Tom Meehan

Technical Sales Manager

What is Carbon Monoxide (CO)?

- A poisonous gas that is a by-product of an incomplete combustion process
- Known as the Silent Killer
- Odourless, tasteless and invisible
- Symptoms are often mistaken and misdiagnosed
- A tragedy that could be avoided
- Detection is the only sure way of knowing its present

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The Silent Killer

HSE UK figures – 1995 to 2009

Deaths & incidents are under reported

CO Production

Produced during the incomplete combustion of any 'HYDRO-CARBON' fuel

- **Natural Gas**
- **Propane**
- **Butane**
- **Kerosene**
- **Gas Oil**
- **Coal**
- **Wood**
- **Coke**
- **Biomass**
- **Wood Pellet**

Why is CO so Dangerous

- Is not detected by human senses
- It can also lead to short and long term illnesses
- Exposure to even small amounts can be life threatening
- Not easily diagnosed
- There are sources of CO in almost every home

Effect on Humans

Headaches
Dizziness
Flu Like Symptoms
General Lethargy
Nausea
Vomiting
Diarrhea
Palpitations
Reddish Appearance
Unconsciousness
Death

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Effect on Humans

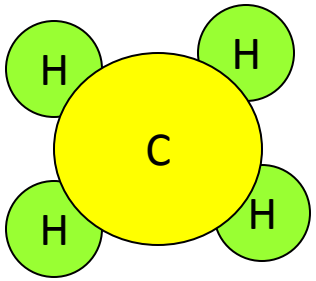
CO p.p.m.	Exposure	Effects
50		Threshold limit – No apparent toxic symptoms
100	Several Hours	No symptoms for long periods
200	2-3 Hours	Possible headache
400	1-2 Hours	Frontal headache & nausea
800	45 Minutes	Headache, dizziness & nausea
800	2 Hours	Collapse & possible unconsciousness
1600	20 Minutes	Headache, dizziness & nausea
1600	2 hours	Collapse & possible unconsciousness, possible death
3200	5-10 Minutes	Unconsciousness & possible death
6400	1-2 Minutes	Headache & dizziness
6400	0-15 Minutes	Unconsciousness & possible death
12800	Immediate	Unconsciousness
12800	1-3 Minutes	Death

How CO poisoning happens

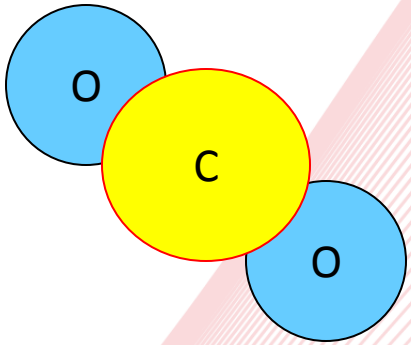
- CO enters through the lungs where it binds to the hemoglobin in the blood
- Reduces the blood's oxygen carrying capacity
- Binds to the iron sites on the red blood cell with an affinity 200-250 times that of oxygen

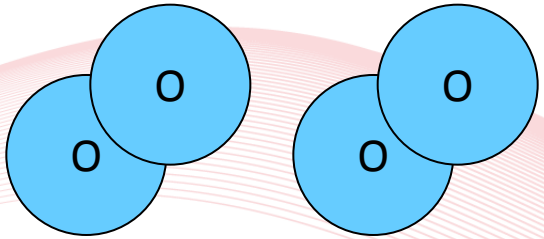
Complete Combustion

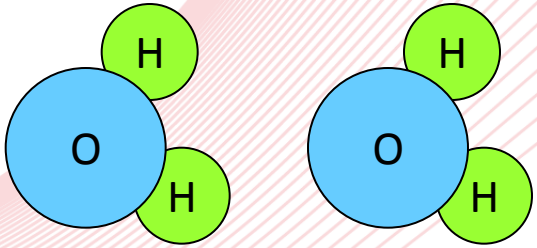
Natural Gas - CH_4



Carbon Dioxide – CO_2





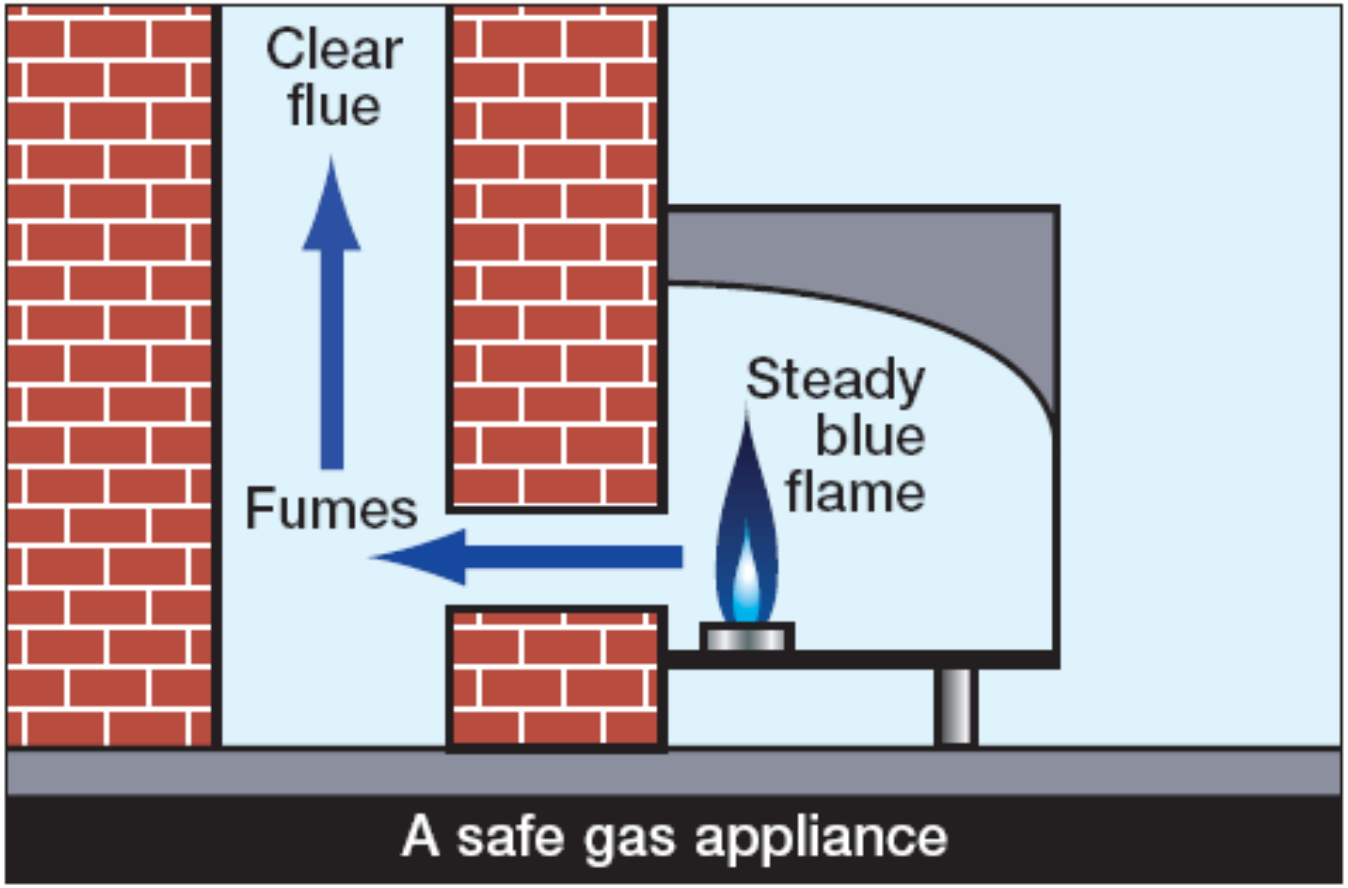


Oxygen – O_2 (x 2)

Water – H_2O (x2)

No CO – all carbon has burnt to CO_2

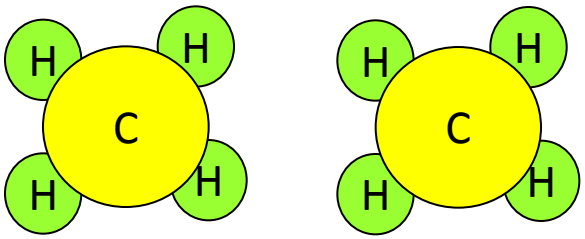
- COMPLETE COMBUSTION
- **Carbon Dioxide (CO_2)+ Water Vapour (H_2O)**



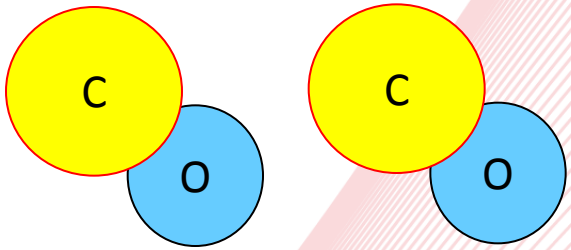
Complete Combustion

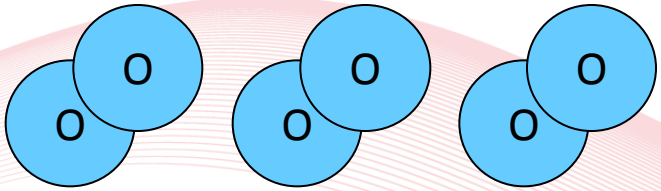
Incomplete Combustion

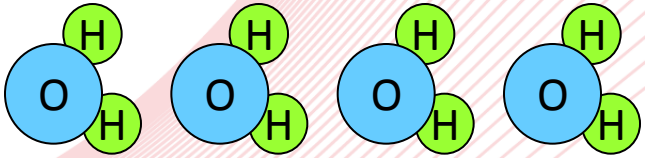
Natural Gas - CH_4 (x2)



Carbon Monoxide CO (x2)







