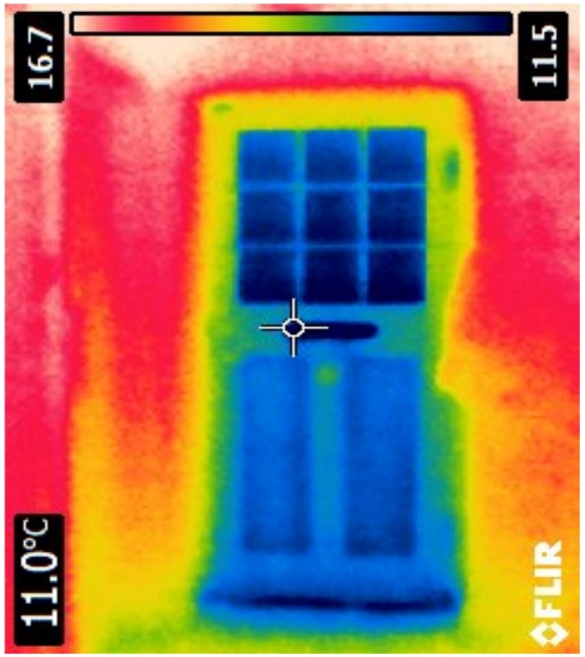
Has suspended floor insulation dropped?

Is the loft hatch insulated?

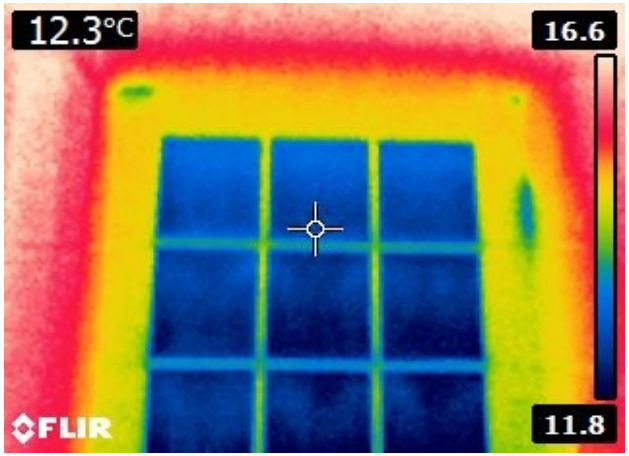
Does insulation extend down when the roof goes down into the first floor?



Windows and Doors



Draughts show as irregular cold area near the crack or gap.



Detect defective windows and doors

Are curtains channeling hot air out of the house?

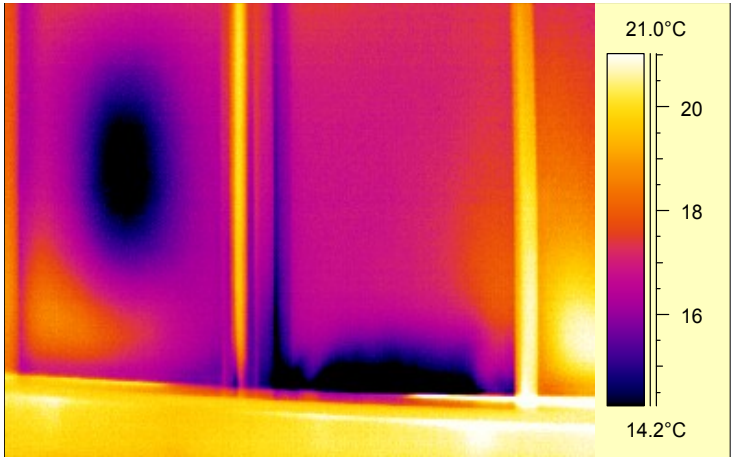
Do door and window openings seal tightly when closed?

Is the join between the window frame and house completely sealed?

Are trickle vents air tight when shut?

Whats coming through your letterbox and keyhole?

Has the gas leaked from a double glazed window?



Source: FLIR

Draughts / Air Infiltration

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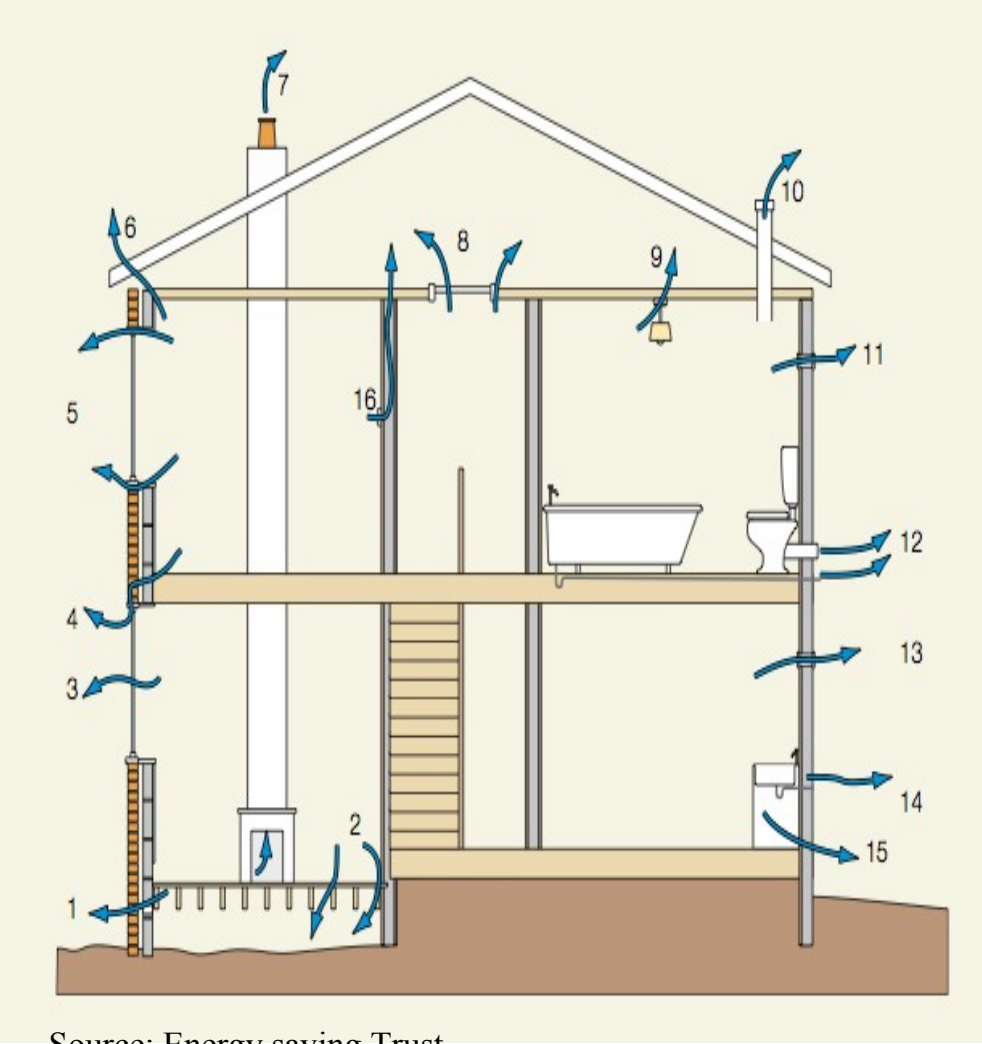
Detect draughts and seal where ventilation is unnecessary



