The Unico System®

3-in-1 heating, ventilation & cooling solution

WHITE PAPER | JANUARY 2023

Reduced humidity, improved indoor air quality, building preservation and optimum living space:

An all-in-one heating, ventilation and air conditioning system (HVAC)

Warm in winter. Cool in summer. Always beautifully fresh, filtered air.

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Introduction

This white paper looks at the relative performance of traditional air conditioning systems in comparison with Unico small duct high velocity (SDHV) technology. It highlights the importance relative humidity in the specification of air conditioning. It further discusses the advantages of Unico as an all-in-one system that addresses the control of humidity and the provision of efficient ventilation, cooling, heating and filtered air.

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Background

According to provisional statistics from the Met Office, in 2022 England had its joint hottest summer in a series which runs from 1884. Four of the five warmest summers on record for England have occurred since 2003 as the effects of human-induced climate change are felt on summer temperatures. (Press Release 1 September 2022. https://www.metoffice.gov.uk/about-us/press-office/news/weather-and-climate/2022/joint-hottest-summer-on-record-for-england).

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In July 2022 five weather stations from London to Lincolnshire reached 40 degrees centigrade or more. Nights were exceptionally warm with records being broken and 28.5 degrees centigrade being recorded overnight in Surrey. The Met Office went on to say that under a high emissions scenario we could see temperatures in the future exceeding 40 degrees centigrade as frequently as every three years. The UK will have to adapt to these extreme events. (https://blog.metoffice.gov.uk/)

Whilst in the UK fixed air conditioning systems are not currently commonplace, there is no question that these changes in our climate mean that they are likely to be much more in demand than ever before.

PAS 2035 and the heat buildings strategy

PAS 2035 is a specification for what is called ‘whole house’ or ‘whole building’ retrofit. This is an approach to the installation of energy efficiency measures (EEMs) which takes into account the requirement of the entire building, both from a technical standpoint and considering factors like occupancy comfort.

The Heat and Buildings Strategy sets out the UK government’s plan to significantly cut carbon emissions from the UK’s 30 million homes and workplaces in a simple, low-cost and green way whilst ensuring this remains affordable and fair for households across the country. (https://www.gov.uk/government/publications/heat-and-buildings-strategy).

Unico and the USA

In the United States, 90% of homes are using some form of air conditioning according to data released by US Energy Information Administration (EIA). In comparison, less than 10% of households in Europe have an air conditioning unit. But that is expected to increase as a consequence of extreme summer temperatures. Quartz , July 2022 (https://qz.com/2190842/nearly-90-percent-of-american-homes-are-now-using-air-conditioning).

Considerable research has been undertaken in the United States into the effects of humidity on well-being and on how air conditioning systems are able to counteract its effects inside the home. Small Duct High Velocity systems (SDHV) designed and manufactured by Unico System are already employed in 1000s of installations throughout the United States to provide highly energy efficient air conditioning as well as heating and ventilation. It counteracts the effects of humidity and addresses the issue of indoor air quality (IAQ). It is a system that offers significant advantages over conventional air conditioning systems.

In the United States, Unico Inc. has a manufacturing facility with over 100,000 square feet of manufacturing and storage space with sales operations in North America, the UK and Europe, Africa, Central and South America, India, and China. The company is considered the leader in Small Duct High Velocity (SDHV) heating and cooling systems with over 25 years’ experience. Unico led the effort in getting SDHV systems approved as a class of product with the US Department of Energy. Aligning with other major HVAC manufacturers, conservation groups, and other industry partners and influencers, this designation was granted in 2004 to recognize SDHV as its own classification of product.

Unico and the UK

In the UK, Unico System is represented by Richard Soper CBE and through Bell Plumbing Supplies Limited as the national distributor, together with a UK-wide network of Unico Specialist Partners (USPs) covering installation, commissioning and other expert services.

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Addressing humidity and indoor air quality

If not controlled properly, humidity, together with indoor air pollution, negatively affects the health and comfort of a home’s occupants. It can also be detrimental to the fabric of the building and its components. This makes finding ways to reduce humidity and improve indoor air quality (IAQ) in the home so vital. In addressing this issue it is important to understand the concepts of relative humidity and related indoor air pollution.

Relative humidity is a measure of the water vapour content of air expressed as a percentage of the maximum water vapour that the air can hold. This measurement affects the how we “feel” temperature, making it an important indicator for the level of comfort in the home. Optimum comfort is between 45-55% relative humidity (RH) and above 60% the air feels muggy. When relative humidity is high on a summer’s day, the prevailing temperature may feel a few degrees higher. So when it sometimes feels stifling indoors on a summer afternoon – even when an air conditioning system is running – humidity is the likely culprit.

