

# Dirty ventilation needs an airing

**T**he very ventilation or air-conditioning system that is intended to ensure a good standard of indoor-air quality can introduce all manner of undesirable substances. Peter Bateman considers the problem.

Well designed, carefully installed and professionally maintained air conditioning is undoubtedly a blessing to mankind. However, if any one of these three factors is wrong, air conditioning can create more problems than it solves. Of the three, professional maintenance is usually the weakest area.

### Pollutants

Air drawn into a building from the outside may carry a range of airborne pollutants which need to be filtered out. In addition, its temperature and humidity may need to be modified to provide the required environment within the building.

**"The ventilation ducting constitutes by far the largest part of any air-conditioning or ventilation system, and yet it is often the most neglected"**

The filters, humidifiers, and cooling and heating coils necessary to achieve this control are often housed in a single air-handling unit. Each of the processes intended to alter the characteristics of the air provides opportunities for reduced hygiene standards if maintenance is neglected.

Clogged or damaged filters will not function efficiently. Filters cannot be installed once and then forgotten; regular inspection and cleaning is essential. The use of portable instruments to measure air pressure and flow rate can help the working efficiency of a system. Filter manufacturers and suppliers must be consulted and give firm advice on the maintenance needs of their products.

Air intake grilles also need to be checked and

cleaned regularly, and damaged units replaced.

The process of humidifying incoming air has led to the development of a wide range of

humidifier types.

Designs that use cold water to introduce moisture into the airflow require particular attention. The dirty and

moist conditions often found, can allow microbes to flourish in humidifier trays and on the filter material itself. Microbial material blown into the

airstream from clogged humidifier filters is thought to be a prime cause of humidifier fever. Humidifiers have not been implicated in

outbreaks of Legionnaires' Disease, but the regular inspection, and, where necessary, cleaning and disinfection of humidifier