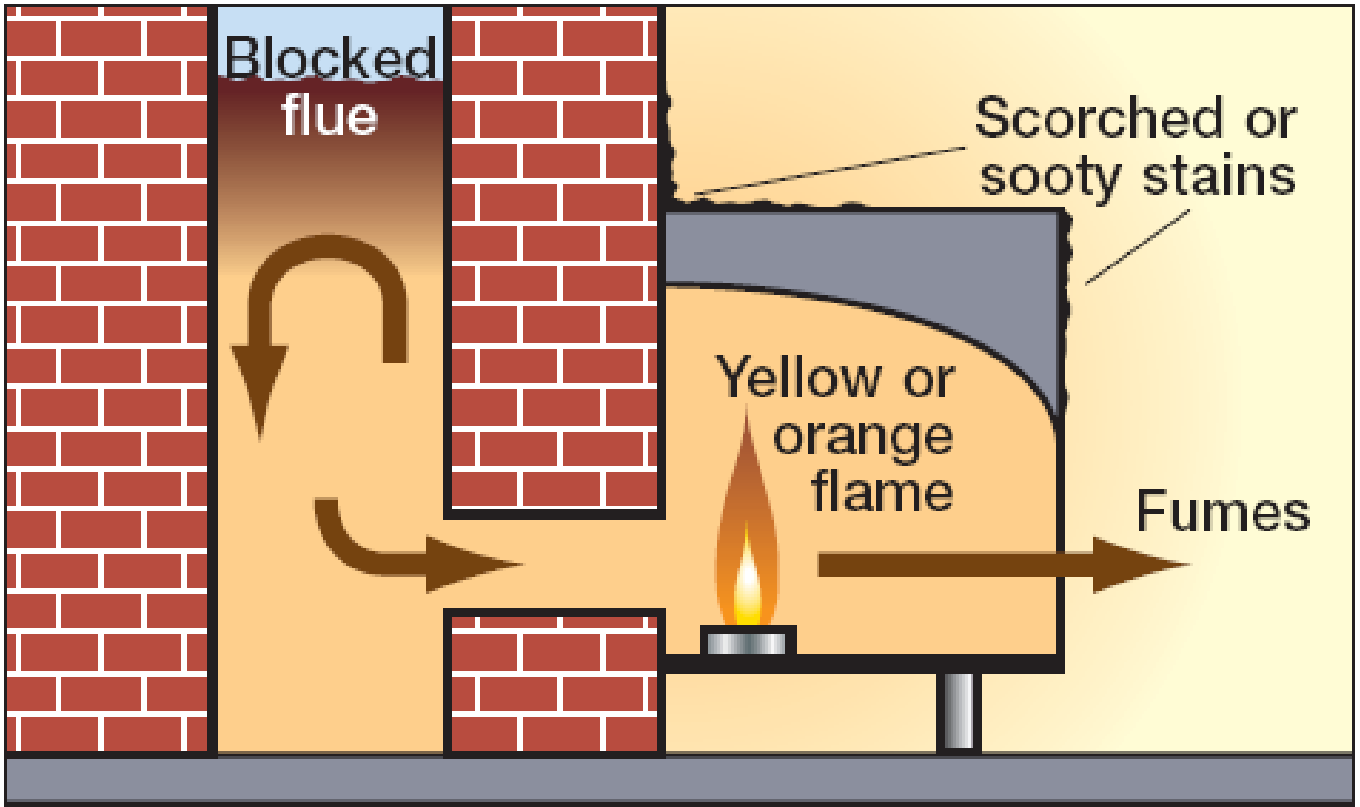
Oxygen – O_2 (x3)

Water – H_2O (x4)

Carbon has burnt to CO but not to CO_2

INCOMPLETE COMBUSTION

- Carbon Monoxide (CO) + Water Vapour (H_2O)



A dangerous gas appliance

Incomplete Combustion

Lack of Ventilation
Interference of a flame
Dirty and un-serviced appliances
Incorrectly set or un-commissioned appliances

Condensation

Visual Indications

Soot

Discoloration of Appliance / Room Decoration

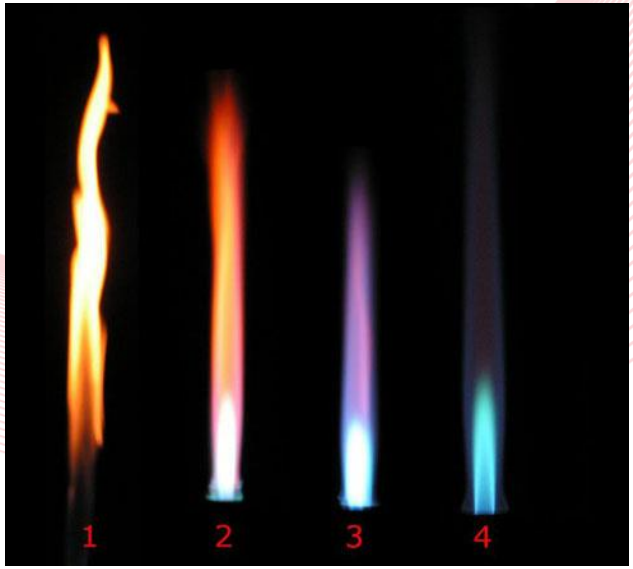
Incomplete Combustion

Visual Indications

Yellow Flame (Vitiation)

Unstable Combustion

Excessive Condensation (Spillage)



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Awareness Of Symptoms

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http://www.carbonmonoxide.ie/htm/gpfactsheet-poisoning.pdf

Carbon Monoxide - Carbon M... | carbonmonoxide.ie

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Page | Safety | Tools

BORD GÁIS NETWORKS

REGISTERED RGI GAS INSTALLER

NSAI

IRISH LPG AS ASSOCIATION

HSE Feidhmeannacht na Seirbhíse Sláinte Health Service Executive

CARBON MONOXIDE POISONING

A guide for GPs and other medical professionals

This fact sheet covers:

EN 10:11

Awareness

Spotting the signs of Carbon Monoxide.

Frequency of symptoms.

Headache 90%

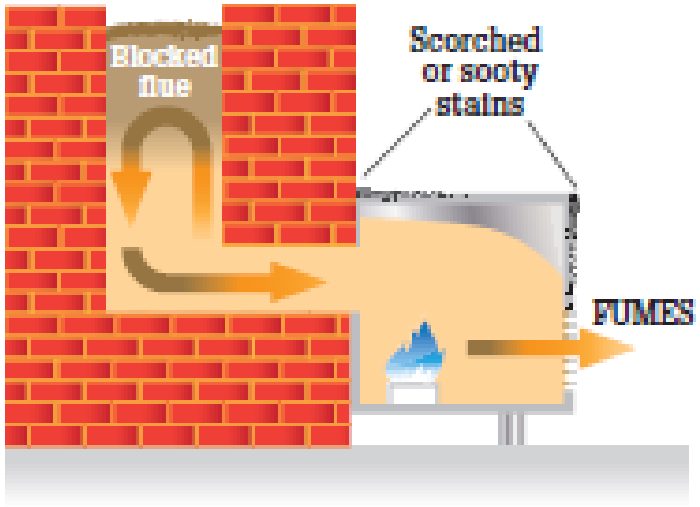
Nausea & Vomiting 50%

Vertigo 50%

Alteration in Consciousness 30%

Subjective Weakness 20%

Near Miss



If the flue is restricted – CO leak into the property

- 5 elderly ladies having afternoon tea.
- One lady went home feeling sick.
- Doctor diagnosed CO poisoning.
- Other ladies were unconscious in house.
- Thankfully saved

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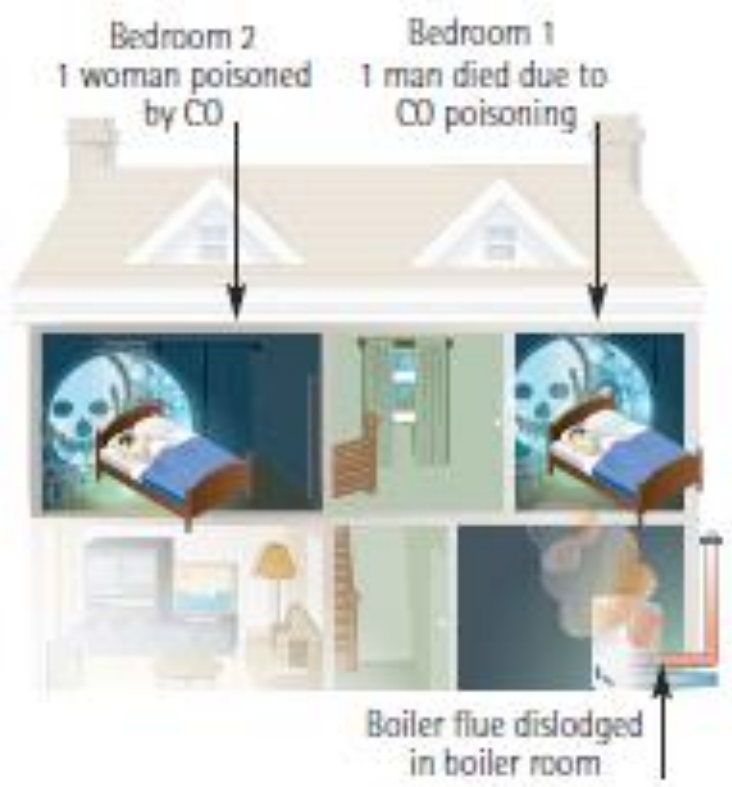
Incorrect diagnosis

Tragic Incident



- Exhaust flue became dislodged.
- CO spilled into boiler room and entered bedrooms above
- 1 man died and a woman was hospitalised.
- Family convinced CO alarm could have saved his life.

Accidents/Events that can lead to CO poisoning

- Faulty or damaged heating appliances
- Heating appliance not maintained or serviced
- Rooms not properly ventilated
- Blocked chimneys or flues
- Indoor use of a barbecue grill or outdoor heater
- Poor installation of heating appliances
- Improper operation of heating appliances
- Property alterations or home improvements, which reduce ventilation
- Running engines such as vehicles or lawnmowers in garages
- Using cooking appliances for heating purposes

Prevention is always better than cure

CO Awareness and Prevention is key

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Friday 8th March 2013

Three people have been taken to hospital with suspected carbon monoxide poisoning, according to the fire service.

Emergency services and the gas board were called to a flat in Garvel Road in **Glasgow's** Barlanark area at 2.15pm on Friday.

Two crews from Easterhouse Fire Station scrambled to the scene where they cleared people out of the four-storey flat.

"Firefighters forced entry into the flat and evacuated the building," said a spokesman.

Two males and one female were taken to Glasgow Royal Infirmary with suspected poisoning from carbon monoxide.

A spokeswoman for Scotland Gas Networks said: "We were called to a property in Garvel Road in Barlanark earlier this afternoon following reports of a gas escape.

"We have finished our safety checks in our capacity as the national gas emergency service provider and our engineers have now left the property."

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Friday 8th March 2013

THREE people were taken to hospital and two cats died in a suspected carbon monoxide poisoning incident at a **Swansea** house early today. Mid and West Wales Fire and Rescue Service were called out to a farmhouse in the Morriston area just before 3.50am.

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Thursday 14th March 2013

Bodies of man and dog found at house

MYSTERY surrounds the death of a popular Porthmadog man and his dog who were found at their home.