Source: Energy saving Trust

1. Underfloor ventilator grilles
2. Gaps in and around suspended timber floors (skirting and floor boards)
3. Leaky windows and doors
4. Pathways through floor / ceiling voids into cavity walls and then to the outside
5. Gaps around windows
6. Gaps at the ceiling to wall joint at the eaves
7. Open chimneys
8. Gaps around loft hatches.
9. Service penetrations through the ceiling / roof.
10. Vents penetrating the ceiling /roof
11. Bathroom wall vent or extract fan
12. Gaps around the bathroom waste pipes
13. Kitchen wall vent or extractor fan
14. Gaps around kitchen waste pipes
15. Gaps around floor to wall joints (particularly timber frame)
16. Gaps in and around electrical fittings in hollow walls.

Remember some air vents are required, e.g for fires, boilers and floor ventilation!

Damp / Mould

Heating

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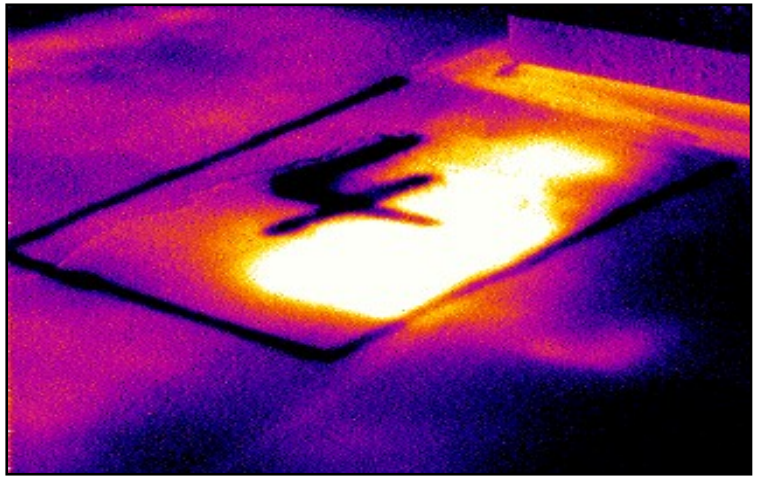
Detect moisture in / on walls and roofs

- Are there blocked drains or leaky pipework?
- Is a flat roof beginning to fail?
- Are there missing tiles?
- Does brickwork need repointing or external render repairing?



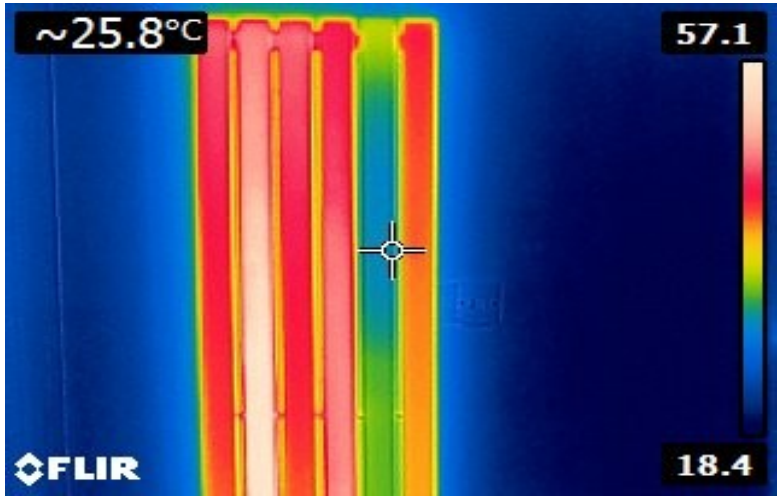
Source: FLIR

Detect condensation at cold points before mould appears

- Can you increase the amount of ventilation?
- Could moving furniture increase air movement?

Heating

- Detect if underfloor heating warmth lines are flowing where you would expect.
- See how draughty an open fire is when not in use



Check radiators

- Cold at the bottom suggests sludge and the central heating system would benefit from draining and cleaning.
- Cold at the top and air has got in, and the radiators would benefit from bleeding.