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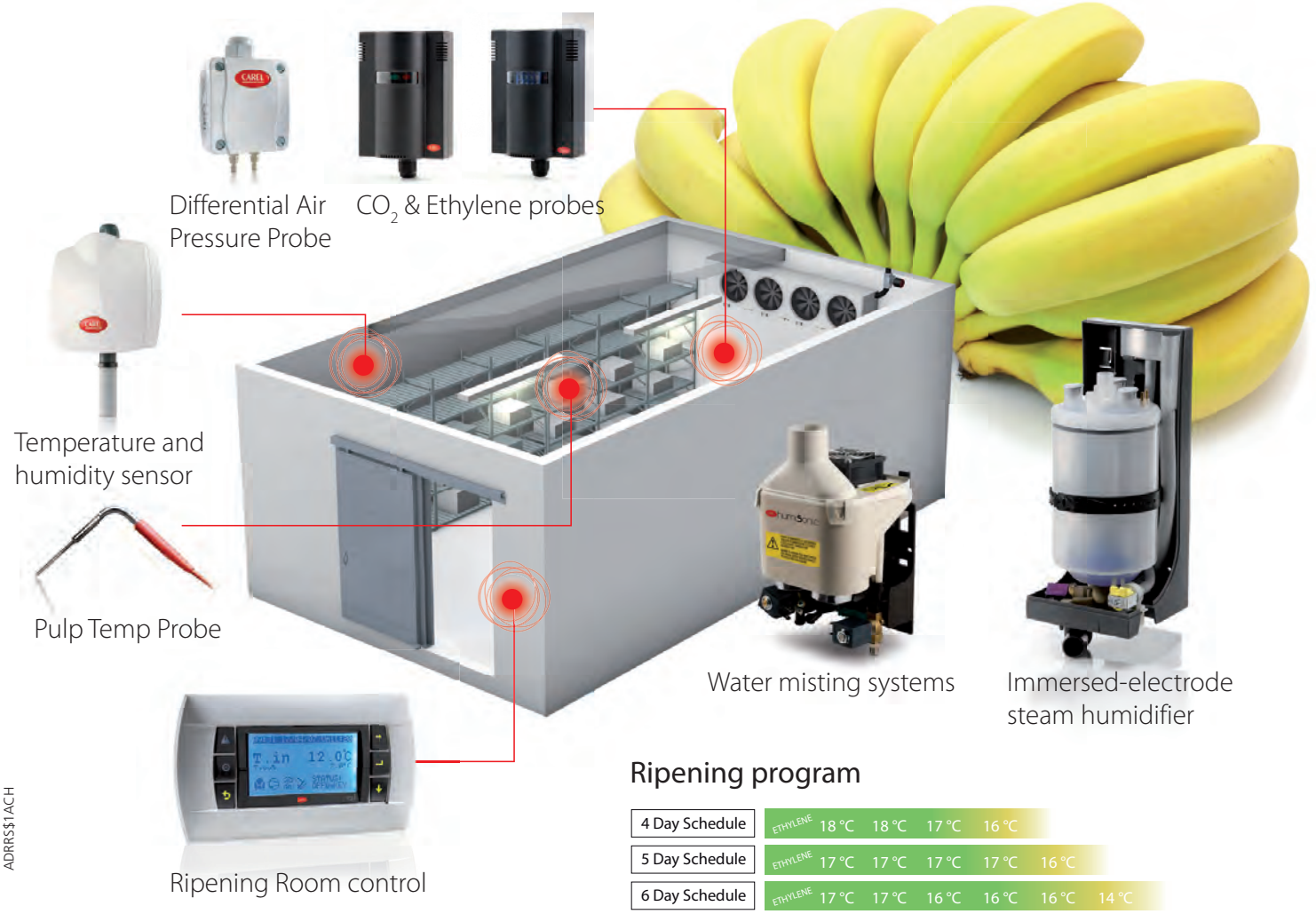

Ripening program

4 Day Schedule	ETHYLENE 18 °C	18 °C	17 °C	16 °C				
5 Day Schedule	ETHYLENE 17 °C	17 °C	17 °C	17 °C	16 °C			
6 Day Schedule	ETHYLENE 17 °C	17 °C	16 °C	16 °C	16 °C	14 °C		
7 Day Schedule	ETHYLENE 16 °C	16 °C	16 °C	16 °C	16 °C	14 °C	14 °C	
8 Day Schedule	ETHYLENE 14 °C	14 °C	14 °C	14 °C	14 °C	14 °C	14 °C	14 °C

Integrated solutions for ripening

- Flexible Control System for Fruit Ripening
- Set parameters within a program (Temperature, rH%, time, Ethylene ppm, CO_2 ppm)
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- Control of reversible air-flow systems
- CO_2 extraction by door or by Fan/dampers
- Control for pressurised ripening

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Publisher's Letter

Hello and welcome once again to *Cooling India*.