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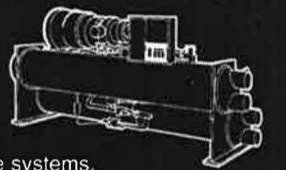
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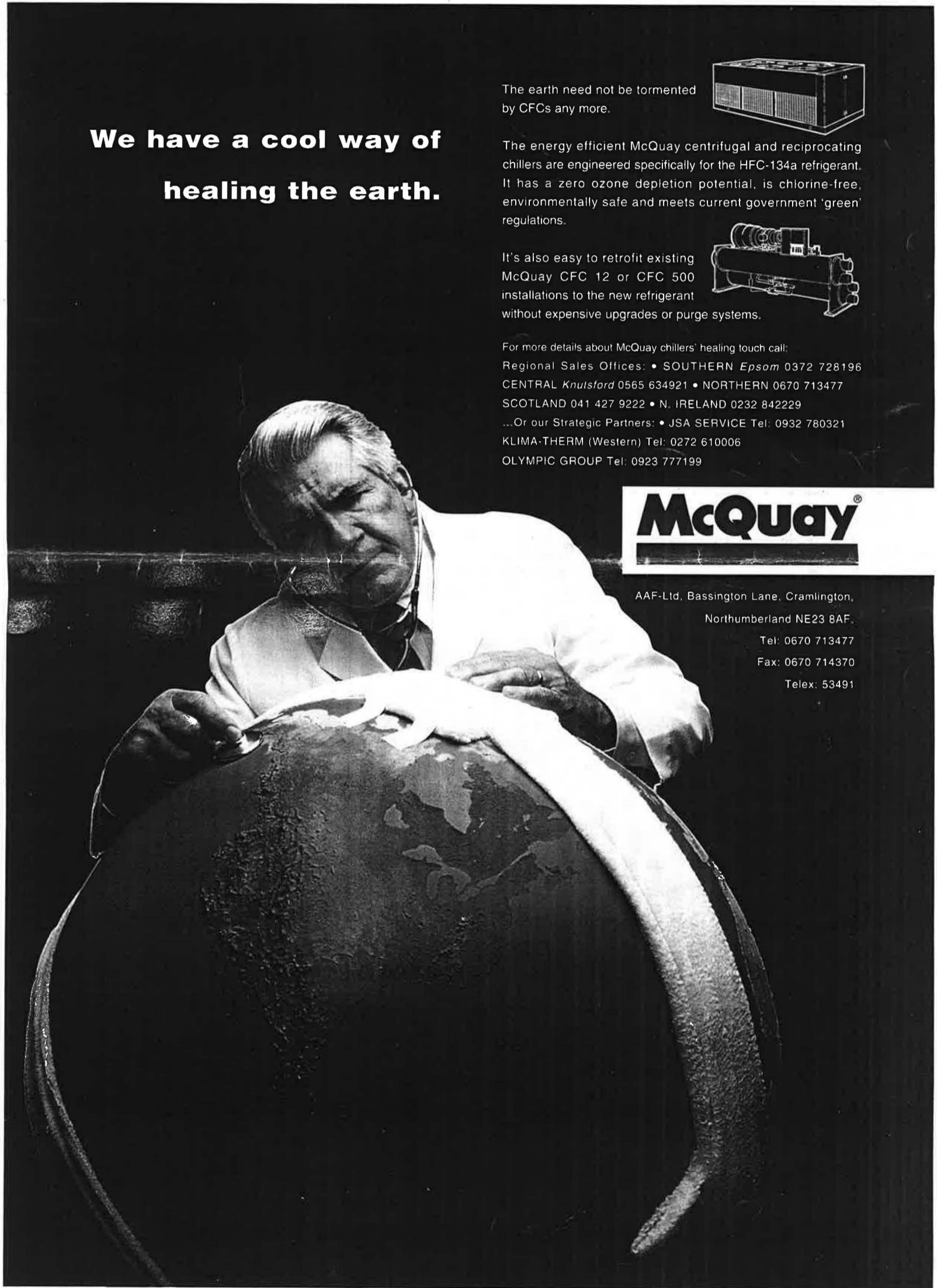
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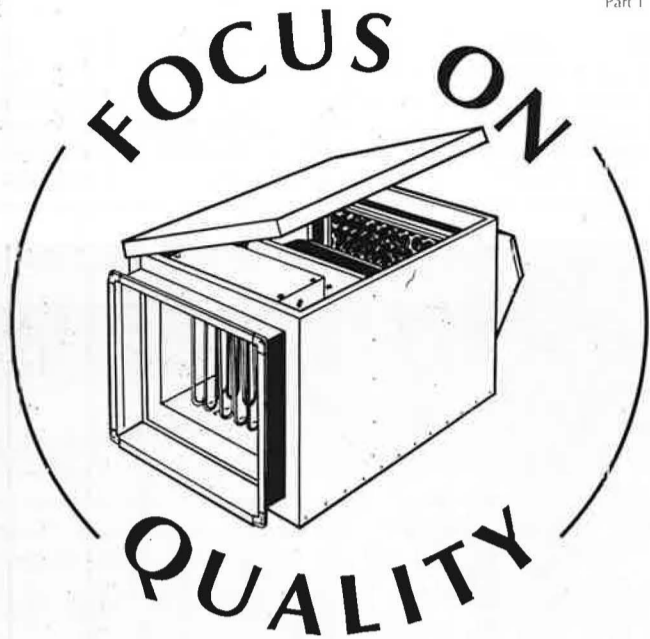