Humidity makes us feel uncomfortable because when it’s hot, our bodies release heat through our skin. But if it’s too humid, sweat does not evaporate, trapping heat on the body, leaving clothes feeling damp as they absorb the sweat instead.

Research In the United States conducted by the renowned Mayo Clinic recommends achieving an indoor relative humidity between 30% and 50%, which is ideal for reducing the risk of certain health problems. According to Mayo Clinic, “high humidity can make your home feel stuffy and can cause condensation on walls, which can trigger the growth of harmful bacteria.”

When talking about the quality of air inside buildings, the key factor is how it can affect the health and well-being of the occupants. An increase in the number of people suffering from respiratory problems, coupled with recognition that there can be two to five times more pollution indoors than outside, means that IAQ is under more scrutiny.

Furthermore, new build homes are highly energy efficient, better insulated and more tightly sealed than ever before. There are already instances of new properties requiring some means to alleviate humidity and provide cooling in upper floor bedrooms overnight and in some cases even at ground floor level.

If this is not addressed, lower indoor air quality will result in the creation of an environment for trapped contaminants to have a negative impact upon health especially for those who have allergies, asthma, other breathing difficulties or suffer from immune system problems.

A lack of ventilation can also result in damage to the building fabric itself as the effects of humidity and condensation can lead to mould growth on walls and window frames leading to long term problems.

SHDV systems, traditional air conditioning and relative humidity

Conventional air conditioning systems optimise home comfort in terms of temperature. When it is warm and muggy, conventional air conditioning systems deliver cool air into a room at around 15 to 18 degrees centigrade until the thermostat detects that the room is at the desired temperature. Then the cooling shuts off while the system enters a cycling mode that moves the air around the home but does not remove humidity. (This is for conventional air handlers which operate at 188.7 litres per second).

This is why many homeowners with conventional systems complain about being uncomfortable even when the thermostat shows that the home is at the set temperature. Typically, they manage their discomfort by turning down the thermostat. Even with conventional systems that have high Seasonal Energy Efficiency Ratio (SEER) ratings, that means the AC system runs more often, using more energy.

A Unico Small Duct High Velocity (SDHV) system operates at around 141 litres per second. (Mini-splits are in-between although maybe closer to conventional than SDHV conditions). The air conditioning mode of the system removes more humidity from the home and optimises for ideal comfort, not just the temperature set on the thermostat. The air handler operates with lower airflow and has thicker cooling coils than those found in conventional systems. It may seem like a small difference, but circulating air sits on the cooling coil longer in a Unico System.

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The principles of SDHV technology

A Unico SDHV system works like other central air systems but has significant differences and benefits. Air is distributed through small flexible ducts that can fit almost anywhere. They connect to a main duct in the loft or between floors. The ductwork is optimised for low noise and maximum efficiency.

Ductwork installed in unconditioned areas will reduce system efficiency. This is often a big problem with large conventional ducts. If the ducts are inside the conditioned (insulated) envelope, duct efficiency is not a big issue other than possibly uneven temperatures. Small ducts are obviously easier to locate inside the conditioned space. Similarly, duct efficiency is not an issue for mini-/multi-split units.

Putting values to duct efficiency:

Conventional air conditioning system: 70 to 85% efficient and sometimes as low as 60% if significant leakage occurs from improper installation.

Unico SDHV system: 85 to 95% efficient based on installation practice.

The air handler has a smaller footprint and can be conveniently located out of the way in a loft, utility room or cupboard. The system works by aspirating stagnant air with small jets of conditioned air that eliminate drafts and cold/hot spots in the living space.

The system's coils are designed specifically to remove significantly more moisture/humidity for a drier home when cooling. The system is very flexible using a range of coils (heat exchangers) and depending on the heat source provides a number of options for heating. This makes the Unico System an ideal match with air-to-water and F-Gas heat pumps.

SDHV duct efficiency:

85-95%

based on installation practice

Unico delivers cool air at around 11-13 degrees centigrade which improves efficiency. It continues to optimise for both temperature and humidity to maintain the homeowner's level of comfort. When homes with conventional systems start to feel muggy, homeowners use the thermostat to turn down the temperature to get the air conditioning system to run again.

On the other hand, by optimising for comfort instead of temperature, Unico System users save on their energy bills in the long term as they can set the thermostat two to three degrees higher and never need to manually change the temperature on days when it's really hot or humid.