Despite the relatively slow GDP growth, India remains one of the fast growing economies in the world. According to the International Monetary Fund (IMF), though India's economic growth is "weaker" than expected, the country will still be the fastest-growing major economy in the world and much ahead of China.

India has witnessed a surge in demand for commercial buildings in the last couple of decades - thanks to a sustained economic growth and the increase of industrial activities. However, maintaining Indoor Air Quality (IAQ) in commercial buildings remains a major challenge.

According to the US Environmental Protection Agency (EPA), people tend to spend around 90 per cent of their time indoors i.e. in offices. Studies reveal that IAQ in office buildings can directly affect the well-being and comfort levels of its occupants, particularly employees. On the other hand, office buildings are susceptible to poor IAQ that can be attributed to the lack of proper ventilation systems and faults associated with HVAC systems. Here, we have discussed the various aspects of HVAC in commercial buildings.

According to the International Energy Agency, air-conditioning accounts for major energy-use in buildings. The demand is expected to triple by the year 2050 - with 30 per cent coming from commercial buildings. Notably, HVAC systems are the highest energy consumers in any building. HVAC systems account for 39 per cent of the energy used in commercial buildings in the United States, whereas in India, it is nearly 50-60 per cent. Therefore, energy efficient HVAC systems are the need of the hour as far as operations in commercial buildings are concerned, as substantial savings can be achieved by optimising HVAC systems. This time, we take a closer look at how to achieve energy efficiency in the commercial buildings.

We hope you enjoy reading this issue as always! Please write to me at pravita@charypublications.in

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Editor: Mahadevan Iyer

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Blue Star wins order of Rs 253 Cr from Mumbai Metro Rail Corporation

Air conditioning and commercial refrigeration major, Blue Star Limited, has won a prestigious air conditioning and tunnel ventilation system order valued at Rs 253 crore from Mumbai Metro Rail Corporation Limited (MMRCL). The scope of this order includes design, engineering, supply, installation and commissioning of the air conditioning, tunnel ventilation and environmental control system for nine underground stations and associated tunnels on Line 3 corridor of the Mumbai Metro between Mumbai Central and Bandra.

This turnkey project will require approximately 8200 TR of water-cooled screw and magnetic bearing chillers, chilled water and condenser water pumps, air handling units, fan coil units, piping, ducting, insulation, tunnel ventilation fans, dampers, compressed air system, associated electrical work and a SCADA system, amongst others.

On account of space constraints in Mumbai, the size of each station box is smaller as compared to metro rail systems in other parts of India, due to which the system design, sizing and placement of the equipment has to be managed within the limited available space. Blue Star with its engineering prowess, proven project management expertise and impressive track record of on-time completion is well poised to execute such complex projects.

Vir S Advani, Vice Chairman & Managing Director, Blue Star Limited adds, "This order is yet another milestone in the history of the company and we are proud to be associated with Mumbai Metro Rail Corporation. Blue Star's superior and advanced project management capabilities have helped the company bag many such orders in the past and as the market grows, it is well-positioned to win many more in the coming years." ■

Schneider Electric inaugurates new office in Pune

Schneider Electric, one of the global specialists in energy management and automation, announced the opening of its new office facility designed completely on an open office concept in Pune, Maharashtra. Schneider Electric is the preferred energy management partner for premium customers in the city and its surrounding suburbs. On the back of this expansion, the company aims to consolidate its leading position and revenues in the cultural capital of Maharashtra for its wide array of energy management products and solutions. This is an integrated facility of the company for all its business operations as well design engineering centre of ASCO Power Technologies, USA. The new office facility will showcase Schneider Electric's superior products and solutions and also enhance the efficiency of employees to serve the customer quicker. Speaking on this occasion, Manish Khandelwal, Vice President, National Sales, Schneider Electric, India expressed his thoughts on the importance of inclusive, open and futuristic workplaces. He stated that the new facility of Pune will be one of the best campus of company in India and will set a new benchmark in office spaces. Shrikar Paithankar, General Manager, Schneider Electric India, while welcoming guests, said, "This expansion expresses our understanding of the potential of the city and our to help the local businesses grow much faster through the enhanced customer experience. Being at a strategic and central location, it allows us to be more customer centric and accessible." The new facility, located at Amar Caliber, CTS No 911, BMCC Road, Deccan Gymkhana, Shivajinagar has been designed to demonstrate Schneider Electric's EcoStruxure solutions for power, buildings, machines and plant. ■

