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A guide to

Heating & Ventilation in Schools

Interactive contents

10m UK students spend *almost* a third of their lives in **school** Around 70% of that **time** is spent indoors

The need for smarter ventilation

UK schools today house approximately 10 million students who spend almost a third of their formative years in school. Around 70% of that time is spent indoors. This means that, after their homes, classrooms are the most important indoor environment for children, and for their teachers. These heavily populated environments mean children are exposed and vulnerable to air pollutants much more so than when outdoors. Most importantly, they can suffer prolonged exposure to high levels of CO_2.

CO_2 is the primary indicator of Indoor Air Quality (IAQ), and high concentrations are a tell-tale sign that stale air is not being replaced quickly enough in relation to the occupancy levels of the room. Many studies have proved consistently that excessive build-up of CO_2 can result in poor concentration, lethargy, headaches, nausea, aggression and has a significantly detrimental effect on attentiveness, attainment and behaviour too. Studies have concluded that good IAQ is crucial in order to keep students performing to the best of their ability.

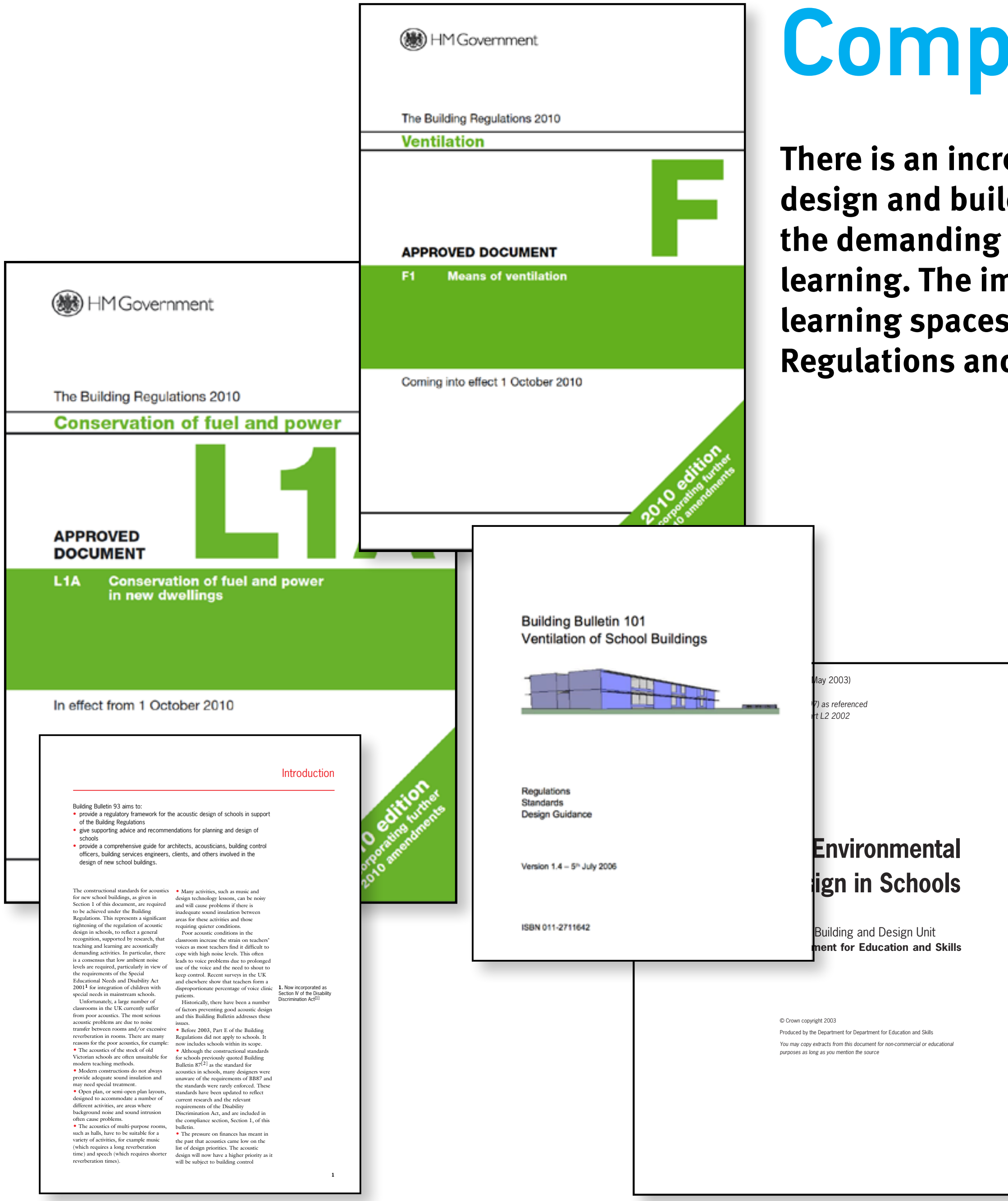
An example of this research was the 2011 study of *"Ventilation Rates in Schools and Pupils' Performance"* by the University of Reading's School of Construction Management and Engineering[1]. The study investigated the effects ventilation – or lack thereof – had in eight different primary schools across the UK. The results provided strong evidence that low ventilation rates in classrooms significantly reduce a pupil's attentiveness and vigilance, and had a negative effect on their concentration and memory.

