

What are VOCs?

Volatile Organic Compounds (VOCs) are organic (carbon-containing) chemical compounds that readily vaporise (i.e. transition into the gas phase) at normal indoor temperatures and pressures. Because of this volatility, they can emit from materials, products, or processes as gases into indoor air.

Key characteristics / properties

- They tend to have low molecular weights and relatively high vapour pressures, enabling significant evaporation under ambient temperatures.
- They can be **colourless and odourless** (especially at low concentrations), which means the absence of smell does *not* imply absence of emission.
- Their concentrations are often higher indoors than outdoors because of enclosed spaces and proximity to sources.

Relevance in UK residential and retrofit / extension contexts

In UK house-building, home renovation and retrofit projects, VOCs are relevant because many building materials, finishes, adhesives, sealants, furnishings, paints, cleaning agents, and everyday consumer products contain VOCs or precursors. As homes become more airtight (to improve energy efficiency or meet Part L standards), VOCs may accumulate if ventilation is inadequate.

Furthermore, the existence of published guidance for VOC concentration levels in indoor air in the UK highlights the importance of considering them in design and retrofit.

Health, comfort, and other concerns

- At elevated concentrations (or even modest concentrations over time), VOCs can irritate the eyes, nose, throat, or respiratory tract; exacerbate asthma or allergies; cause headaches, dizziness or fatigue; or in some cases (for specific VOCs) pose more serious chronic risks (depending on dose and exposure duration).
- The health effects vary greatly by specific VOC (e.g. formaldehyde, benzene, toluene, acetaldehyde).
- Because VOCs tend to be “silent” (no smell, no visible sign) under many circumstances, they are a hidden indoor pollutant that ventilation and source control must manage.

UK indoor guideline / benchmark levels

- Public Health England published a review “Indoor Air Quality Guidelines for selected Volatile

Organic Compounds” (2019) which proposes guideline values for certain VOCs.

- In the absence of strong regulation for *all* VOCs, one commonly referenced informal upper threshold is **300 µg/m³ (micrograms per cubic metre) TVOC over an 8-hour period** (though this is a generic guideline rather than a statutory limit)
- Note: these are guideline values, not mandatory legal limits in residential buildings; relevant regulation is generally through ventilation requirements (e.g. Building Regulations Part F) rather than direct pollutant caps.

How VOCs are emitted (sources)

Typical sources in domestic / renovation settings include:

- **Paints, varnishes, lacquers, primers, sealants, adhesives** (during application and curing).
- **Surface treatments:** wood preservatives, solvents, cleaning chemicals, degreasers.
- **Furnishings and finishes:** carpets, engineered wood flooring, laminates, upholstery, manufactured wood composites (e.g. MDF, particleboard).
- **Consumer products:** cleaning sprays, air fresheners, aerosols, cosmetics, glues.
- **Processes:** combustion appliances (especially incomplete combustion), heating, or use of solvents.
- **“Off-gassing”:** slow release from materials even long after installation.

In a newly refurbished extension, for example, freshly painted plasterboard walls sealed with primer and varnish can emit VOCs for days or weeks; without adequate ventilation, residents may experience irritation or odours until levels decline.

Control and mitigation / design implications

To manage VOCs effectively in UK houses and retrofits, a best-practice ventilation-oriented approach emphasises:

1. Source control / low-emission materials

- Select materials and products certified as low-VOC or ultra-low VOC (e.g. low-VOC paints, adhesives labelled to standards such as EN 16516 / ISO 16000 series).
- Delay installation of volatile items until finishing phases or after occupancy (if possible).
- Use sealed containers and careful storage of solvents and cleaning fluids.

2. Adequate ventilation & purge ventilation

- Provide steady background ventilation (trickle vents, positive input ventilation or dwelling-

level mechanical ventilation) so that VOCs are regularly diluted.

- When high-emission activities (painting, gluing) occur, use **pulsed/purge ventilation** (i.e. open windows or boost extract mechanical ventilation temporarily).

- Ensure extract ventilation in wet rooms (kitchens, bathrooms) meets or exceeds requirements of **Approved Document F** for dwellings.

- In highly airtight new builds or heavily insulated retrofits, consider **mechanical ventilation with heat recovery (MVHR)** or **mechanical extract ventilation (MEV)** as permitted in Part F strategies. (The revised Part F of 2022 anticipates stricter ventilation solutions in more airtight dwellings)

3. Commissioning, verification and maintenance

- After installation or retrofit, measure indoor VOC concentrations (if possible) or use proxy parameters, to confirm that ventilation strategies are effective.

- Maintain systems (clean filters, check ducting, ensure fans operate) so ventilation continues at design performance.

- Use continuous or periodic monitoring (sensors) as part of good practice.

4. Occupant behaviour and education

- Educate occupants about opening windows during and after renovation, using extract fans, and minimising simultaneous pollutant-generating activities.

- Schedule high-emission tasks when the house is unoccupied, or ventilate intensively during that period.

Practical example

Imagine a homeowner refurbishing their kitchen: they install new kitchen cabinets made from MDF with laminate finish, apply adhesives, paint walls, lay new laminate flooring, and seal joints. These actions emit VOCs continuously over days or weeks. If the house is tightly sealed, those VOCs may accumulate to discomforting or harmful levels. A best-practice solution is:

- Choose low-VOC or zero-VOC adhesives, paints and laminates.
- After finishing work, run the mechanical extract fan at high rate (or open windows widely) for several hours (purge ventilation).
- Continue with a background ventilation system (e.g. MVHR or trickle vents plus extract fans) to gradually dilute residual emissions.
- After occupation, monitor IAQ or VOC proxy indicators (e.g. CO₂ as a ventilation indicator) and adjust ventilation rates if needed.