Amateur actor and radio enthusiast Alan Skellern, 79, and his dog, Sian, were found dead at their home in Madog Street last Tuesday evening. Police were contacted by a neighbour and Porthmadog dog groomer, Paula George, after they became concerned after not hearing or seeing Alan for over a month. Officers attended Alan's home at around 5.30pm on 5 March and removed a window to gain access to the property, where they found them both dead. Police said this week they were awaiting toxicology results before they investigate the possibility of **carbon monoxide poisoning.**

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Thursday 14th March 2013

Pembroke Dock family saved by carbon monoxide alarm
A Pembroke Dock family had a lucky escape after their carbon monoxide alarm alerted them to a potentially fatal leak of the deadly gas in their home.
Mid & West Wales Fire and Rescue Service is urging the public to be alert to the dangers of carbon monoxide following the incident on Tuesday evening.
Residents at the property were alerted to the presence of the gas by their carbon monoxide detector, which fortunately provided an early warning allowing them to safely leave their home

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CO Deaths in UK – 1995 to 2009

Fuel breakdown by CO-Gas year (September to August):

Year	95/6	96/7	97/8	98/9	99/00	00/1	01/2	02/3	03/4	04/5	05/6	06/7	07/8	08/9	09/10	Total
Solid fuel	27	19	26	14	18	14	5	8	3	5	8	14	10	6	5	**182**
Gas Mains	32	22	18	24	14	16	7	11	9	14	12	9	11	18	4	**221**
Gas Portable	8	8	5	6	10	5	7	7	6	4	7	4	3	5	5	**90**
Petrol	6	7	3	6	3	3	8	1	2	3	2	9	4	4	6	**67**
Oil	-	2	-	-	-	-	-	-	-	-	-	1	-	1	-	**4**
Paraffin	-	-	1	1	-	-	-	2	-	-	-	-	1	-	-	**5**
Unknown	1	-	-	-	-	-	4	4	1	2	4	2	1	3	3	**25**
Total	74	58	52	51	46	38	31	31	23	28	33	39	30	37	23	**594**

Near-Misses from Accidental Carbon Monoxide Poisoning in UK

Year	95/6	96/7	97/8	98/9	99/00	00/1	01/2	02/3	03/4	04/5	05/6	06/7	07/8	08/9	09/10	Total
Near misses from accidental CO	467	449	320	386	335	297	87	145	171	213	151	329	193	254	176	**3,973**

(Fifteen years from September 1995 to August 2010) **Total: 3,973**

of whom **2,085** required hospital treatment (of those **365** had lost consciousness).

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Where CO Deaths Occurred

Tenure:		
	Owner/Occupier	343
	Council	61
	Private Rental	62
	Housing Association	15
	Other (e.g. hotel)	9
	Unknown	104

Situation:				
	House	279	Hostel	1
	Flat	87	Commercial Premises	3
	Bungalow	41	Campervan	10
	'At home'	18	Polytunnel	1
	Garage	21	Shed/Cabin	7
	Car	6	Lorry	7
	Caravan	23	Hotel	5
	Boat	21	Public House	3
	Workshop	5	Care Home	1
	Work Place	12	Aeroplane	4
	Shop	4	Club House	2
	Tent	7	Unknown	26

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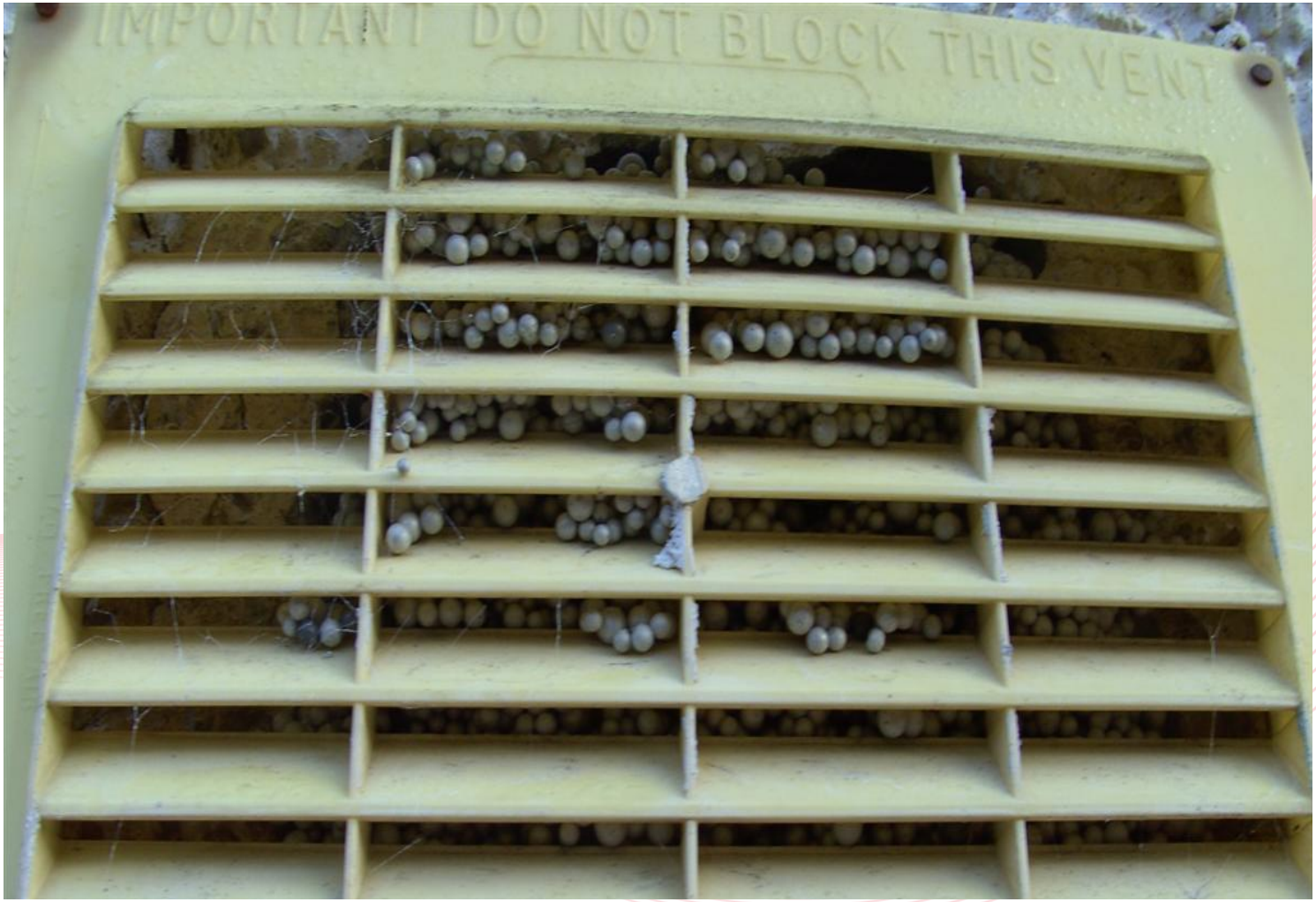
Potential Risk

External Wall Insulation & Domestic Gas Installations

Ask the customer if they have had any work done recently

Potential Risk



Potential Risk

Potential Risk

EYE SPY

Too close for comfort

Rick Moss found this flue from a gas fire while he was working on a customer's central heating. Needless to say the appliance was disconnected and labelled.

Window pain

Regulations

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Regulations

Approved Doc J England & Wales.

Clause 2.34 “Where a new or replacement fixed solid fuel appliance is installed in a dwelling, a Carbon Monoxide Alarm should be provided in the room where the appliance is located”.

Clause 2.35 “Carbon Monoxide alarms should comply with EN 50291:2001 and be powered by a battery designed to operate for the working life of the alarm. The alarm should incorporate a warning device to alert the user when the working life of the alarm is due to pass. Mains powered EN50291 Type A Carbon Monoxide alarms with Fixed wiring (not plug- in Type) may be used as an alternative application provided they are fitted with a sensor failure warning device.

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Northern Ireland

- Technical Guidance Document L

- **Technical Guidance Document L of the Building Regulations in Northern Ireland has been amended to cover protection against Carbon Monoxide. Regulation 72 is the important one to remember and it says**

"Where a combustion appliance is installed in a dwelling , reasonable provision shall be made to detect and give warning of the presence of Carbon Monoxide Gas at levels harmful to people"

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Republic Of Ireland Regulations

- On The Way
- Hopefully before End of year.

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European Standards for Domestic CO Alarms

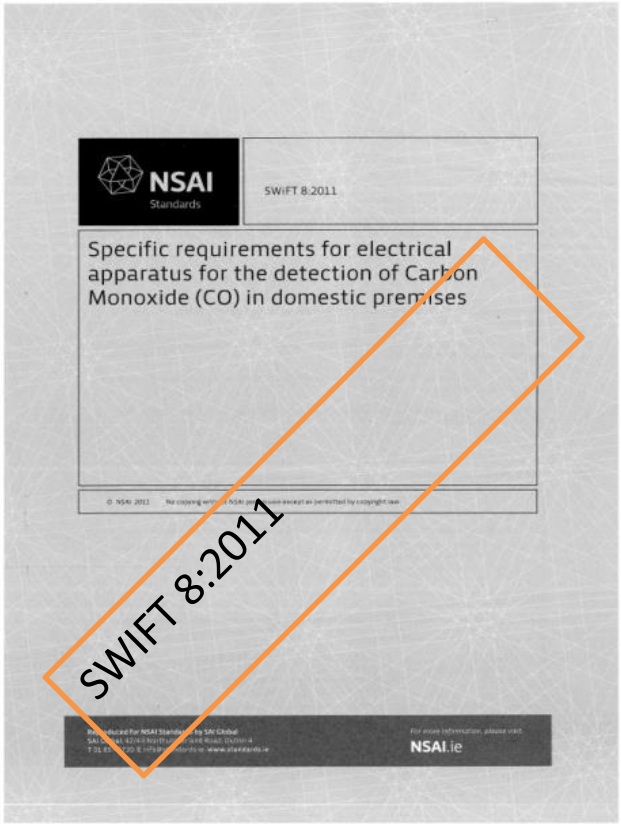
Requirements

- EN50291-1:2010
  - General requirements for the construction, testing & performance of electrically operated CO gas detection alarms.

  EN50291-2:2010

  Battery operated Carbon Monoxide Alarms Approval for use in Caravans and Boats.
- EN50292-1:2002
  - Guide to selection, installation, use & maintenance of CO alarms.
- SWIFT 8 – NSAI Document
  - Requirements in addition to EN50291-1:2010
  - Mainly the addition of an EOL feature.