Unfortunately, all too often teachers (as well as other people) think that simply opening a window is sufficient for increasing ventilation. However, this is not the case. Opening a window lets in cold air during the winter months and noise pollution from outside all year round – not ideal in a situation where children's concentration can be broken by the slightest distraction. Not to mention the possible reduction in air quality from external pollutants.

However if windows are kept closed in poorly ventilated classrooms, not only does the CO_2 concentration build up but high humidity caused by poor air circulation can lead to excessive condensation, thus creating the ideal breeding ground for black mould and dust mites. As these can seriously impact our health, the need for effective ventilation is also crucial in any indoor environment frequented by the vulnerable, such as the elderly or young children, and particularly in schools where children will be spending hours on end.

Finally, in the summer, when good ventilation is necessary to remove warm air and replace it with cooler air to maintain comfortable indoor temperatures, it is also effective for "free" night time cooling. In buildings with high thermal mass, using a ventilation system for night cooling will cool the building fabric; helping to temper rising temperature in the occupied spaces as they warm up during the day. This helps support the temperature control function of a ventilation system and can reduce energy consumption.

[1] Ventilation Rates in Schools and Pupils' Performance (2011) The University of Reading School of Construction Management and Engineering. http://www.deepdyve.com/lp/elsevier/ventilation-rates-in-schools-and-pupils-performance-qGxHygxotG



Compliance is critical

There is an increasing challenge facing schools, and those who design and build them, across the United Kingdom – how to meet the demanding requirement for a healthy environment for optimal learning. The importance of improving indoor air quality (IAQ) in learning spaces now sits alongside the need to satisfy Building Regulations and deliver sustainable, energy-efficient design.

In addition, different local authorities have their own requirements, over and above these national regulations. Firstly though, we must consider all of the regulations that affect heating and ventilation in an educational building project:

General

- Building Regulations Approved Document F (Ventilation)
- Building Regulations Approved Document L (Conservation of fuel and power)

Educational Buildings

- Building Bulletin 87 (Guide for environmental design in schools)
- Building Bulletin 93 (Acoustic design of schools)
- Building Bulletin 101 (Ventilation of school buildings)

Building regulations cover not just new build projects, but also work to existing buildings. One of the most important pieces of documentation is the ‘Building Bulletin 101: Ventilation in Schools (BB101).’ This gives guidance on providing ventilation and avoiding overheating in school buildings, and stems from Part F of the Building Regulations: 'There shall be adequate means of ventilation provided for people in the building.'

Building Bulletin 101: Ventilation in Schools (BB101)

BB101 is also quoted in Approved Document L as giving guidance on how to prevent summertime overheating in schools.

The BB101 guidelines for ventilation in schools are as follows:

The recommended ventilation should be provided to limit the concentration of carbon dioxide in all teaching and learning spaces. When measured at seated head height, during the continuous period between the start and finish of teaching on any day, the average concentration of CO_2 should not exceed 1500 parts per million (ppm).

Where mechanical ventilation is used, enough fresh air must be provided to achieve a daily average concentration of CO_2 during occupied core hours of less than 1000ppm and so that the maximum concentration does not exceed 1500ppm, for more than 20 minutes each day.

Where natural ventilation is used, the system must be capable of providing enough fresh air so that the average concentration of CO_2 during occupied core hours is in the range of 1000 to 1500ppm and so that the maximum concentration does not exceed 2000ppm for more than 20 minutes each day.

Natural ventilation:

Purpose-provided ventilation (i.e. controllable devices to supply air to and extract air from a building) should provide external air supply to all teaching and learning spaces of:

- a minimum of 3 l/s per person (litres per second per person), and
- a minimum daily average of 5 l/s per person, and
- the capability of achieving a minimum of 8 l/s per person at any occupied time.

Mechanical Ventilation

If a mechanical ventilation system is specified, it should be commissioned to provide a minimum daily average of 5 l/s per person. In addition, it should have the capability of achieving a minimum of 8 l/s per person at any occupied time.

In addition to meeting these IAQ regulations, many schools must also meet energy efficiency building guidelines including the Building Research Establishment Environmental Assessment Method (BREEAM) rating specification.

EFA Baseline Designs

The EFA Baseline Designs focus on how at the beginning of the school building design, natural ventilation needs to be considered. It then offers recommendations for certain building designs which utilise natural ventilation on how to offer deliver enhanced IAQ – including classroom, atrium and lower floor designs – thus promoting natural ventilation as the strongest solution to effective ventilation.

While the EFA Baseline Designs strongly support natural ventilation, mechanical ventilation is also proposed, but only when there is insufficient heat:

"A room ventilation unit will provide fresh air to the teaching rooms primarily when the outside temperature drops to the point when the internal loads are insufficient to heat the incoming air to a comfortable condition.

It will be located at high level on the end wall in a bulkhead; access will be provided for maintenance and cleaning. A radiator located on the end wall will provide space heating and out of hours frost protection.

The hall will require a dedicated mechanical ventilation system mounted at roof level. This will incorporate high efficiency fans and heat recovery. CO_2 sensing and absence detection will control the volume according to the occupancy."

School Building Requirements Checklist:

Fresh Air Rates
(if not being controlled based on CO_2 concentration)

- No less than 3 litres per second per person (l/s/p)
- Minimum daily average of 5 l/s/p
- Capability to achieve 8 l/s/p

CO_2 levels

- Average CO_2 levels during normal school hours not to exceed 1500 parts per million (ppm).
- Ability to lower CO_2 levels to 1000 ppm.
- Not to exceed 5000 ppm during the teaching day

Temperature

- Temperature not to exceed 28°C for more than 120 hours during the school year
- Temperature difference between indoor and outdoor not to be more than 5°C in summer conditions.
- Temperature in normal classrooms not to be lower than 18°C – in areas of greater activity, 15°C is considered acceptable.
- Internal air temperatures not to exceed 32°C when rooms are occupied.