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Reader Reply No. 23

**FEATURE - 6**

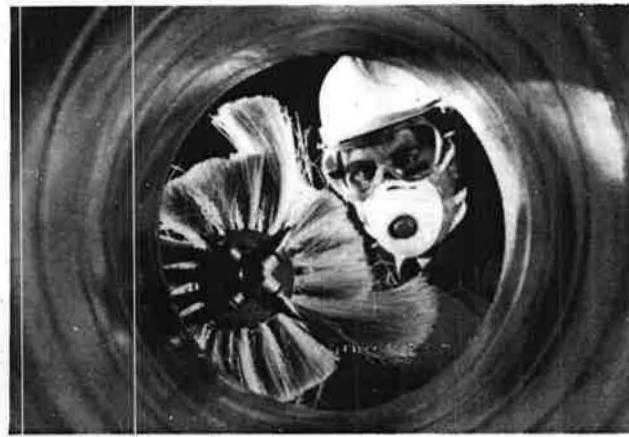
Continued from Page 23  
trays, filters, and spray heads should be an integral part of the system-maintenance programme.  
Cooling of incoming air is achieved by passing it across cooling coils or chiller batteries in which cold water is circulated. Condensation that forms on the outside of the cooling unit collects in a drip tray which then leads to drainage.

**Ductwork**

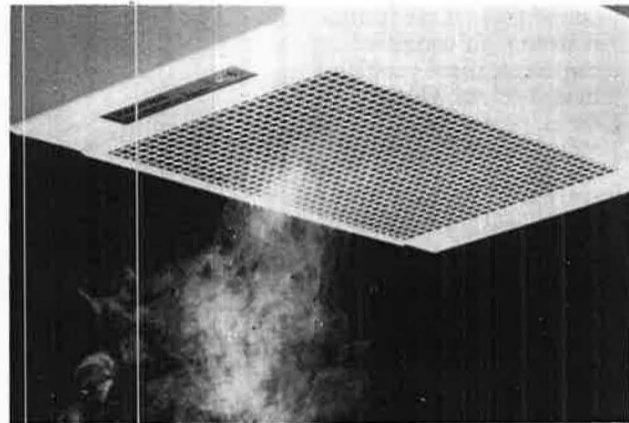
The ventilation ducting constitutes by far the largest part of any air-conditioning or ventilation system, and yet it is often the most neglected. Once away from the immediate vicinity of the plantroom, 90% of the ductwork may be hidden from view and receive little or no maintenance.

Condensation in cool spots in ductwork could lead to pools of contaminated water and conditions suitable for humidifier fever.

Even where intake filters are installed, very fine dust particles pass through and into the air-conditioning systems. These fine particles will settle and accumulate on the inside of ventilation ducting.  
The accumulation of



*Dirt trap - the problem of dirt and dust accumulating unseen in ductwork is solved by treatment provided by Rentokil's water and ventilation service.*



*Preventive measures - electrostatic air cleaners can help solve the problem of dirty ductwork by removing contaminants at source in occupied areas.*

thick coatings of fluffy, dry deposits inside of trunking must be regarded as a serious fire hazard. Fire dampers can become so seriously clogged that

their emergency function is dangerously impaired. Where filters are installed to prevent this material entering ductwork, they can

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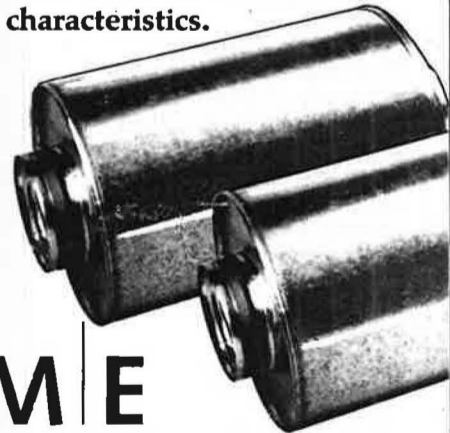
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Reader Reply No. 25

become so blocked that very little air passes through them. Under these conditions the ventilation systems will struggle to provide the correct control of temperature and humidity in the building. This failure can have serious implications on the health of people in the buildings. The efficiency of staff will undoubtedly be affected by factors such as temperature and humidity which contribute to their general feeling of well-being.