SWIFT 8:2011- Overview



- EOL visual & audible indicator fitted.
- Indicator shall be yellow and be clearly visible.
- EOL fault signal
  - Based on timer.
  - Based on low battery condition*.
  - Sensor short or open circuit check
- Labelling
  - EOL & Certification mark on package
  - EN Compliance statement on product & Package
- Instruction Booklet
  - Detector should be tested as per Mfg. instructions
  - EOL instructions included
- **3rd party tested and certified to EN50291-1:2010 (e.g. BSI Kitemark)**
- **Other manufacturers also have this but some don't (be careful when purchasing)**

***If used, battery life shall not exceed sensor life**

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EN50292-1:2002

GUIDE TO SELECTION, INSTALLATION, USE AND MAINTENANCE.

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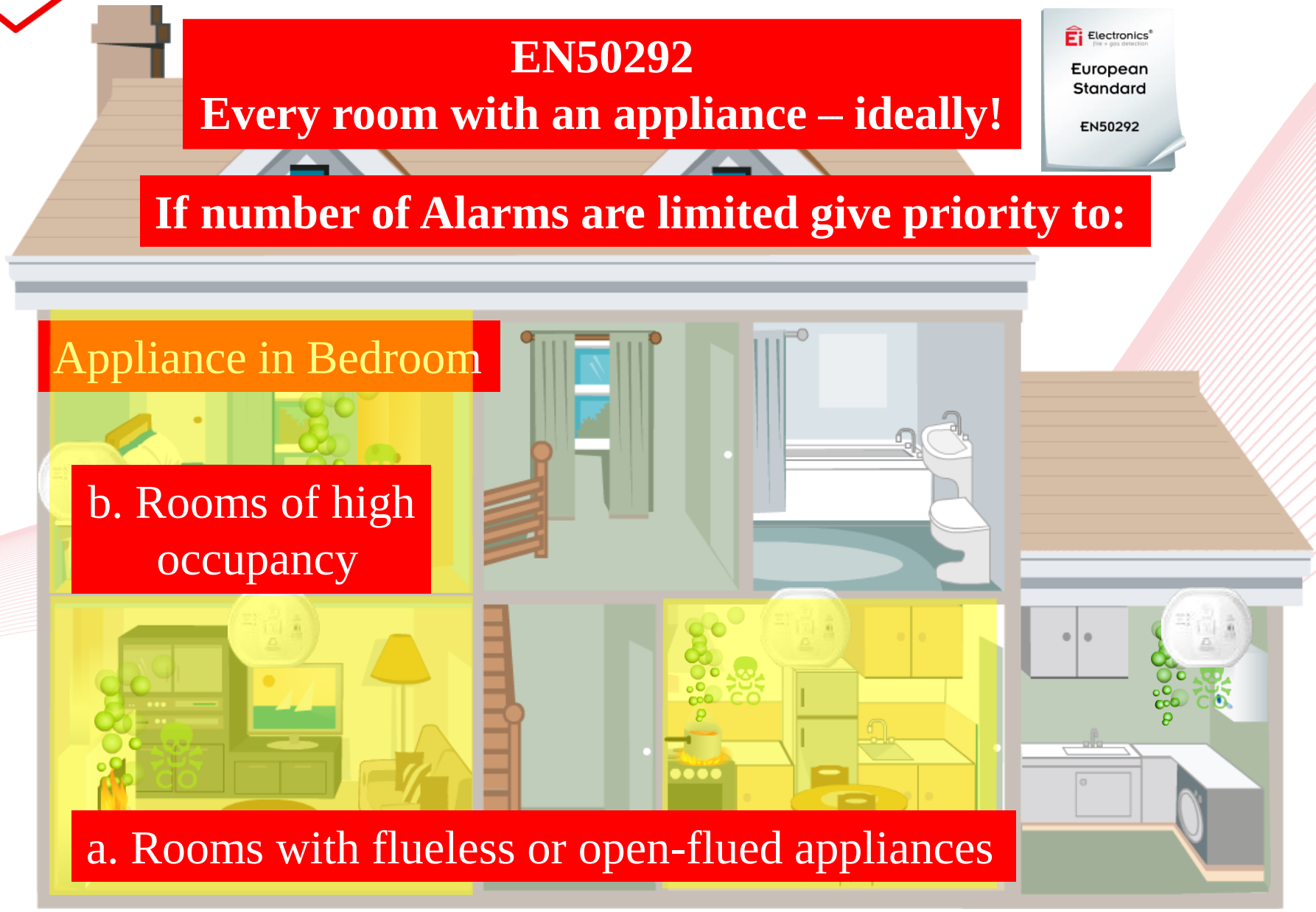
Where to locate CO Alarms

Which Rooms?

EN50292
Every room with an appliance – ideally!

If number of Alarms are limited give priority to:



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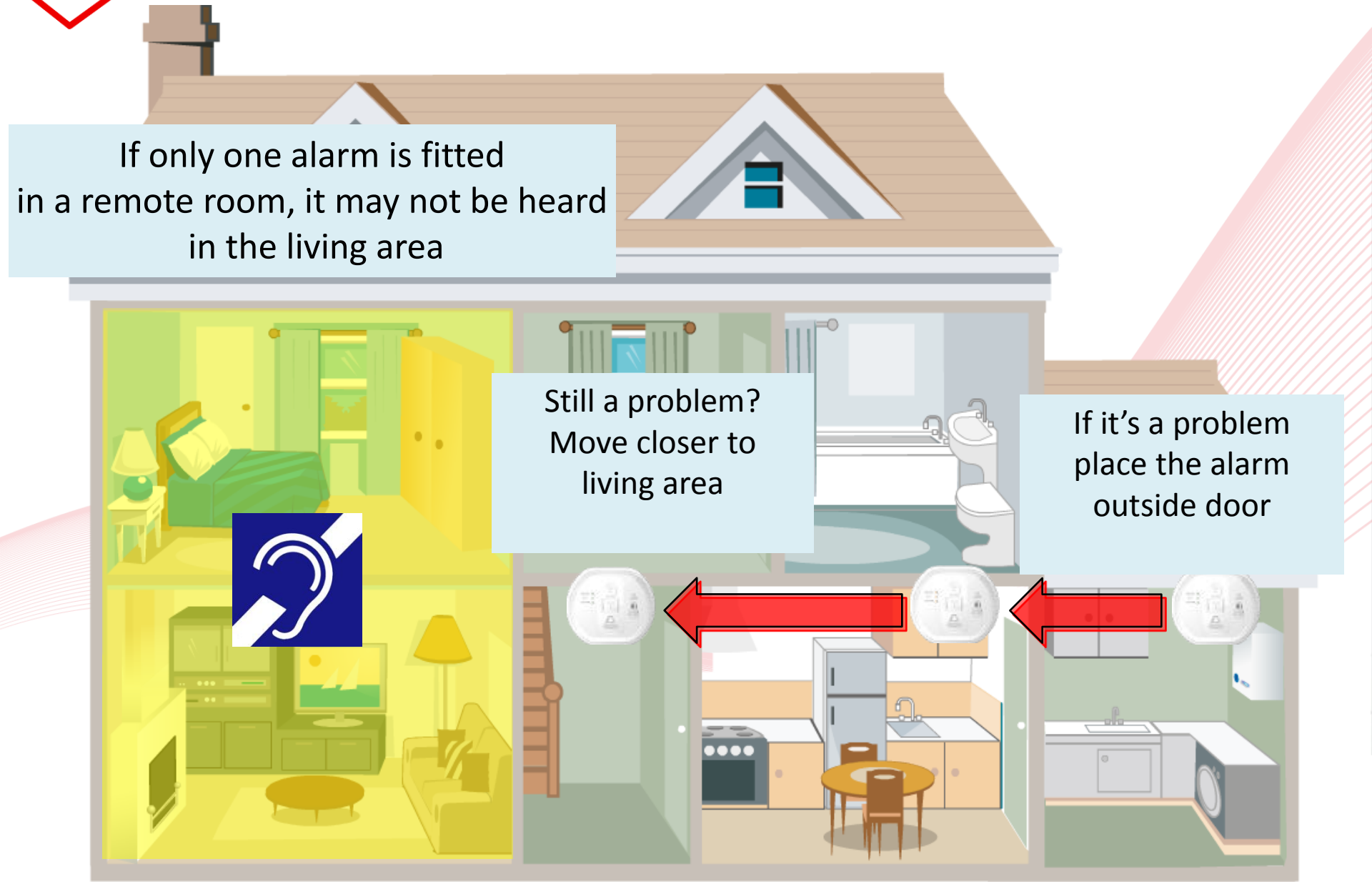
One Alarm only?



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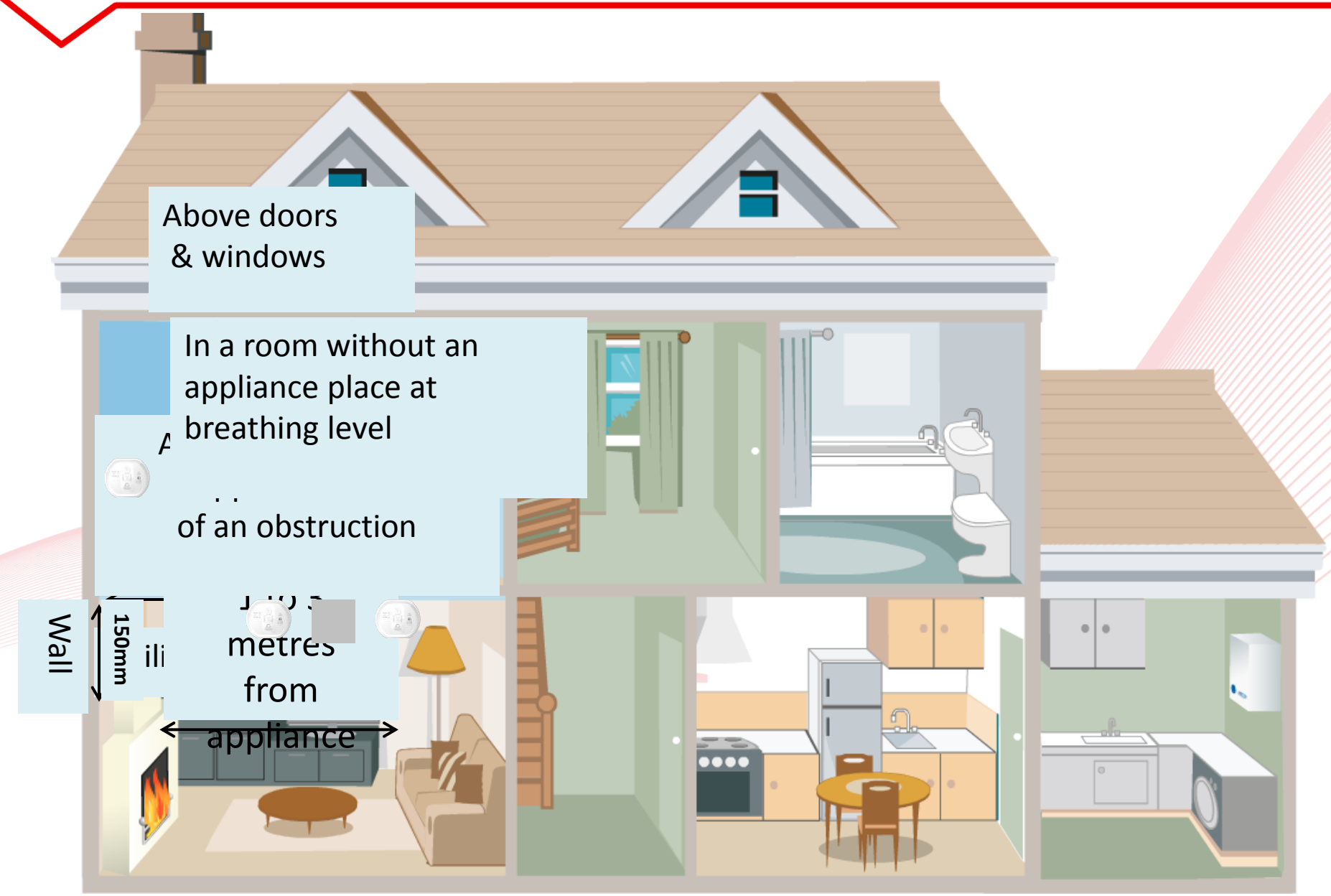
Where in the Room?