Energy

- Mechanical ventilation has weighted average fan power not exceeding 0.8W/l/s
- Demand-Controlled Ventilation aligns energy consumption to ventilation requirements.

Noise

- Indoor ambient noise level for classrooms and general teaching areas not to exceed 35 LAeq, 30min (dB).

Other design considerations

As well as implementing a ventilation system that is capable of achieving good indoor air quality (IAQ) in the most energy efficient way, there are other key considerations that need to be contemplated at the beginning of any project.

Variable Occupancy

A good ventilation system needs to be able to react to varying occupancy rates in classrooms. While regulations are based on 30 pupils per class, plus one teacher and one other adult, this is not always the case with every application. A ventilation system must be equipped with the ability to react quickly to changes in occupancy in order to ensure optimum IAQ and energy efficiency.

Wind Speed and Direction

Some ventilation systems rely on the correct wind speed and direction to provide the intake of fresh air into the space. However, we can't control wind speed and direction and the performance of these systems is, at best, variable and they may not always provide the necessary amount of fresh air.

Controllability

How a ventilation system is controlled has a significant effect on the overall performance of the system. Opting for simply opening the window is often popular due to its perceived low cost and simplicity. However, a teacher's decision as to when the window should be opened or closed is based on his/her subjective opinion rather than any objective data – and just opening a window has been shown to be the least effective form of ventilation.

Fully automatic monitoring and control of the indoor climate saves time and distraction, allowing teachers to concentrate on their pupils, and pupils to concentrate on the task at hand.

Acoustics

It is crucial that in a learning environment, noise is kept to a minimum. This includes the running of a ventilation system and intrusive and distracting noise from traffic and passing pedestrians, which can often discourage teachers from opening windows. A good ventilation system should be quiet in operation as well as attenuating noise from outside.

Costs

Cost is always going to be of utmost importance when considering a ventilation system. When identifying the right solution, it is important to consider whether the system will be able to adapt with future changes to the building – will it stand the test of the time and integrate with future building additions. We must also look at lifetime costs, not just capital cost.

Integrated Heating & Ventilating

When specifying a ventilation system for any application, it is important to ensure that both heating and ventilating requirements are met. In colder weather, a heating system must be able to compensate for the introduction of fresh air at lower temperatures, preferably by tempering that cold air before it is released into the occupied space.

For a cost-effective and energy-efficient solution, an integrated heating and ventilating system should be applied.

Full Demand Controlled Ventilation can also be manually or automatically controlled in relation to CO_2 levels. This can be on a modular room-by-room basis or linked to other control systems via a building management system

How to approach integrated heating & ventilating

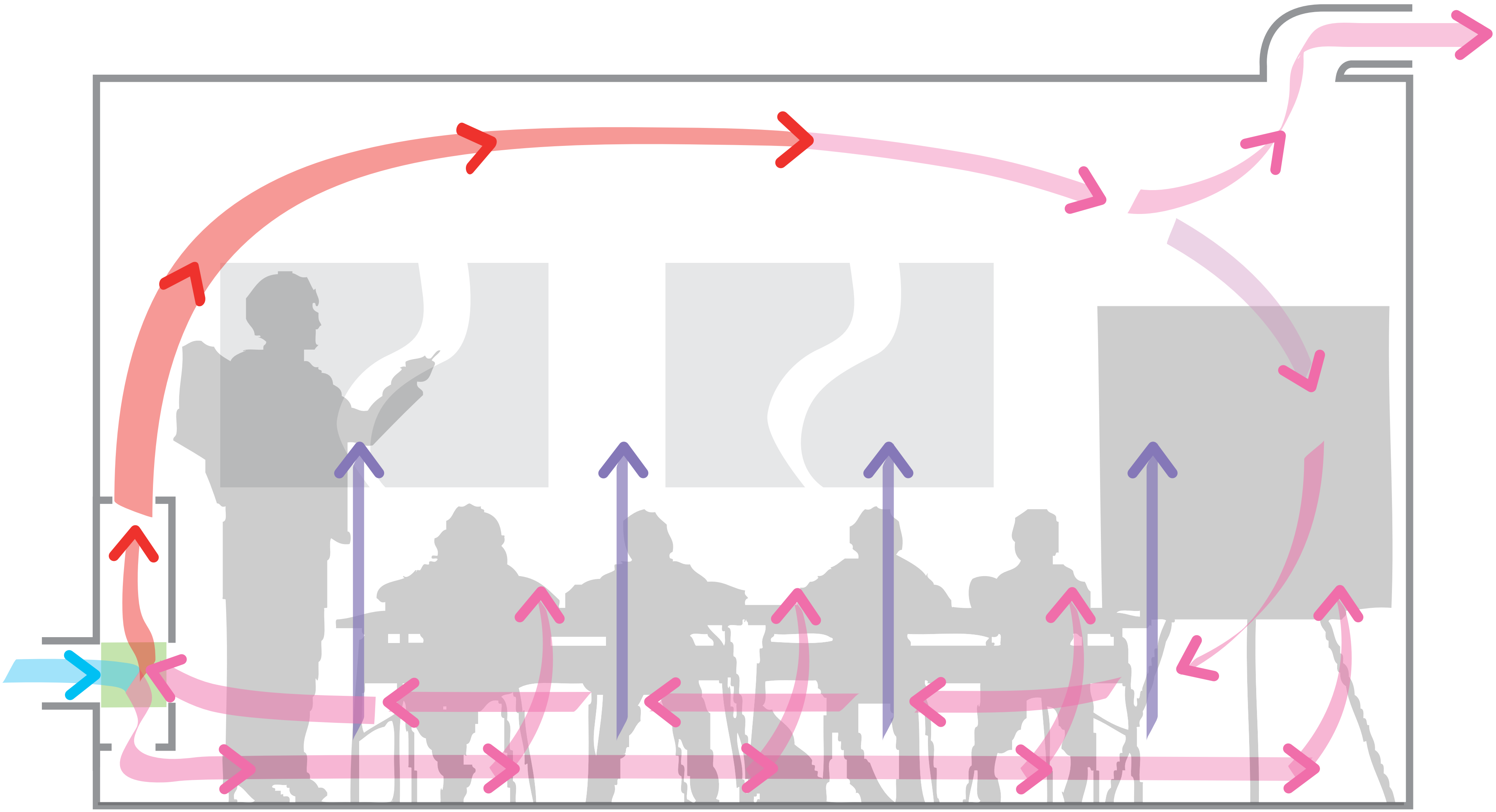
There are three different general approaches to integrated heating and ventilating system design, and each one has its own particular features and components. Here's an overview.