In the United States significantly more research has been undertaken on the comparative performance of SDHV systems and conventional air conditioning. The results from a Florida Solar Energy Center study found that a Unico Small Duct High Velocity System (SDHV) provided an average relative humidity of 41.2% in comparison to a level of 54.3% when employing a conventional air conditioning system (within the home). Unico was shown to remove around 30% more humidity.

This is achieved due to evaluation of Unico's moisture control capability revealing that its coil removed more humidity from the home than both centrally ducted systems and ductless multi-split systems.

In the UK, SDHV systems provide a significantly more comfortable-feeling heat because of the air distribution system. Similar to cooling, when in heating mode, a SDHV system has a greater temperature rise. This provides a warmer sensation in the room. In addition, the air registers for a SDHV are located in positions that mean air is not blowing directly onto the occupants unlike conventional central air registers.

Unico coils are designed to remove significantly more humidity to create a drier home – up to 30% more than conventional air conditioning and heating systems. Unico is very flexible and with its hot water coil provides a number of options for heating, enabling homeowners to dispense with traditional radiators and underfloor heating.

Air systems are faster reacting than radiant systems so will maintain more precise control and have less over/under heating. Typically radiant allows for lower room temperatures but only if the radiator is in direct line-of-sight of the occupants. More or less, like a campfire. Air systems keep the air mixed and radiant effects are not important if the building is properly insulated and sealed; therefore, precise control is more advantageous.

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Homeowners and better indoor air quality

As companies increasingly move away from full-time offices and more to a work-from-home schedule, more of us are aware of the need for home comfort, including indoor air quality (IAQ).

According to the United States' Environmental Protection Agency (EPA) (www.epa.gov/indoor-air-quality-your-home) a large step to improving the air quality of a home means preventing mould caused by moisture. Moulds produce allergens, so if someone in the family has allergies or asthma, lowering relative humidity may help reduce allergy triggers.

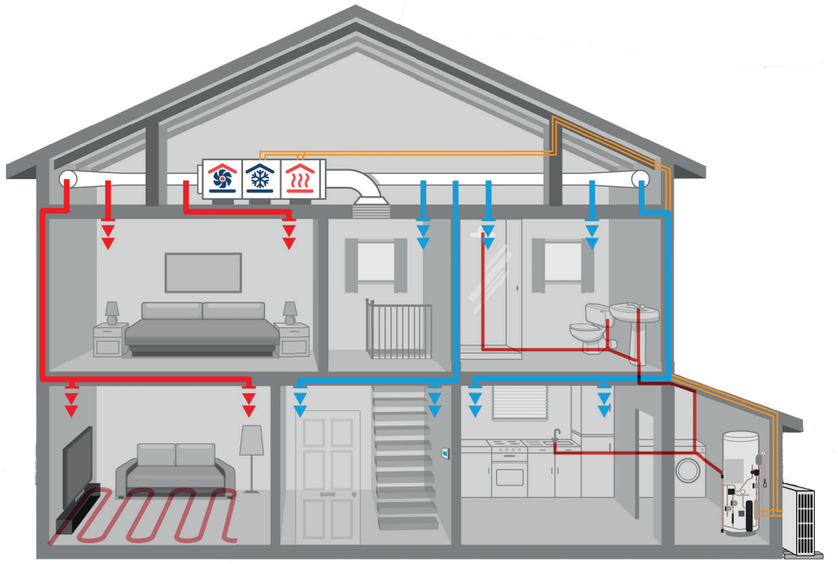
According to The Buildings As Safe Havens Guide published by Building Engineering Services Association (BESA), " it is not surprising that reducing the risk of fires is the primary focus.....but in truth, it is likely that the poor standard of building ventilation can be linked to many more deaths. Covid-19 was shown to be transmitted through the air. Even if only 10% of all Covid-19 related deaths could be directly attributed to the failure to adequately ventilate indoor spaces, that would be more than 15,000 since the start of the pandemic - a shocking statistic that should make everyone sit up and take notice." (https://www.thebesa.com/news/besa-launches-safe-havens-blueprint-for-air-quality/)

It would appear that the easiest way to ventilate a home is to simply to open a window or two. Whilst that may be feasible in the summer, assuming urban noise pollution and safety is not a problem, it is not a viable solution if polluted air from the outside is let in and expensively heated indoor air is going out. Another simple approach would be to use room extract fans to remove some pollutants but these too suck out the heat.

Controlled ventilation technologies are being incorporated more and more into new homes from the outset. They can use low carbon and renewable sources of energy. Some can also be used within property renovation projects. A mechanical ventilation system with heat recovery (MVHR), central extraction, passive ventilation systems, displacement ventilation and central extraction can all be considered, dependent upon the property and application.