The problem of dirty ductwork often stems from the time the equipment was installed. The lack of pre-commissioning cleaning can also contribute. Whenever any building work is carried out, it is likely that large quantities of dust will find its way into the ductwork. A cleaning programme will ideally be included as a normal part of any building schedule.

Attention must also be given to ensuring grilles are maintained in good repair. Where these are damaged or absent, birds can gain access to ductwork. The material left behind by these birds in the form of droppings, nests, and the dead bodies of birds themselves, can

encourage infestation and other micro-organisms.

**Micro-organisms**

Pathogenic or allergenic bacteria and fungi readily enter a building from outside or breed inside air-conditioning systems. The ductwork then provides an ideal distribution system for spreading organisms throughout the building.

**“90% of the ductwork may be hidden from view and receive little if any maintenance”**

Generally, micro-organisms are sufficiently small (less than 10 microns) to pass through standard filters in the air-handling units. Their concentration in recirculated air will therefore increase with time. Studies in the USA have isolated a wide variety of bacteria and fungi from inside ventilation ductwork, with 31% of buildings surveyed being contaminated with potentially pathogenic or allergenic fungi.

The relationship between many of these organisms and sick-building syndrome is poorly understood and remains to be investigated. However, the link between some fungi and respiratory problems is well established, for example between *Aspergillus fumigatus* and bird fancier's lung. Birds can readily penetrate ductwork through broken grilles, and together with their nests, droppings and corpses can harbour many other pathogenic fungi, as well as insects such as mites and fleas. Mites, or rather their dried faeces, are well established as a cause of asthma. Up to 100 mites per gram of dust have been found in office furnishings.

**Dust**

There is also a link between SBS and dust or particulate matter in the air. For example, studies in Denmark have shown a correlation between elevated rates of irritation of mucous membranes and the amount of allergenic floor dust and wool in the building. The build-up of dirt and dust in ductwork is not only a health risk, but also leads to the clogging of filters and grilles, and can adversely

affect the airflow balance. Removing dirt, dust and micro-organisms from inside ductwork is likely to benefit not only the health of the occupants, but also improve the performance of the air-conditioning system. The key to

economical deep cleaning and disinfection of ductwork is equipment capable of penetrating long distances inside the ducts, without the need to cut frequent access points. With such equipment, it is now possible to maintain

clean and hygienic conditions inside ductwork on a regular basis. Ductwork can now come within the same regular maintenance schedule that is required for other previously

*Continued on page 26*

**Modar beats chlorine corrosion**

Never again will the air-handling unit at Macclesfield Leisure Centre have to be replaced because of corrosion. The eight-year-old unit has been replaced with a new Easdale AHU supplied by AAF and built from Modar composite material.

This new unit was supplied in knock-down form to overcome the problems of restricted access and limited space. The double-stacked unit replaces the original unit which was in an advanced state of corrosion due to the aggressive chlorine environment in the swimming pool which it serves.

The totally enclosed, high-fibre reinforced pultruded sections provide an insulated thermal barrier and vapour seal.

Further protection against corrosion by precoating the 50 mm-thick galvanised panels on

both sides, brass-cased heating coil and an acrylated rubber finish for all internal surfaces — including the fan impellers.