Full Demand Controlled Ventilation

Demand controlled ventilation (DCV) has proved to be the most effective way to meet exacting requirements for optimal indoor air quality and thermal comfort - in an energy-efficient way.

DCV Systems monitor the IAQ of the space and react accordingly. It is also possible to have an manual override to boost the ventilation rate or shut down (temporarily) the zone or the system. DCV systems have been proven to offer the highest levels of responsiveness and efficiency in most situations – however it is important to ensure thorough mixing of air and to avoid short-circuiting of the air flow. This is generally achieved through careful positioning of the extract unit intake grilles on the opposite side of the room from the fresh air intake.

Additionally, whilst the initial capital cost of completely integrated and automatically controlled DCV systems can sometimes be slightly more expensive than alternatives, the costs are quickly recouped through the proven energy savings achieved, leading to lower lifetime costs and of course, whilst not of monetary value, students' attentiveness, concentration, behaviour and attainment will also improve as a result of the improved, balanced IAQ. Ultimately, that's the best measure of all!



As the air is mechanically pulled into a room at low level-tempered **in the heating season** by passing it over a heat exchanger – it displaces stale air, pushing it higher towards the extraction fan. The result is the right amount of fresh air brought into the space exactly when and where it is needed, without cold draughts.

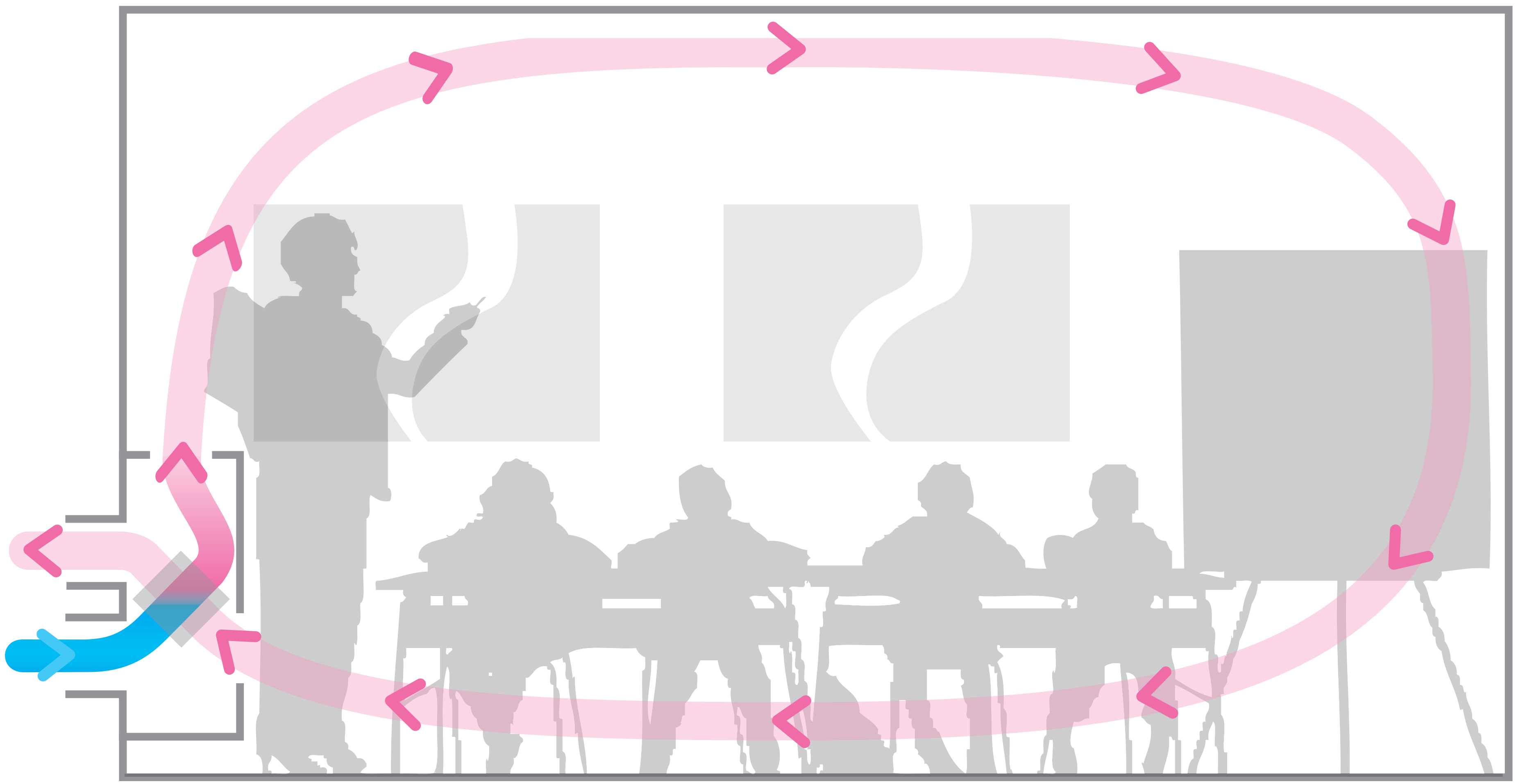
Additionally, because the intake of fresh air is demand controlled, there is no possibility for over ventilation or overheating. The system delivers the precise quantity of fresh air that is needed – and only warms it when required – hence there is no need for an expensive heat recovery system that relies on over-ventilation to operate effectively.