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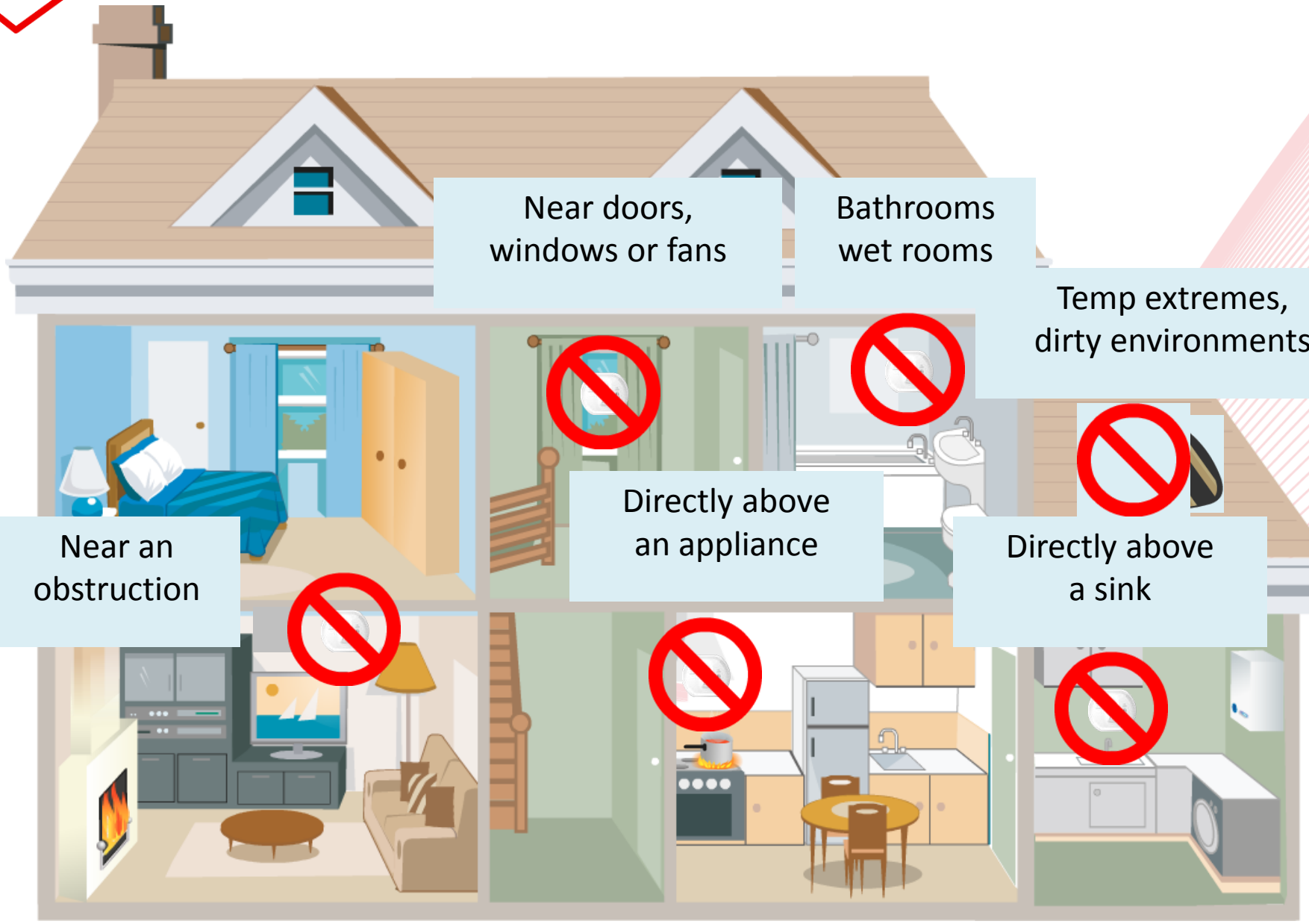
Where *not* to place Alarms!



Install Locations

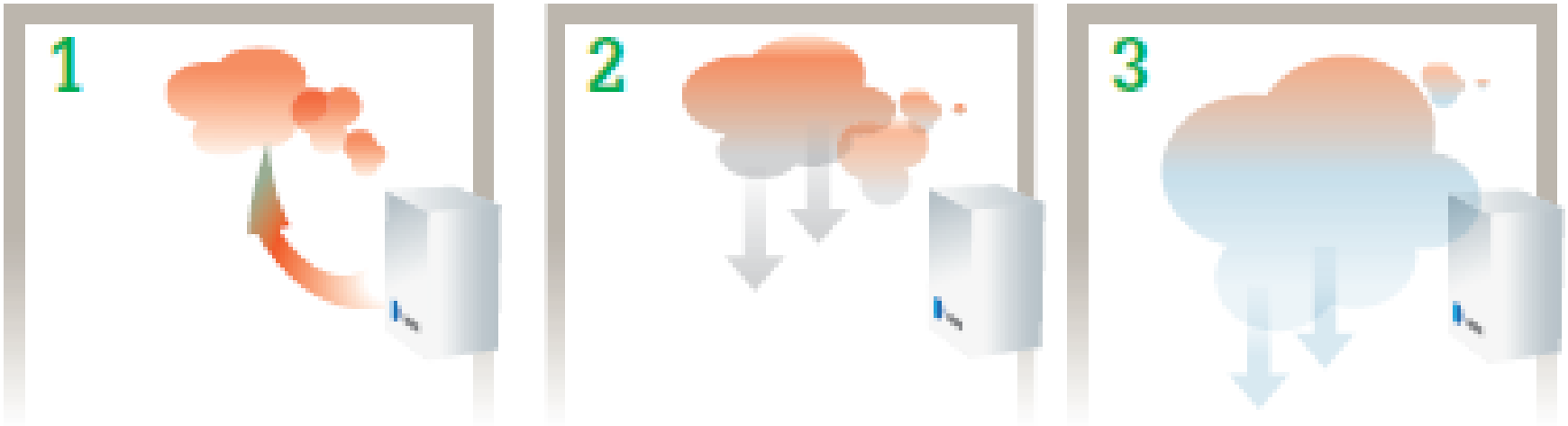
- **Which Room?**
  - **<u>Every room containing an appliance (Ideally)</u>**
  - Consider Remote Rooms with high occupation (living room, TV lounge)
  - Consider every bedroom
- **Practical (prioritise)**
  - Appliance in room where people sleep
  - Room with flueless and/or open flue appliance
  - High occupancy
  - Outside entrance to closed room with appliance or install remote siren (type A alarm)
  - Near the bed in bedsits / single room dwelling
- **Recommend interconnect**
  - Fitting at least 2 interconnected alarms will:
    - Enhance early detection of CO
    - Raise the alarm sound levels (sound pressure)
  - Fit one alarm in the room with appliance and a 2nd in the bedroom area
- **Other Locations (consider)**
  - Parking garages

Unsuitable locations

- In an enclosed space (cupboard or behind curtain)
- Where it can be obstructed
- Directly above cookers / sinks, radiators, hot air vents
- Damp & humid areas
- Close to fan (extractor)
- Next to air vents
- Temp extremes < -10°C, >40°C.
- High dust and dirty environments
- Close to cooking appliances


CAR

Ceiling or wall mounted



- In the room with an appliance place alarm on the ceiling
- In a room with <u>no</u> appliance place alarm on wall at breathing level

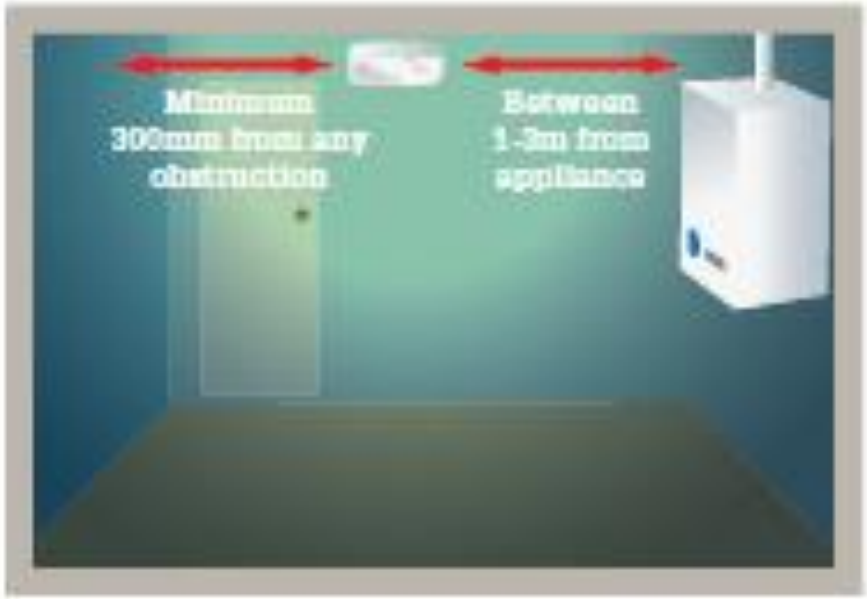
CO emitted from the appliance is warm so it rises