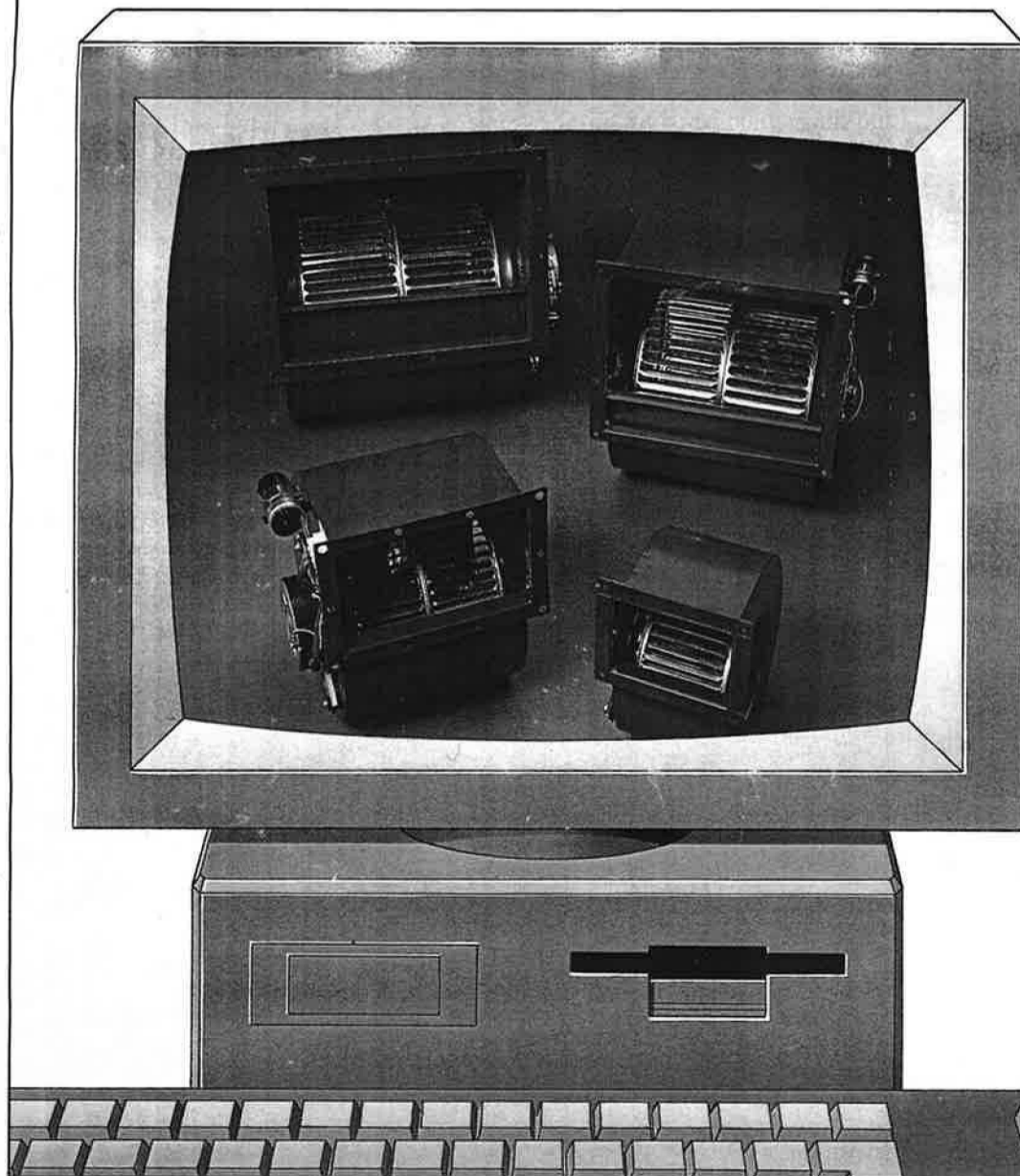
Heat is recovered from the extract air by a 2650 mm-diameter thermal wheel, which is

also treated to withstand the corrosive atmosphere.

Consultants were the Manchester office of Ove Arup & Partners. AAF and the mechanical contractor EMCO Building Services installed the unit. **Reader Reply No. 129**



Replacing an eight-year-old steel-framed air-handling unit at Macclesfield Leisure Centre is an AAF unit, with a frame of Modar composite material, that will not corrode in the harsh chlorine atmosphere.



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Think of the name Airflow and naturally 'quality' immediately comes to mind. However, what you may not have considered is the extensive range of fans that are readily available to meet many air movement requirements.

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neglected parts of the air-conditioning system, namely the cooling tower and air-handling unit.