Constant Velocity Mechanical Ventilation with Heat Recovery

A constant velocity system with heat recovery is basically a combined inlet and outlet system that runs at a fixed speed (for example, during school hours), but pre-heats the incoming air using warmth from the extracted air.
While the main advantage of this system is that the energy used to heat the air is considerably less than other systems, it does result in almost certain over-ventilation – therefore using more energy anyway.

Additionally, unless dampers are installed, a constant velocity system does not offer demand controlled ventilation capability – adding to capital and installation costs, and maybe not even providing the required IAQ.

It should also be noted that if a heat recovery unit is directly mounted to the external wall, there is a risk that some of the discharged stale air will be mixed into the fresh incoming air as the two connections will be quite close together.
With a ducted unit the inlet and outlet can be separated to minimise this affect, however the separation will incur greater costs.



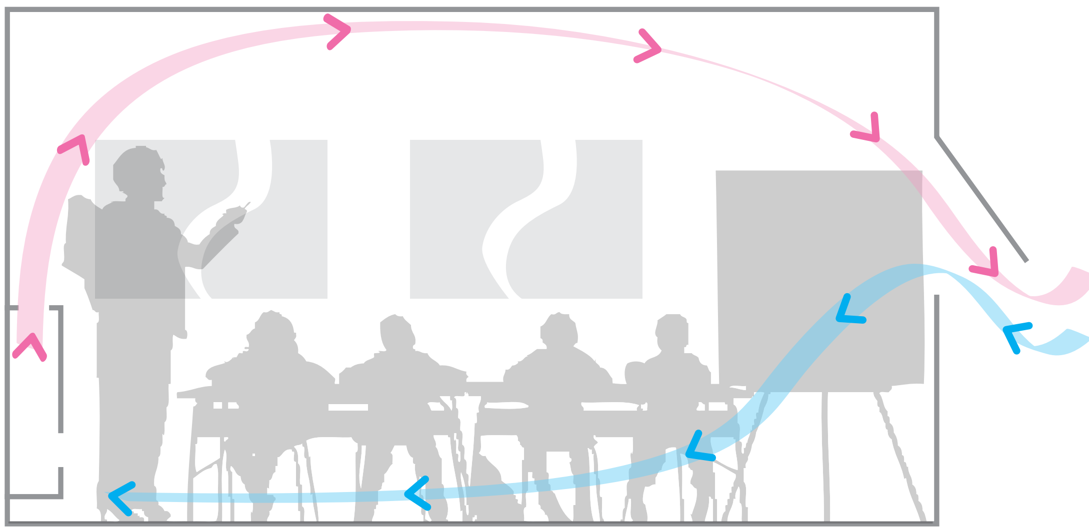
A relatively compact unit with integrated cross-flow heat exchanger is fitted either into the ductwork or directly to the outside wall. It then brings the fresh air in from outside at a rate that is fixed to achieve heat transfer from the outgoing stale air. As the heat exchanger will be designed to perform under a certain set of conditions anything outside of that will result in negligible heat transfer.

The heat recovery unit itself can be large enough to accommodate the entire building, or small enough to just handle one room, depending on the application.

Natural Ventilation

Natural ventilation is often the preferred ventilation system of choice, as there are a number of perceived advantages. Firstly, it is perceived as the most cost efficient option – it costs nothing to open a window, although providing extra opening sashes can be expensive with extra frame and hardware costs. But it is a simple system, easy to maintain and is perceived to operate with low noise levels.

However, as opening the window only provides an inlet, some form of extract system is required to effectively ventilate the space. This will rely on a stack or mechanical extract creating a negative pressure within the space, thereby drawing air in through the open window or natural louvre. This system then in turn relies heavily on two factors:



1. The wind – we have no control over this so it is easy to over or under ventilate as a result of increased or decreased wind speeds or even a change in direction. Over ventilation costs money and reduces comfort in the winter whilst under-ventilation means poor IAQ.

2. The occupant opening the window – again very little control over this as it relies on one person's perception of air quality and thermal comfort, so during the winter windows may well stay closed when they need to be open.