SRF's new refrigerant blend is ASHRAE listed

Indian refrigerant manufacturer SRF Limited says it has obtained ASHRAE (American Society of Heating, Refrigeration, Air-conditioning Engineers) certification for R-467A, its new, low GWP refrigerant blend for stationary air-conditioning applications. It is the first-ever refrigerant from India to have received this certification by the ASHRAE Standards Committee under the Designation and Safety Classification of Refrigerants.

Developed using in-house, patented technology, the new R-467A is a non-toxic, mildly flammable refrigerant designed mainly for use in stationary air-conditioning applications. The product offers superior refrigerant performance and stability and will be marketed under SRF's FLORON brand of refrigerants.

Commenting on this development, Prashant Yadav, President and CEO, Fluorochemicals Business, SRF Limited said, "An approval by the ASHRAE Standards Committee is testimony to the fact that SRF has always been at the forefront of major fluorine-based gas transitions set by international regulations to reduce the global emissions of greenhouse gases. Backed by breakthrough R&D, SRF continues to remain committed to developing the next-generation of fluorinated gases that have minimal impact on the environment. We believe that this will provide a good mid-term solution and option to our customers globally." ■

Badal inaugurates first mega food park in Telangana

Union Minister of Food Processing Industries, Harsimrat Kaur Badal has inaugurated the first Mega Food Park in Telangana promoted by M/s Smart Agro Food Park at Village Lakkampally, Nandipet Mandal of Nizamabad district, Telangana state.

Badal said that the Mega Food Park will leverage an additional investment of about Rs 250 crore in 22 food processing units in the park and generate a turnover of about Rs 14,000 crore. The park will also provide direct and indirect employment to 50,000 youth and benefit about 1 lakh farmers.

The minister said that Pradhan Mantri Kisan Samman Nidhi is an initiative by the government of India in which all small and marginal farmers will get up to Rs 6,000. Telangana government also providing financial support to farmers, ultimately the farmer will be benefitted.

Mega Food Parks shall further complement the government's scheme by reducing post-harvest losses and hedging the farmer's risk, she added.

Badal also said that the Ministry of Food Processing Industries is focusing on boosting the food processing industry so that agriculture sector grows exponentially and becomes a major contributor to doubling the farmer's income and 'Make in India' initiative of the government.

Mega Food Parks create modern infrastructure facilities for food processing along the value chain from farm to market with strong forward and backward linkages through a cluster-based approach.

Common facilities and enabling infrastructure are created at Central Processing Centre and facilities for primary processing and storage is created near the farm in the form of Primary Processing Centers (PPCs) and Collection Centers (CCs). Under the scheme, the Government of India provides financial assistance upto Rs 50 crore per mega food park project. ■

Honeywell suite of building integration help improve efficiency

Honeywell, one of the leaders in smart building technology and services, introduced the next generation of Enterprise Building Integration (EBI), Command and Control Suite (CCS), and Digital Video Manager (DVM), a suite of solutions enabled by the Honeywell Forge for Buildings platform, that help drive facility efficiency and oversight, streamline complex functions, and deliver savings across an enterprise. A key component to making this all work is keeping facilities and occupants safe. Along with EBI, CCS and DVM Honeywell is launching a portfolio of enhanced cybersecurity solutions to help companies protect against the rising risk of unexpected attacks on data, network systems and buildings infrastructure.

"For buildings to be smarter, more efficient and effective, an operating system must be in place that works to constantly improve resource management," said Mark Verheyden, President, Honeywell Building Solutions. "These systems help keep people safe and secure, enhance the building experience, and protect the data and processes that drive operations. The overall health of the building ecosystem can impact business success – just like great

talent and experience. Our building operation teams help customers address building use and critical infrastructure challenges."