It moves lower down the room as it starts to cool

When its at the same temperature as the air it will be at all levels in the room

Mounting in Room with Appliance

Ceiling Mounting

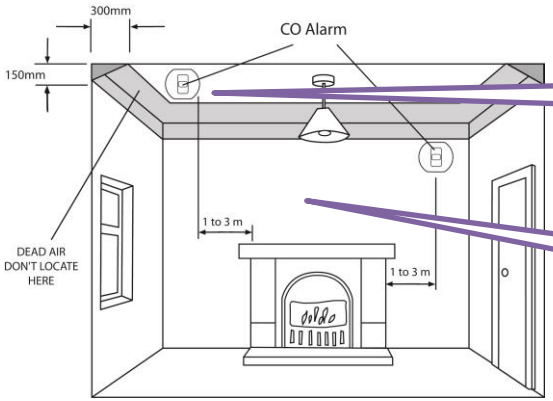


- >300mm from any obstruction
- 1 to 3m from appliance

Wall Mounting

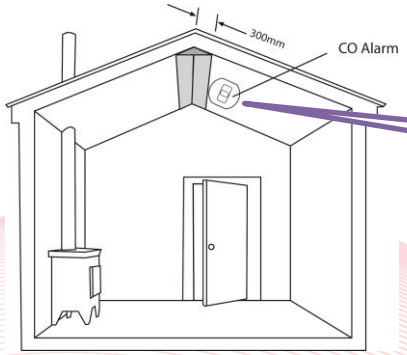
- >300mm from any obstruction
- 1 to 3m from appliance
- >150mm from ceiling
- Above any door or window

Siting considerations

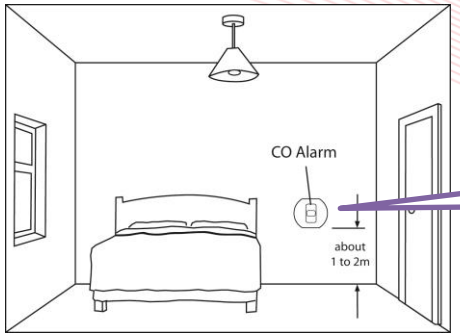


Preferably on the ceiling but can be wall mounted

Do not install directly above appliance



On sloped ceilings place alarm > 300mm from apex



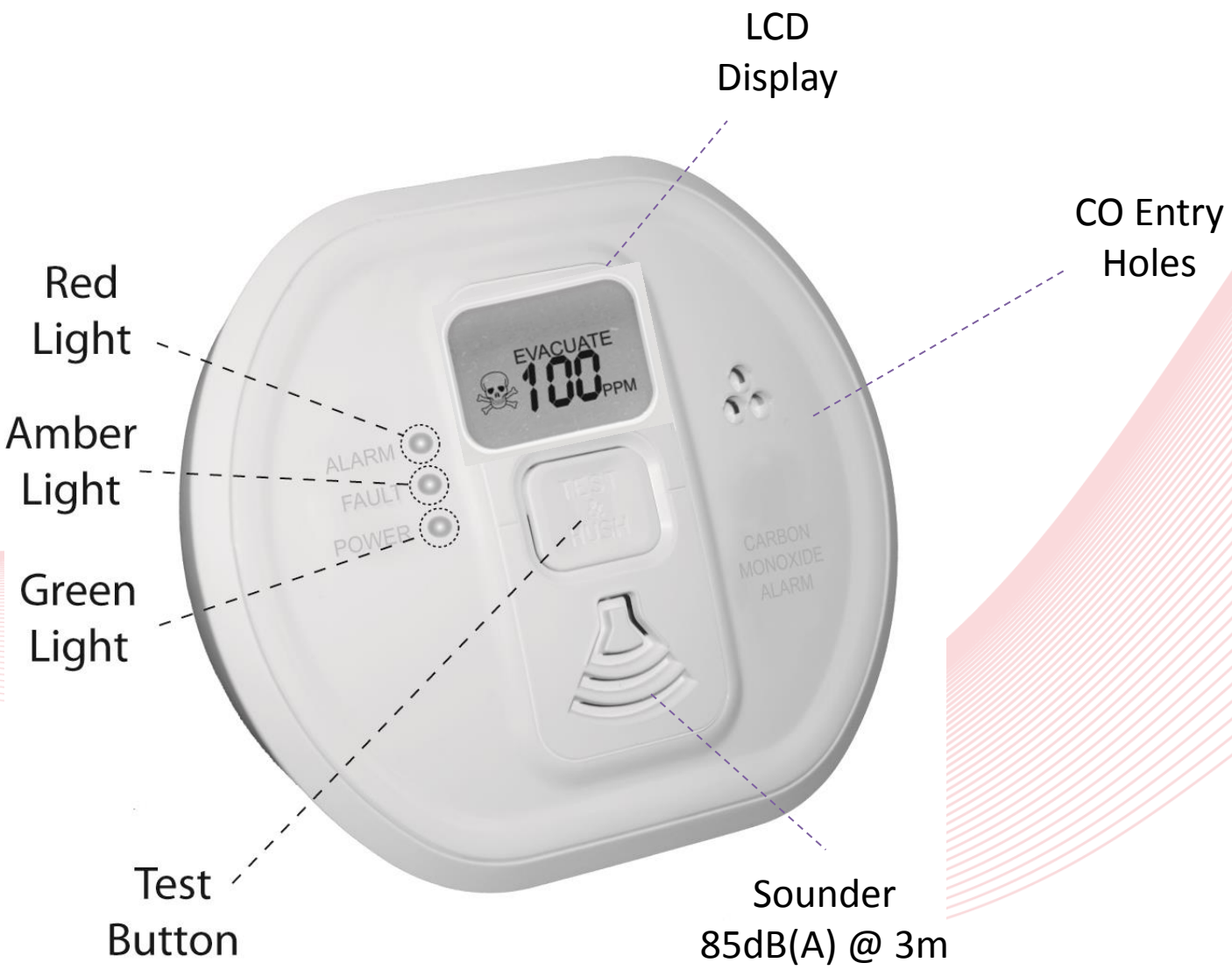
In rooms with no appliance place at breathing height

The Products

CO Alarms

Ei207 / Ei208 Carbon Monoxide Alarm Series

CO Alarms


LCD Display
CO Entry Holes
Red Light
Amber Light
Green Light
Test Button
Sounder 85dB(A) @ 3m
EVACUATE
100 PPM
ALARM
FAULT
POWER
TEST & HUSH
CARBON MONOXIDE ALARM

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Ultra Bright LED's
alarm, fault & power visual indicators

RF Module
optional RF interconnect to elimate hard wiring

Intelligent Integrated Circuit
customized designed algorithms provides intelligent diagnostic features

Digital Display
visual indication of co levels and alarms warnings

Dual Battery Option
standard replaceable AAA or powered-for-life lithium ion cell

CO Sensor
Proven high reliability electrochemical technology

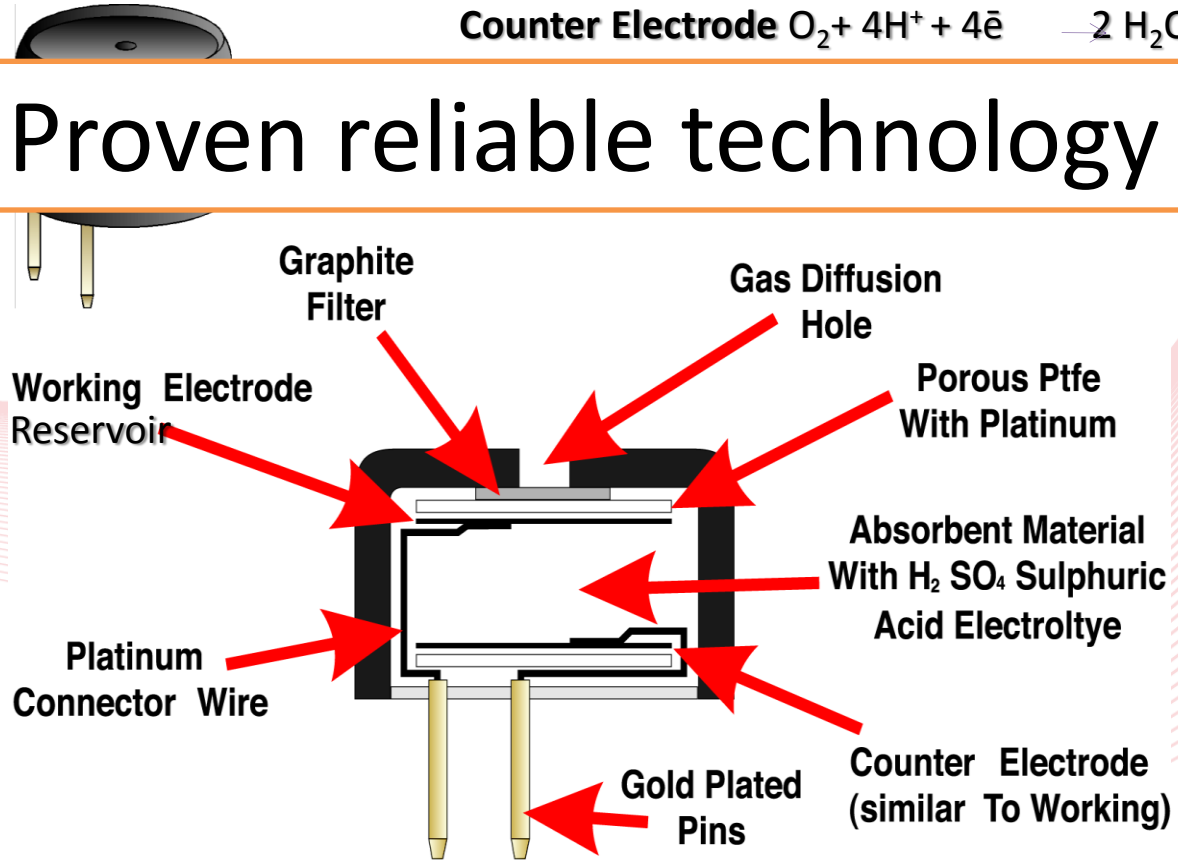
ELECTROCHEMICAL SENSOR

Sensing Electrode

$$2\,CO + 2H_2O \rightarrow 2\,CO_2 + 4H^+ + 4\bar{e}$$

Counter Electrode $O_2 + 4H^+ + 4\bar{e} \rightarrow 2\,H_2O$

Proven reliable technology



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Type A and B Detectors

Type A Detector

to provide a visual and audible alarm and an executive action in the form of an output signal that can be used to actuate directly or indirectly a ventilation or other ancillary device.