Typical MVHR systems bring in only a small amount of air and only the outside air is filtered. Whereas a central air system not only brings in outside air, it also recirculates significantly more. All of which can easily be filtered. Mini-/multi-split systems have minimal filtration and no outside air ability. Also, it should be noted that bringing in filtered outside air is the primary purpose of ventilation systems. Adding a heat recovery option is an attempt to improve efficiency not indoor air quality. The level of savings is highly dependent on the difference of temperature between the indoor and outdoor. For ventilation-only systems without recovery, it is easy to show there is a reasonable payback for recovery.

However, for a central air conditioning system, bringing in outside air is essentially free (fan



is already running) so recovery has a much smaller payback if at all.

When it comes to air purification, choosing the right filtration depends on specific needs and the ability to capture particles. Solutions include standard and electrostatic filters, HEPA filters that can trap 99.97% of all particles larger than 0.3 microns, ultra-violet technology that is often used in conjunction with a particulate filter system and bipolar ionisation technology that can actively seek out and kill bacteria and viruses including Covid-19.

However, none of these approaches offer an holistic approach to IAQ and climate control. A complete strategy would also consider the heating and cooling solution, keeping room temperatures even for maximum occupier comfort and controlling humidity which, as we have seen, plays a major role in IAQ.

Unico SDHV technology does provide a complete solution. As a central air distribution heating and cooling system, it has the lowest temperature fluctuations (no greater than 1 degree C floor to ceiling). Temperature throughout a home is highly dependent on design and installation and would be around 2 degrees C when properly adjusted and, if necessary, zoned. It gives the option to upgrade to the highest standards of air filtration and provides an easy means to add UV light air disinfection. It can integrate ventilation control and removes humidity to prevent the formation of damp and mould which can produce airborne toxins.

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Preserving heritage properties and architectural features

In historic or heritage homes, indoor humidity is often the enemy of preserving some of their most important architectural features. After prolonged periods of high humidity, wooden floors, doors and window frames can swell and warp. At best, summer brings frustrations

as floors get creakier, and windows and doors get stuck more often. At its worst, humidity can lead to expensive repair bills and reduces the value of these properties.

In the United States, Unico's SDHV system is widely specified for installation into such properties. The Unico System has been chosen by the renowned This Old House TV programmes for more than 40 projects over the last 24 years. Its small, flexible ducts can be installed without tearing up or damaging walls. That means homeowners don't need to choose between lower humidity and personal comfort or preserving a home's unique character. For added aesthetic value, Unico's discreet room outlet covers can match the finish of any wall, ceiling, wood floor or architectural feature.

In Washington DC, the National Trust for Historic Preservation (NTHP) recommended Unico for President Lincoln's Cottage in Washington, D.C. Installing a standard central air conditioning system would have required removing portions of the ceilings, walls and floors to make room for the bulky metal ductwork. Thanks to Unico's flexible tube ducts, the remodelling team added an air conditioning system that removed the humidity threatening the presidential character of the home without tearing into one wall or pulling up a single floorboard. Today, visitors get to experience the museum as an accurate recreation of what it looked like when Lincoln drafted the Emancipation Proclamation there.

For an historic barn in Berkshire UK, Unico was specifically chosen to provide a heating only solution for all rooms on the upper floor which would not compromise the architectural integrity of this historic building. Due to the age and construction of the property, the installation of a conventional heating system was not possible and the owners wanted to maximise the limited wall space available for furniture.

The solution featured a 14kW Unico System installed throughout the loft area to provide heating to three bedrooms, the hallway gallery and a small annex with an additional bedroom and kitchenette. The flexible supply ducts connected to discreet, ceiling mounted outlets provide the perfect comfortable environment to the entire upper floor. The Unico System is connected to an Air to Water Heat Pump which provides energy efficient renewable heating.

The system provides individual temperature control to three separate zones with variable speed operation. The Unico System's EC fan motor along with the heat pump provides extremely low running costs in this off-grid location.

Maximising a home's living space

In the United States, Wade Paquin, host of Building on an Island from The Build Show Network, has said that Unico's dehumidification properties help maximise living space for his clients. The owners of the custom-built home on the show wanted to utilise a previously damp basement. Humidity was a major concern and the previous home that stood here had major issues with moisture and mould. Paquin was asked to ensure that this ground-level, walk-out half-basement was not going to have those same issues. Installing a Unico System helped the homeowners manage humidity levels by mitigating excessive moisture.