It is possible to lessen the first of these problems by using a mixed mode system, where the inlet is left as an opening but there is a mechanical extract system in place to ensure that low pressure is constant to draw in the fresh air. This can be linked to individual CO_2 control.

To control the second problem, an automatic opening system could be implemented. This could be automatic opening windows or even an opening in the wall with a controlled damper. Whichever method is chosen, some form of control is necessary to ensure that the opening is adequate to allow sufficient airflow and is closed to avoid over-ventilating.

It is important to note however, that as with anything else, once components are added to ensure the system effectively ventilates, costs begin to build. So the initially "cheap" system becomes a lot more expensive and is still not as effective as a full DCV system.

While each system has its advantages and disadvantages, it is crucial for a designer to assess all the options early on in the design phase to ensure the right ventilation strategy is chosen

Ventilation system options

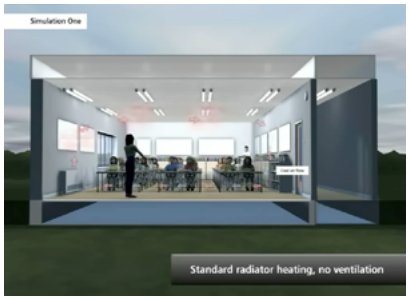
Identifying the best ventilating system for any application can be complex and often overwhelming. Concerns like indoor air quality, energy-efficiency and sustainability are of prime importance and underwritten by legislation and regulations in educational new builds and refurbishments. So it is not surprising that the range of ventilating systems and solutions available has widened.

However, with each different system come different components and control options for ensuring efficient and effective ventilation. While each system has its advantages and disadvantages, it is crucial for a designer to assess all the options early on in the design phase to ensure the right ventilation strategy is chosen for the project.

Below are a series of animations based on tests carried out at our laboratories in Belgium to show the airflow patterns produced by the most popular types of system available to today's designers.

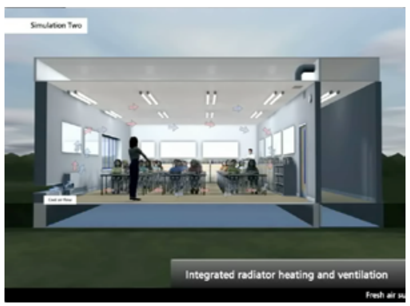
Natural Ventilation

Simulation 1:



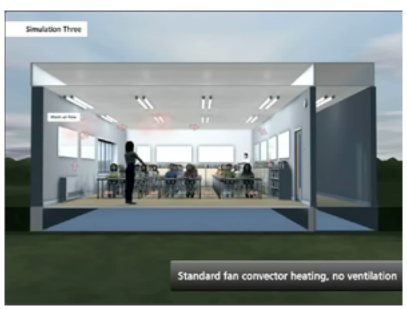
Standard radiator heating – no ventilation

Simulation 2:



Underfloor heating or radiator providing heating and manually opening windows providing fresh air ventilation

Simulation 3:



Radiator providing integrated heating and ventilation. Fresh air supply by natural, unpowered ventilation with high level extract

Advantages

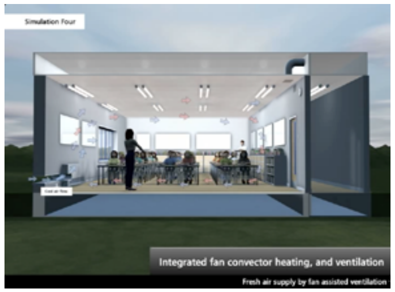
- Perceived as less expensive through manually opening windows
- Simple
- Quiet in operation
- Potential BREEAM points

Disadvantages

- Building compromised with large multiple grille/damper assemblies
- Power supply required if dampers/louvres used
- Limited control
- Performance affected by wind speed and direction
- Limited opening may limit level of summer cooling available
- Potential loss of heated air, wastes energy
- Natural ventilation does not provide effective control of IAQ
- Vulnerable to external noise
- Possible security risk

Powered Ventilation - Fan Convectors with Fresh Air Dampers

Simulation 4:



Standard fan convector heating, no ventilation

Simulation 5:

Fan convectors with fresh air dampers. Fresh air drawn in through air inlet with damper system, using fans in convector unit

Advantages

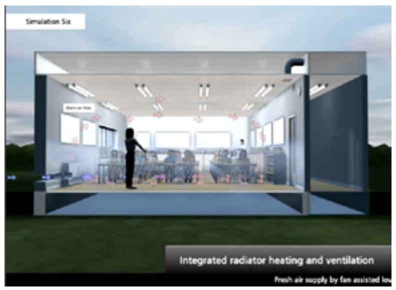
- Simple to use
- Familiar to building services engineers
- Localised control at room level (possible BREEAM points)

Disadvantages

- Basic control options
- Effective mixing with room air requires higher fan speeds, using more energy
- High potential for draughts
- Potentially noisy
- Require large air intakes through building fabric

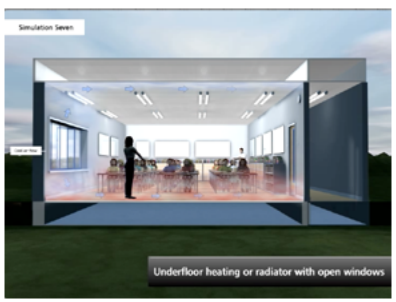
Powered Ventilation - Constant Volume, High Level Supply and Extract