Detector fitted with an RF Module or Hard wired Interconnect makes it a type A device

to provide a visual and audible alarm only.

Ei208W = Type B Detector

Ei208WFR = Type A Detector

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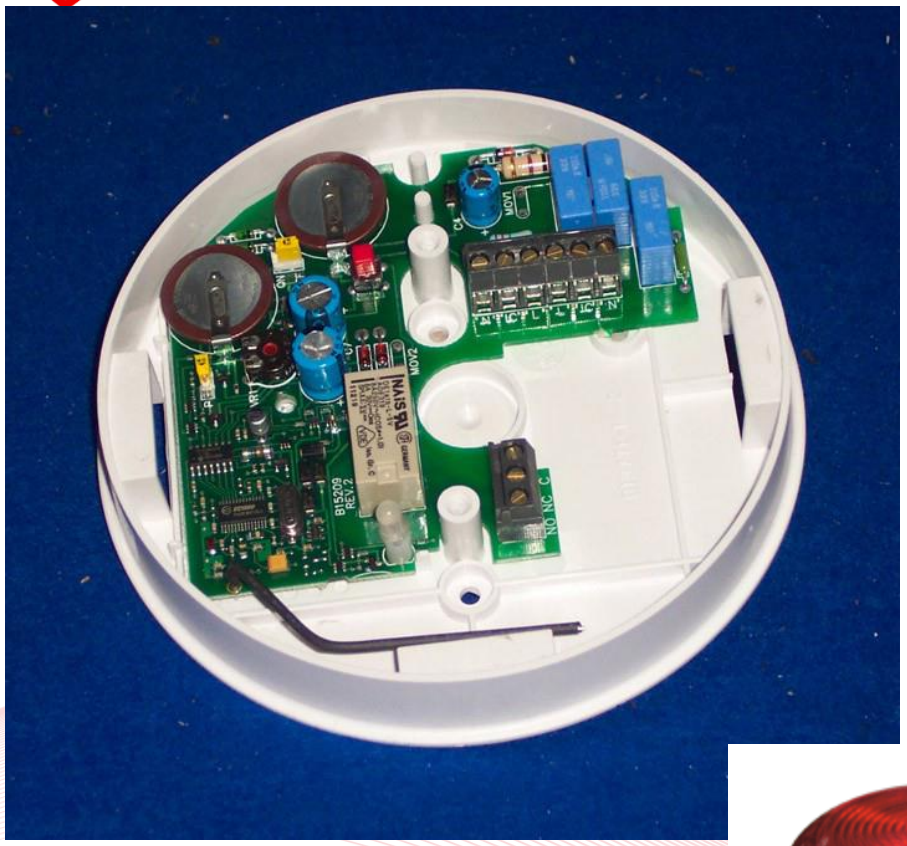
fire + gas detection



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CO Response Table

	Red Light	Display Icon (before horn sounds)	Display Icon (after horn sounds)	Horn / Sounder
CO Gas Level				
0 < ppm < 10 ppm	Off*	Blank	Blank	Off
10 < ppm < 30 ppm	Off*	PPM level (flash) on - 4 seconds, off - 12 seconds	PPM level (flash) on - 4 seconds, off - 12 seconds	Off
30 < ppm < 43 ppm	Off*	PPM level	PPM level	Off
43 < ppm < 80 ppm	1 flash every 2 secs	VENTILATE 060 PPM	EVACUATE 060 PPM	on within 60-90 mins (typ 72 mins)
80 < ppm < 150 ppm	1 flash every sec	VENTILATE 100 PPM	EVACUATE 100 PPM	on within 10-40 mins (typ 18 mins)
> 150 ppm	2 flashes every sec	VENTILATE 150 PPM	EVACUATE 150 PPM	on within 2 mins (typ 40 secs)

* unless it has alarmed previously (see CO Alarm Memory below)

ppm values shown in table are for example purposes only

24 Hour Memory

Up to 24 hours after Alarm

CO Level	Flash Rate	Horn
50ppm to 100ppm	2 flashes / 50 seconds	Off
100ppm to 150ppm	4 flashes / 50 seconds	Off
> 150ppm	8 flashes / 50 seconds	Off

Mains powered CO Alarms

Ei261ENRC

- 220 VAC
- Rechargeable Battery

Ei262

- 220 VAC
- Rechargeable Battery
- RF built -in

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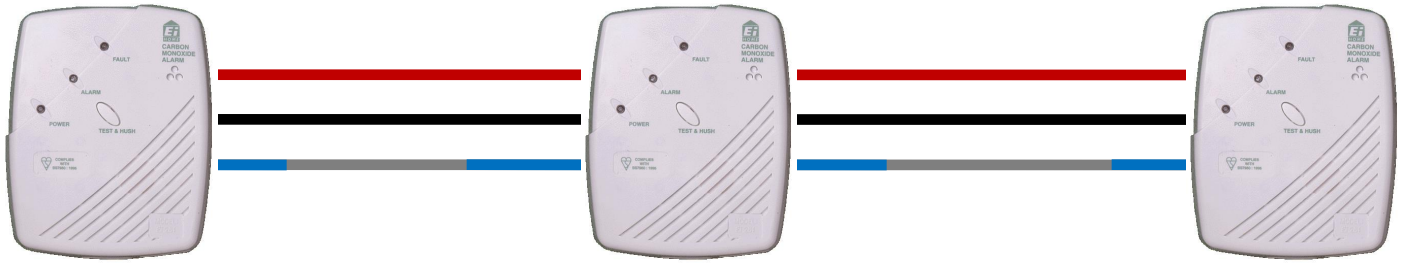
Interconnecting CO Alarms

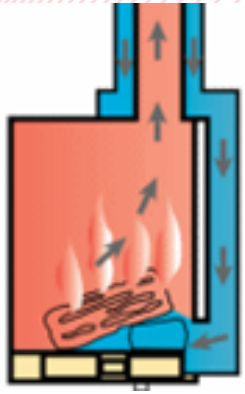


Interconnecting CO and smoke Alarms

Only with a switch

CO Alarm Developments

Deaf Alarm
Strobe & Vibration
Panel



CO alarms transmit RF
Alarm signals
to other devices

Ei428 Relay Module
can be used for control boiler shut
off valve for example

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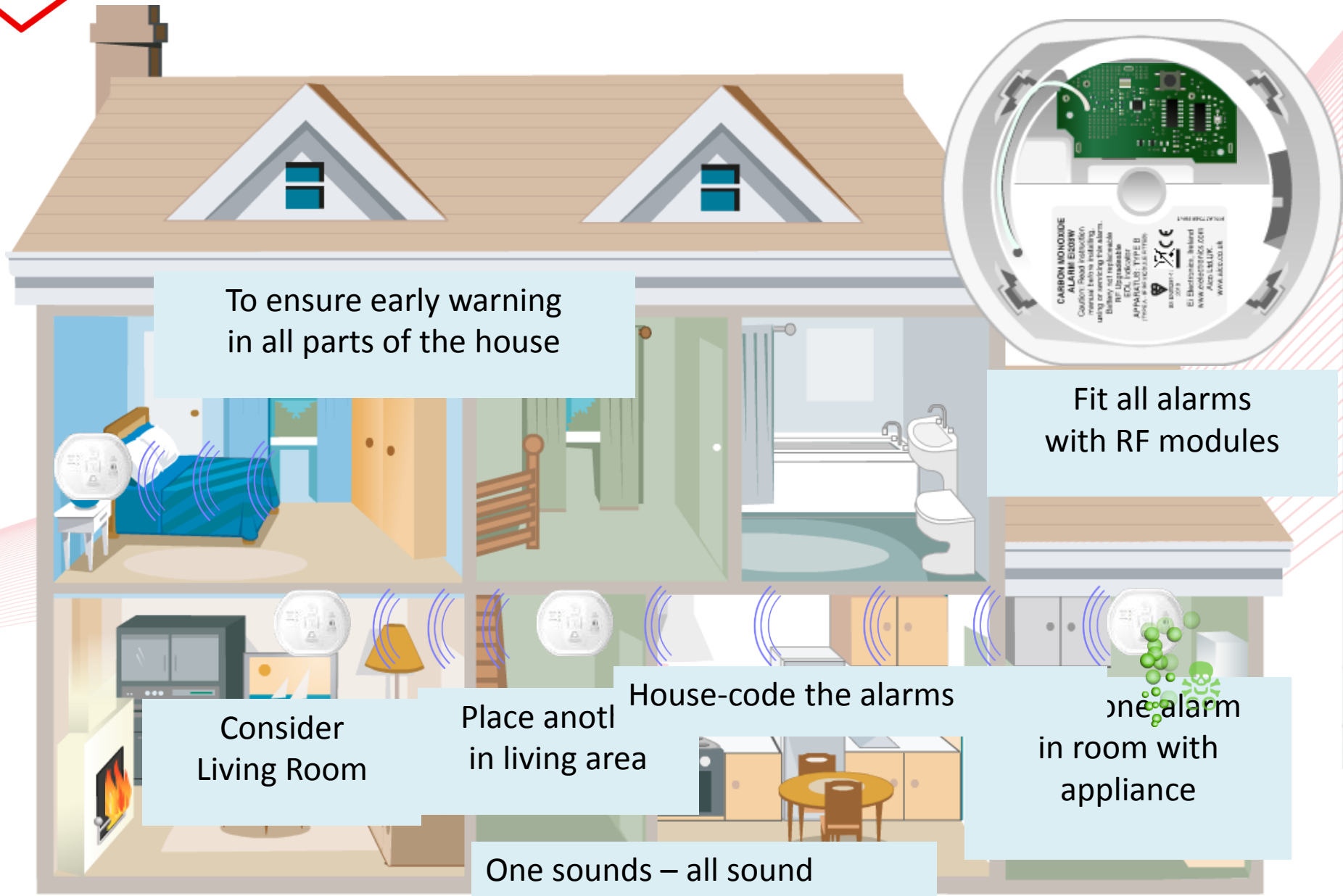
Why Interconnect?



Summary

- CO detection and annual maintenance complement each other – both are required
- All fossil fuel burning appliance produce CO
- CO Alarms should be fitted in all dwellings that contain these appliances.
- Accidents do happen – majority of deaths are from gas appliances
- High efficiency boilers are prone to produce higher levels of CO
- Annual maintenance is a point in time process, CO detection with CO Alarms is continuous.