A development in achieving efficient cleaning of inaccessible ductwork has been introduced by Rentokil's water and ventilation hygiene service. It consists of a unique air knife developed for Rentokil at the Royal Aircraft Establishment, which forces air out through its nozzles at more than the speed of sound. Most of the dust is dislodged, and the final traces are brushed off by a specially designed multiple head fitted with carefully contoured rotating brushes. All this dust is then removed by an extremely high-volume extraction unit designed to Rentokil's specification for the service.

This is then followed by a bacterial fogging with a food-area approved bactericide in the form of a mist of 20 micron droplets which penetrate for 6 m each way along the duct system. A 30-second burst at each access point is sufficient to build up a biocidal deposit.

If there are insufficient removable grilles or panels, access hatches can be cut and neat removable panels fitted to facilitate subsequent cleans.

**Electrostatic filters**

Dust and micro-organisms can also readily be removed from the occupied spaces of a building by electrostatic air cleaners.

This approach has three main advantages. Firstly, the occupied areas are a major source of dust and micro-organisms. If contaminants can be effectively removed at source, they will not be able to recirculate and build up in the ductwork. Secondly, such cleaners are more effective than filters in air-conditioning systems at removing micron-sized bacteria and fungal spores. Thirdly, the recirculating airflow through an electrostatic air cleaner helps to create a uniform temperature distribution.

When electrostatic air cleaners are used inside buildings, it is possible to achieve a 10-fold reduction in airborne bacteria and fungal spores.

Electrostatic cleaners also remove the particulate matter of cigarette smoke. They are suitable for offices, restaurants, bars, computer suites, reception areas and conference rooms and can be sited to provide protection for non-smoking staff or customers in areas where smoking is still permitted.

**"The problem of dirty ductwork often stems from the time the equipment was installed"**

Green foliage in plants not only looks attractive but can significantly reduce harmful trace pollutant gases. Volatile organic compounds (VOCs) such as formaldehyde, benzene, trichlorethylene and solvents from paints and adhesives have been suggested as causes of SBS. The measured concentrations of such gases are generally well below the established long-term occupational exposure standard but since up to 80 VOCs have been identified inside buildings, the possibility remains of some synergistic or additive effects between low levels of the individual gases.

Attempts to remove VOCs from building construction materials have not yet been successful. However, an interesting novel approach that both removes gases and adds to the internal aesthetics of the indoor environment is the use of living plant foliage. Plants have adapted to remove low concentrations (300 p.p.m.) of carbon dioxide from the atmosphere. Studies by NASA in the USA have also demonstrated that plants are effective in removing benzene, trichlorethylene and formaldehyde — three of the gases identified as present in modern buildings. Gerbera daisy can remove trichlorethylene at 8.5 micrograms/cm<sup>2</sup> of leaf and benzene at 23.4 micrograms/cm<sup>2</sup>. English Ivy can remove and detoxify formaldehyde at 9.7 micrograms/cm<sup>2</sup>. Other plants that were effective were spider plants, *Philodendron* and *Pothos* species. The relaxing nature of the colour green and the psychological benefits of indoor plants are well known. Now it appears that plants can also help to improve indoor air quality. □

Peter Bateman is a director of Rentokil Environmental Services, Felcourt, East Grinstead, West Sussex RH19 2FY.

# Proving fan performance



Computer software for fan performance can provide an immediate analysis of the noise spectrum achieved and precisely match fan and attenuator.

The ability to select a fan knowing its precise performance under your specific installation conditions, including its noise properties, is vitally important to any air-system engineer and, ultimately, the customer. Chris Lack examines the issues.

Axial fans are hardly a new concept, but their aerodynamic performance and the methods used to test and record performance have greatly improved in recent years.

A major factor is the revision to British Standard 848 Part 2, 1985 'Acoustic fan performance', which introduced far greater test demands than had previously been the case. This test standard is complemented by 'Methods of testing performance' BS 848 Part 1, 1988.