Simulation 6:



Underfloor heating – high level fan assisted supply and extract with heat recovery

Simulation 7:



Radiator heating, central system constant volume, high level supply and extract

Advantages

- Central extract makes easier for maintenance in new build projects
- Potential for heat recovery at extract

Disadvantages

- Potential for poor mixing with room air
- Potentially noisy
- Typically not demand controlled
- Central plant requires additional dampers for local control
- Decentralised plant results in increased maintenance costs

Powered Ventilation - Displacement with Low Level Supply & High Level Extract

Simulation 8:

Low level displacement fresh air supply with high level extract

Advantages

- Low fan speeds, no draughts, low energy consumption, low noise
- Supply and extract rates synchronised to ensure balanced air flows
- Effective mixing of fresh air and room air with no draughts
- Potential for modulating fresh air control in relation to CO_2 levels
- Localised control at room level possible (potential BREEAM advantage)
- Potential links to other control systems, including BMS
- Ventilation operates independently of but in partnership with heating so fresh air can be tempered
- Potential low energy solution (inverter fans/EC motors)
- Graphical display of energy consumption possible
- Secure "free" night cooling directly into the classroom

Disadvantages

- Poor extract design could result in 'short-circuiting' of air flow
- Requires multiple units to achieve sufficient flow rates with low volume and low velocity, thus increasing maintenance requirements
- More expensive than simple fan convectors

DCV components

Demand controlled ventilation (DCV) with CO_2 control and balanced intake and extract has proved to be the most effective way to meet exact requirements for optimal indoor air quality and thermal comfort - in an energy-efficient way.

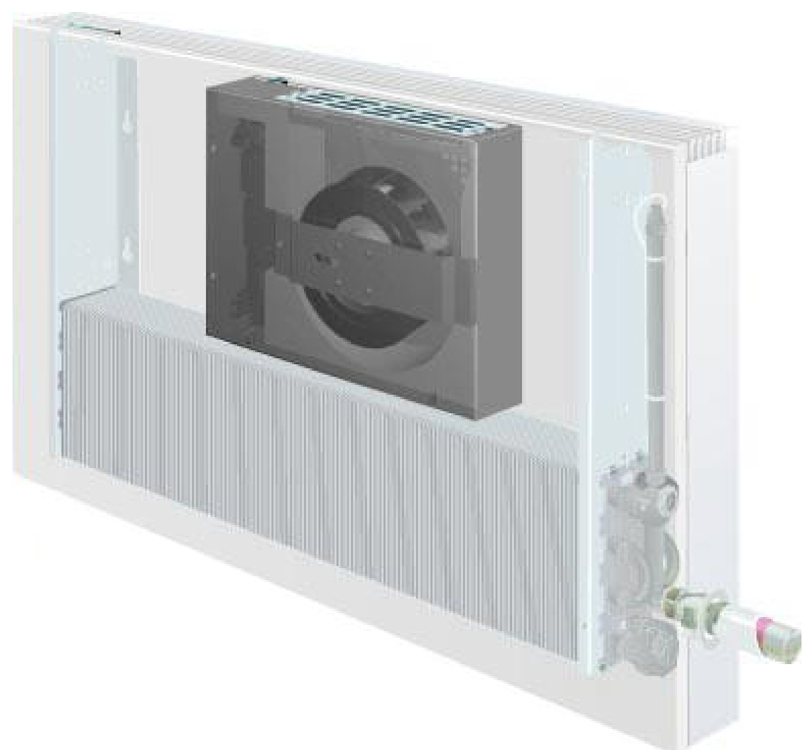
Designed to meet differing needs for optimal IAQ on a room-by-room basis, a good DCV system can allow teachers an override option to briefly boost the flow of fresh air into the classroom, over and above that delivered by automatic operation.

What's more, because it is a fully integrated heating and ventilation solution, any school can benefit from a fresh, healthy and comfortable indoor climate that's conducive to effective learning all year round. This will boost educational attainment.

These are the components that make up a standard DCV system:

1. Low Level Air Inlet Fan

Fully integrated and housed within the radiator, these units draw in the outside air, filter it and supply it into the classroom at a low level to optimise the effect of displacement ventilation.



Depending on particular requirements, multiple units can be installed into each space.

2. Controller

The central controller supplies power and data to all connected components of the DCV system. Sitting at the heart of the solution, the controller continually analyses and reacts to data supplied by each CO_2 sensor around the school to regulate the balanced intake and exhaust of air in each classroom according to individual needs to ensure adequate IAQ in an energy-efficient way.

3. CO_2 Sensor

A CO_2 sensor in each room constantly monitors IAQ by measuring CO_2 concentration and rate of change in the surrounding air and relays this back to the central control system – ensuring appropriate measures are taken.

4. Air Inlets

Each Low Level Air Inlet Fan requires some sort of feed to access the outside air. While air inlets are most common, louvres are also becoming popular due to the less noticeable grill feature on the outside of the building. Additionally, air inlets can feature an integrated open/close damper with an actuator that can be linked to the control system.

5. Manual Override Switch (optional)

A smart switch in each classroom enables teachers to select an override option to briefly boost the flow of fresh air above that delivered by automatic operation. They can use this if they feel it is necessary to help them further refresh a class that appears to be flagging quickly, for example. This also allows for the possibility of local temperature and ventilation control.