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Stop the Killer – Fit CO Alarms

Thank You

UK HSE Endorsement of CO Alarm Reliability

HSE

Health and Safety Executive

RR847

Domestic carbon monoxide alarms

Long-term reliability and use scoping study

KEY MESSAGES

- Approximately 100 CO alarms, previously used by people in their homes, were tested
- Sensors in CO alarms don't last forever
- Before purchasing a CO alarm, always ensure it complies with British Standard EN 50291 and carries a British or European approval mark, such as a Kitemark.
- Ensure that your CO alarm is correctly located
- Audible carbon monoxide (CO) alarms are a useful back-up precaution, but they are not a substitute for the proper installation and maintenance of combustion heating appliances.

http://www.hse.gov.uk/research/rrhtm/rr847.htm?eban=rss-research .

Approved Document J

ADDITIONAL PROVISIONS FOR APPLIANCES BURNING SOLID FUEL WITH A RATED OUTPUT UP TO 50kW

Carbon monoxide alarms

2.34 Where a new or replacement fixed solid fuel appliance is installed in a dwelling, a carbon monoxide alarm should be provided in the room where the appliance is located.

2.35 Carbon monoxide alarms should comply with BS EN 50291:2001 and be powered by a battery designed to operate for the working life of the alarm. The alarm should incorporate a warning device to alert users when the working life of the alarm is due to pass. Mains-powered BS EN 50291 Type A carbon monoxide alarms with fixed wiring (not plug-in types) may be used as alternative applications provided they are fitted with a sensor failure warning device.

2.36 The carbon monoxide alarm should be located in the same room as the appliance:

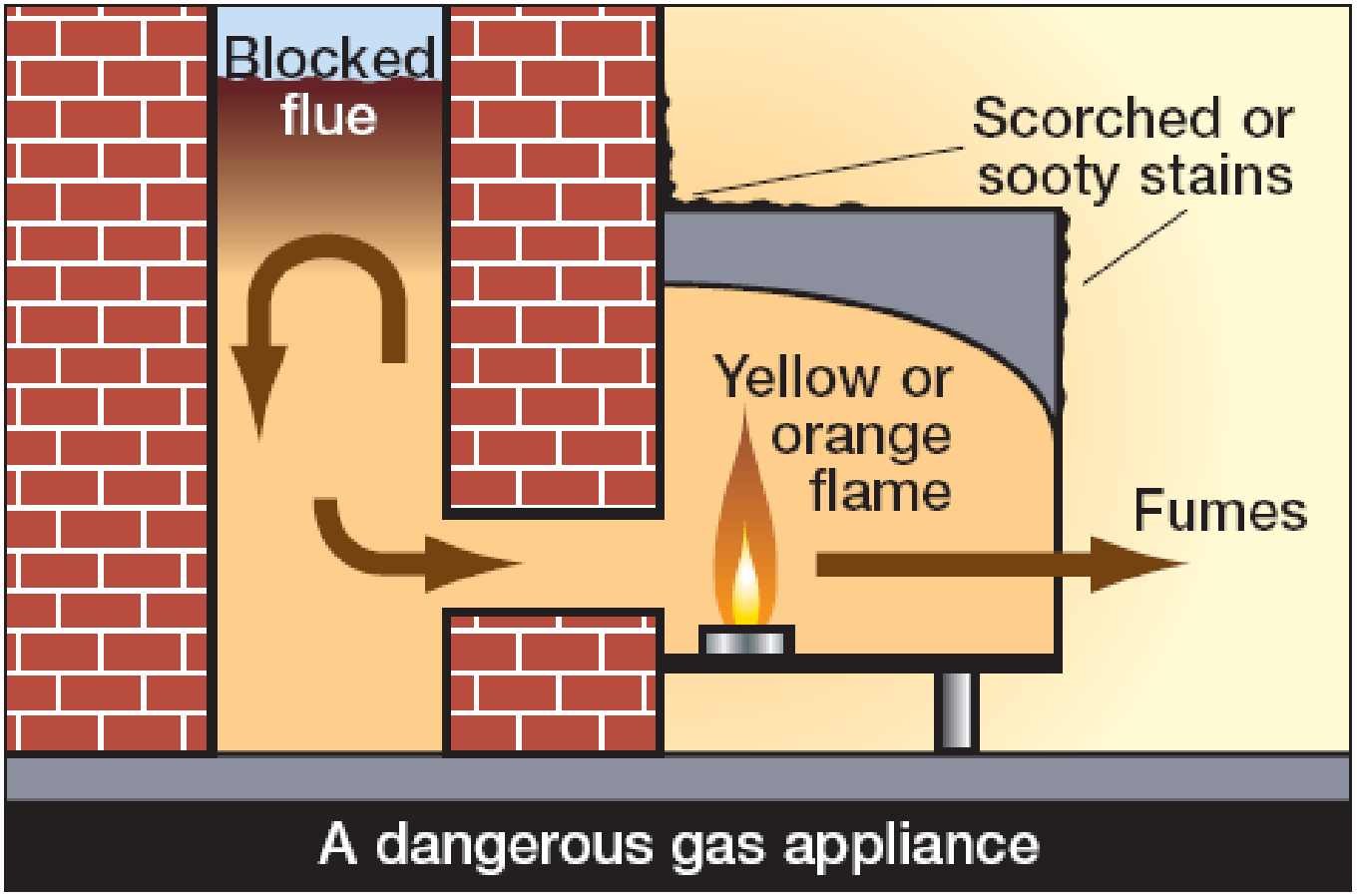
a. on the ceiling at least 300mm from any wall or, if it is located on a wall, as high up as possible (above any doors and windows) but not within 150mm of the ceiling; and

b. between 1m and 3m horizontally from the appliance.

Note: Further guidance on the installation of carbon monoxide alarms is available in BS EN 50292:2002 and from manufacturers' instructions. Provision of an alarm should not be regarded as a substitute for correct installation and regular servicing.

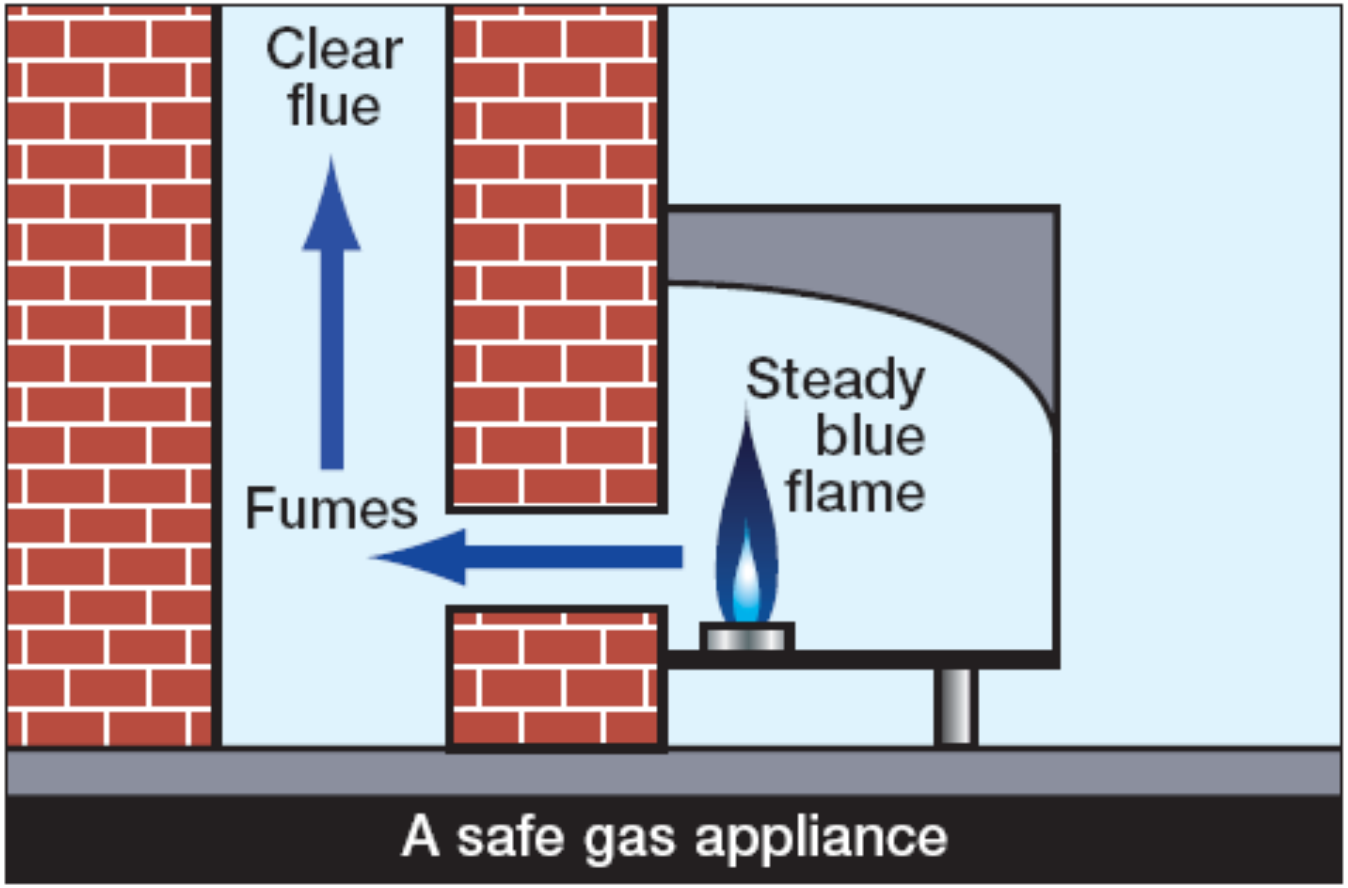
INCOMPLETE COMBUSTION

Carbon Monoxide (CO) + Water Vapour (H2O)



COMPLETE COMBUSTION

Carbon Dioxide (CO_2)+ Water Vapour (H_2O)



CO Health Effects

At 200-300 ppm, can cause fatigue in healthy individuals, and chest pain in those with heart disease.

At higher concentrations, can cause impaired vision and coordination; headaches; dizziness; confusion; nausea.

Can cause flu-like symptoms (*ca.* 250 ppm) that clear up when in clean air.

At 2000 ppm, can be rapidly fatal

Carbon Monoxide (CO)

vs.

Carbon Dioxide (CO_2)

Carbon Monoxide	**Carbon Dioxide**
A byproduct of burning fuels	Gas exhaled with normal breathing
A poison even at low doses	An asphyxiant and poisonous at high doses

Requirements

- EN50291-1:2010
  - General requirements for the construction, testing & performance of electrically operated CO gas detection alarms.
- EN50292-1:2002
  - Guide to selection, installation, use & maintenance of CO alarms.
- SWIFT 8 – NSAI Document
  - Requirements in addition to EN50291-1:2010
  - Mainly the addition of an EOL feature.

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