The data and knowledge achieved when fully testing to these standards brings not only improved noise/airflow data, but also gives fan designers sufficient detail to optimise airflow, space and noise properties — airflow efficiency and noise being synonymous, all of which benefits the end-user.

**Interactive**

Sound levels taken on one side of a fan are greatly influenced by the duct configuration on both sides of the fan. This interactive sound response means that previous simple sound level derivations achieved

undergo cropping to achieve varying diameters, often involves adopting a generalised, empirical relationship (55 log speed) or size ratios, and has been found to be quite inaccurate.

**"Sound levels taken on one side of a fan are greatly influenced by the duct configuration on both sides of the fan"**

Some published sound data for axial fan ranges which follow these laws must be questioned.

However, as the complexity and cost of testing a range of fans is high, it is understandable that fan manufacturers are reluctant to utilise the requirements of the new standard until they introduce a new, or revised range. The latest specifications for testing fans are demanding, but they provide very detailed data that enables highly accurate fan selection, including precise *in situ* noise data for both inlet and outlet sides of the fan.

The use of computer programs is ideal for collating and presenting

before the latest BS 848 standard were not sufficiently reliable. The new test methodology provides a far more complex and accurate sound footprint and insists that the acoustic footprint for a fan range with size and speed variants is derived through a full test programme; less extrapolation is allowed. The use of empirical relationships for size and speed adjustments cannot be assumed.

Tip cropping, particularly with axial fans, which normally

## Duct prices held

Senior Hargreaves has announced that its chain of Duct Shops is holding prices of standard ductwork at 1993 prices.

Each outlet carries a full range of ductwork and accessories, including common sizes of rectangular, circular and flat-oval ductwork. All are

stocked as straight sections, bends, tees and transformation pieces.

There are currently Duct Shops in East Kilbride, Leeds, Bury, West Bromwich and Heathrow. More branches are planned for the near future.

Reader Reply No. 131



Prices of standard ductwork from the Senior Hargreaves chain of Duct Shops have been held at 1993 levels.

## Lego builders breathe easy

Staff in the model workshop at Lego World, Windsor, can breathe easily thanks to air-handling plant supplied by Dantherm.

The workshop houses some 30 model makers, technicians, animators and engineers who have to transform 55 million Lego bricks weighing more than 20 tonnes into models for the leisure park, which is due to open in spring 1996.

As the models are assembled, each component is bonded to the next using a solvent which effectively melts the bricks and fuses them together.

Although the vapours are not known to be hazardous, the Dantherm unit provides local

extraction at each workstation. Full fresh air is supplied to the workshop at the rate of 3.5 m<sup>3</sup>/s against 25 Pa external ductwork resistance. The heat recovery rate is around 65%.

The equipment supplied is a type XVV 44 air-to-air heat-recovery unit with 16 in-built diagonal flow recuperator modules, condensate tray, filters, bypass and supply and extract belt-driven fans. Individual recuperator modules are easily removable for cleaning and maintenance.

Lego World Windsor is expected to attract 1.2 million visitors a year after it is opened. The workshop will continue to carry out necessary repairs and build replacement models.

Reader Reply No. 130



Lego technicians inspect the Dantherm heat-recovery air-handling unit in the model workshop.

fan-performance data. At Elta we provide a free PC disk that provides complete on-screen fan selection simply by keying in the basic performance parameters — airflow and pressure, for example.

**“The latest specifications for testing fans are very demanding, but they provide very detailed data that enables highly accurate fan selection”**

The software gives an immediate fan selection, including key performance parameters such as size, power and noise levels, and permits secondary selection based on prime application performance factors such as noise, power or space-envelope limitations.

With the program one can make a highly detailed, very precise

selection, which without the benefit of test results BS 848 Parts 1 and 2 would have taken many hours of calculation, and even then be subject to fairly wide swings in the actual performance results due to the somewhat theoretical elements inherent in previous methods.