6. Exhaust Units

Exhaust units are used to direct stale air outside or into central corridors to provide a degree of heat recovery, if required. The fan curve of the specific exhaust unit is simply programmed into the central controller to ensure accurate control.

In addition to controlling the ventilation, the heating system will also need controlling to ensure that the fresh air coming in is at a temperature that is not going to cause a cold draught. To do this effectively you will also need the following items.

7. Space Temperature Sensor

This component senses the temperature within the space and sends a signal back to the controller to switch on/off the heating circuit. This sensor can be a separate item or more commonly integrated into one of the other components, such as the CO_2 Sensor.

8. Control Valves

Control valves are exactly that; a valve that controls. Once it receives a signal from the controller it will open or close (or even modulate) to allow water flow through the heating circuit, or cooling circuit. This can be fitted to each heating/cooling emitter, or alternatively a zone valve controlling an area (such as two radiators in a classroom).

Oxygen dynamic integrated heating & ventilation solution

Oxygen is a fully programmable integrated heating and ventilation solution that offers complete controllability and operates almost silently to optimise IAQ on demand, and in an energy-efficient way.

Oxygen is an intelligent, modular and scalable solution, which is monitored and managed by a central controller that is fully programmable and flexible enough to respond to differing demands in the years ahead.

The central controller constantly monitors the level and rate of change in the CO_2 concentration in each classroom and will increase the operational speed of the Oxygen refresh units and exhaust units, to ensure the stale air is replaced before excessively high levels are reached.

Fully automatic monitoring and control of the indoor climate saves time and distraction. Because the air quality in each room is regulated independently, each class will be benefiting from the appropriate IAQ for its size and activity at any given time.

Additionally, Oxygen refresh units efficiently insert cooler night time air from outside to lower the internal temperature. In warm weather, it will also be desirable to be able to use the ventilation system for night-time cooling of the building fabric. This provides an alternative to costly air conditioning systems, whilst using a fraction of the energy.

Furthermore, Oxygen can also be used to simultaneously control other building services management systems, such as heating, thus helping achieve further significant cost savings.

Oxygen Natural Ventilation Solution

Oxygen Natural ventilation offers some of the benefits of the Oxygen Dynamic ventilation, sacrificing some controllability and night cooling functionality.

The Oxygen Natural ventilation option automatically monitors CO_2 levels to optimise IAQ in every classroom, but it achieves this through the use of controlled air inlet dampers rather than Oxygen refresh units. In this system, when the central controller receives data from a CO_2 sensor suggesting that the flow of fresh air needs to be adjusted, it will act to open or close the inlet damper to suit the ventilation demand.

A motorised damper on the natural extract can then be opened or closed, or an extract fan operated, to facilitate the removal of stale air from the room.

A truly tailored approach

Whether it is a small renovation project or a sizeable new-build, we can provide the right advice for any project and equip you with a simply smarter solution for a beautifully controlled indoor climate. At Jaga, we are committed to supplying the best possible solution for your requirements – an intelligent, integrated solution that satisfies all regulatory requirements, stays within the project's budget and provides a great outcome for the client.

Although Oxygen is a one-stop solution that will always meet any integrated heating and ventilating needs, it is far from a boxed system. We will always adopt a truly tailored approach to make sure the solution we supply is carefully considered and specified to suit your particular project.

The Jaga team will work closely with clients and with the design and construction teams from the conceptual stage through to handover and after with remote monitoring, acting as expert advisors and consultants to determine the most practical configuration for your school – one that will deliver the best possible benefits in the years ahead.

Jaga's Low-H_2O equipped radiators

Our low-H_2O radiators are low-mass, low-water content products which require only a tenth of the water and weight of standard panel radiators. Faster response means better comfort and lower fuel bills, plus reduced CO_2 emissions add greater all-round energy-efficiency to help designers, engineers and contractors reach carbon reduction targets.

Oxygen works seamlessly with the following Jaga Low-H_2O radiators:

Strada

Powerful, attractive and modern

Maxi LST

Tough, low temperature casing and exceptional performance

LOW H_2O

Tempo LST

Safe to touch, yet powerful in heating

Guardian LST

Jaga's all new LST with one-piece casing

Play

Heating with colour!

Knockonwood

Nature's beauty, Jaga's power

Cocoon LST

Slim-line and safe

SEE PRODUCTS ONLINE

Our Project Experience

To see recent examples of Jaga's Oxygen technology being used in educational applications please take a look at these case studies:

- Stockwell Primary School

- Haydon Wick Primary School

- Shrewsbury Lodge School

- Torquay Girls Grammar School

- James Aiton Primary School

SEE CASE STUDIES ONLINE

Links to further resources

Jaga's Quality Assurance

Jaga is committed to ensuring all our heating and ventilation solutions meet the highest levels of quality, allowing our customers to have complete confidence in our products. Jaga has been assessed and approved by the global assessment and certification organisation QMS International plc. For more information, including the quality management systems, standards and guidelines **click here**.

Jaga Oxygen website **jaga.co.uk/technology/oxygen**

For more information about our Oxygen heating and ventilating solutions, visit our website, or **click here** to download our Oxygen booklet.

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For sales and all other enquiries please phone **01531 631533** or email **jaga@jaga.co.uk**

Technical Support

Jaga is committed to supplying full after-sales support.

Technical Enquiries **0845 250 7251**

For technical enquiries regarding the selection or installation of Jaga products

Monday–Thursday 8.30am–5.00pm and on **Fridays 8.30am–4.00pm**

Please note that this number is for UK customers only