Unico's air handling unit is compact enough

to fit into attics, crawl spaces or any out-of-the-way space to reduce its footprint in the home.

The simple modular design of the Unico System enables the selection of the optimum system according to a user's lifestyle and budget. It is the perfect option for any new build property or self-build project where the system can be designed to fit perfectly within the fabrication of the building. It is also an ideal solution for top floor installations in the retrofit market where loft space is available.

Across the UK there are thousands of bungalows within local authority or social housing associations. The loft space is usually clear and the Unico System is a perfect solution for the retrofit market as minimal disruption is required.

Discreet room outlets allow homeowners to make maximum use of available internal walls and dispense with unsightly radiators so that furniture arrangements can be optimised and

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the most is made interior living space.

For an existing off gas one bedroom traditionally built bungalow, Mid Devon District Council wanted a system that would deliver efficient, high-quality heating, cooling and ventilation. The system needed to be controllable, efficient, simple, effective and affordable. The installation was required to be scalable, in terms of application and value whilst addressing issues of ventilation, indoor air quality and possible overheating within the property.

For this project, the Unico SDHV system was selected based on its innovative design and delivery of conditioned and enhanced indoor air quality. It integrates a humidistat controlled MEV and maintains an exchange of fresh air to the property. It had the added advantage of being able to locate the distribution system in the roof space.

The longer term operational benefits include the price point, the integration of known technologies (ASHP) and the potential for future installations to be delivered. The enhanced environmental controls maintain healthy households, reducing pressure on the local NHS and GP surgeries. The system is also expected to be fundamental in helping with the reduction of disrepair claims as a result of damp and mould.

Selecting the best HVAC system

Today, air conditioning is taken for granted in every new car. It keeps us cool, it keeps us alert on the road and yet twenty years ago it was a luxury item. If the technology is readily available to keep us cool on the road, then there is no reason why it should not be available in our homes to provide similar climate control and improved comfort. This is especially so with the very real prospect of much warmer summers in the future.

Yet, not all HVAC systems are created equal. Technology from conventional HVAC systems for the home and the workplace has not essentially changed for decades, which means these products are not best positioned to be a long-term solution for meeting new challenges in heating and cooling caused by environmental factors as well as the need to take full advantage of renewable technologies.

In the United States, the FSEC predicts that conventional ducted air conditioning will continue to fall behind as building engineering technologies continue to improve. Homes are becoming tighter with less energy loss, reducing the amount of energy needed to cool a home. This is increasing the periods of low-load cooling, where a variable-capacity system such as Unico will be the only type of system with the ability to reduce relative humidity sufficiently. Unico is also already ahead of the game by employing a heat pump, reducing or eliminating homeowners' reliance on natural gas or oil-burning boilers that use fossil fuels.

The Unico System has features and benefits that other ductless mini split air conditioning systems and conventional air conditioning systems do not have. Whether building a new, modern home or looking to preserve a traditional home, because of Unico's ability to reduce relative humidity levels significantly, occupants feel more comfortable at higher thermostat settings, allowing for reduced operation and resulting in considerable energy savings.

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Conclusion

Changes to the UK's climate mean that inevitably air conditioning systems will be in greater demand. Specifying the right type of system must take into consideration a number of factors, including the need to ensure control of humidity. Research has demonstrated the effectiveness of SDHV technology. As an all-in-one solution for heating, cooling, ventilation and air filtration, it offers significant advantages to homeowners not only in terms of personal comfort and indoor air quality, but also through the practical benefits of building preservation and interior design considerations.

Contact details

For questions relating to this White Paper, please contact Maddie Brighton, Marketing Manager at maddie.brighton@unicosystem.com.

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About The Unico System

The Unico System has been established in the USA since 1985 and is the market leader for heating, ventilation and cooling systems. The system is the chosen technology for climate control in around 350,000 American homes.

In the UK, since 2018, The Unico System is represented by Richard Soper CBE, in partnership with Bell Plumbing Supplies for sales and distribution.

Richard is a Past President of the CIPHE (1995) and an active member of the Construction Products Association (CPA). He is also a recipient of the British Renewable Energy Association's (REA) highly prestigious 'Champions Award' (2008) and the International Ground Source Heat Pump Association's (IGSHPA) Ambassador Award (2015). Furthermore, Richard became a CBE (Commander of the Most Excellent Order of the British Empire) for services to the heating and renewable technologies industries in 2013.

Richard was Managing Director and Chief Executive Officer of Bosch Thermotechnology (including the Worcester, Bosch brand), alongside numerous international roles at board level.

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