The software can, for example, recommend attenuators if necessary, selecting the desired type and providing detailed, immediate analysis of the new noise spectrum achieved and precisely match fan and attenuator. This selection can be supported with a full print-out of all the key performance parameters

## Thousands of products in ‘Big black book’

Fans and ventilation products from the country’s leading manufacturers are all detailed in a new catalogue from Fans & Spares, nicknamed the ‘big black book’.

The book contains 300 pages of technical data on fans for all kinds of

for the fan selected when matching the required duty.

### Reliable information

Printed fan-performance matter is also derived from the latest BS 848 Parts 1 and 2 tests and, well presented, provides the basis for highly reliable information.

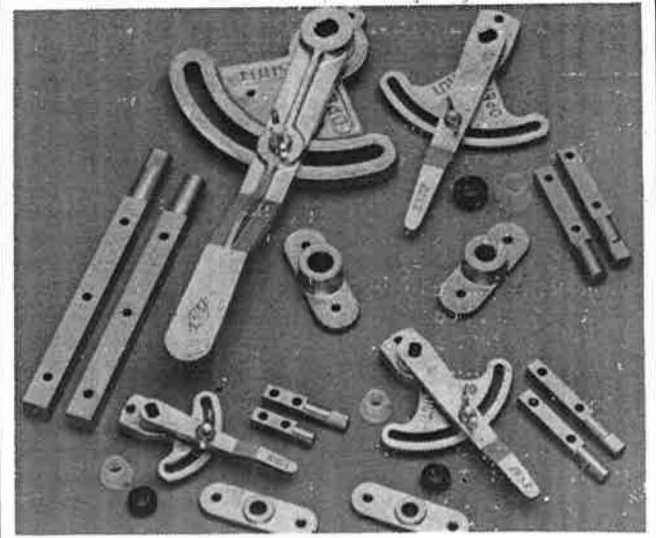
We use our own approach to presenting performance data for axial fans, which we feel is the clearest, most effective method of conveying complex arrays of noise data under varying conditions. We divide the flow/pressure

characteristic generated performance envelope into nine zones and provide the performance values for each zone, including noise data. All our axial impellers have adjustable-pitch blade geometry, so we provide a series of performance characteristics to cover a range of blade-angle settings.

If your company specifies, selects or uses fans, always ensure the basis of the tested performance data and the printed results is totally reliable. For preference, if you want to ensure really meaningful selection data, ensure that the fans have been properly tested to the very latest BS 848 Parts 1 and 2 standards.

Having used these test standards at Elta, we pride ourselves on the fact that any engineer selecting a fan from anywhere in the world can pinpoint the fan’s performance capability for their project, based on either our computer selection program, or published selection data. The result is satisfied customers and no unwarranted call-outs.

Chris Lack is technical director of Elta Fans Ltd, 15 Barnes Wallis Road, Segensworth East Industrial Estate, Fareham, Hants PO15 5ST.



Reduced installation time and low leakage are features of these damper controls available from Contract Components.

## Damper controls bring installation benefits

Contract Components is now marketing the Zest range of damper controls and accessories.

The 100 Series of damper controls has been developed around a patented design with a number of operating advantages. Consistent and high-quality components help meet the leakage requirements of DW/142.

Features include a design of baseplate that is

suitable for use with both rectangular and circular ductwork. Two-point mounting is said to reduce installation time by over 30%.

These dampers are pre-packed for ease of handling and to eliminate the chance of missing components. Neoprene washers ensure an airtight seal between spindle, quadrant base and ductwork.

Reader Reply No. 133

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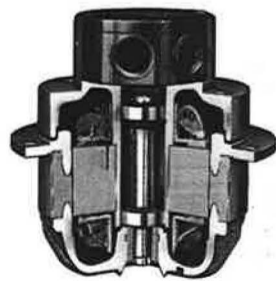
Available in circular flanged, circular spigoted or square flanged casings, the range combines the volume capability of axials with the pressure development of centrifugal fans.

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