These technologies leverage IoT connectivity, interoperable systems and data sharing, and adaptive workflows to help transform inputs and information into actionable outcomes. "Commercial building and critical infrastructure customers are often driving toward similar facility outcomes: streamlined operations, reduced costs, improved safety and security," Verheyden said. "Efforts to reach these goals are markedly different for a hospital or an airport, for example. Within our enhanced integrated platform of offerings, operations teams can tailor services to help meet specific needs through new multi-windows and interactive options that are just a fingertip away." ■

Obama to address Greenbuild 2019

The US Green Building Council (USGBC) and Informa Connect announced that former President Barack Obama will speak at the keynote of the 2019 Greenbuild International Conference and Expo. This year's conference will take place November 19-22 in Atlanta, Ga at the LEED Gold Georgia World Congress Center.

"USGBC is deeply honoured that President Obama has accepted our invitation to speak at Greenbuild 2019," said Mahesh Ramanujam, President and CEO, USGBC. "President Obama is a global leader and a long-time friend of the green building community. While in office, his administration negotiated the landmark Paris Climate Accords, expanded the impact of our field and helped open the door for energy efficiency investments in both the public and private sectors. I know that when he joins us on the keynote stage in November, he will impart his ideas, passion and vision to our growing global green building family."

"As the green building movement evolves and continues to permeate our lives, Obama is a valuable leader to bring that vision to life," said Andrew Mullins, CEO, Informa Connect. "His commitment to unite humanity in combating a changing climate is a great example to follow. At the 2019 event, our attendees, exhibitors, and all participants of Greenbuild will be celebrating the notion that every human, regardless of circumstances, deserves to live a long and healthy life. There is no better voice or embodiment of that than Obama." ■

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Voltas launches new Brand Shop at Gajuwaka, Visakhapatnam

Voltas and Voltas Beko, collectively showcase their range of air conditioning and cooling products, along with their latest range of home appliances at the new brand shop.

The brand store features a well-designed and visually appealing display of new range of Voltas and Voltas Beko' products, comprising air conditioners, air coolers, commercial refrigerators, water dispensers, water coolers, refrigerators, washing machines, microwaves and dishwashers. The Brand Shop is being launched to meet the expectations of consumers from a growing city like Visakhapatnam with technologically advanced products of Voltas and Voltas Beko.

Pradeep Bakshi, Managing Director & CEO, Voltas said, "We are delighted to announce the launch of our brand shop. Customer centricity is at the core of all our offerings and Voltas Beko has been built on the same principles. These brand shops will continue to provide our esteemed customers technologically advanced, relevant and environment friendly products at attractive prices. Voltas is the No 1 AC brand with over 25 per cent market share, having a sizable lead over its nearest competitor. We aim to make Voltas Beko a market leader in the white goods space."

The Voltas 2019 AC product range includes over 100 SKUs, with 46 SKUs in inverter ACs, besides cassette and tower ACs. This year, the company has also launched India's first Adjustable Inverter AC range, which comes with the proposition of 'Flexible Air Conditioning', besides a unique range of Wi-Fi enabled ACs which can be voice controlled through Alexa. In the Voltas Fresh Air Coolers range, the Company has launched 39 new SKUs with unique features like Smart Humidity Controller under various sub-categories such as Personal, Window, Tower and Desert Air Coolers. ■

World Food India to be held in November in New Delhi

Union Minister for Food Processing Industries Harsimrat Kaur Badal has said that World Food India 2019 will be the biggest gathering of all global and domestic stakeholders in the food processing sector. She said WFI 2019 will be held from 1-4 November in New Delhi and will position India as food processing destination of the world.

The minister chaired a meeting with various stakeholders of WFI 2019 including the associated ministries and departments, CEOs of major food processing companies and industry associations. This was followed by a second meeting with the ambassadors or high commissioners of leading food processing or food retailing countries. The meetings were held to discuss the investment opportunities available in India in the Food Processing Sector and to sensitise the gathering about their participation in WFI 2019.

The minister informed the gathering that the second edition of World Food India is planned at a much bigger and grandeur level from 1-4 November 2019 at Vigyan Bhawan and Rajpath Lawns in New Delhi. World Food India 2019 shall consist of several top-level seminars, investment opportunities, exhibitions, high level CEO roundtables, country sessions, B2B and B2G networking etc. For the year 2019, the Ministry is targeting to partner with at least 15 countries and participation from at least 80 countries. The tagline of the event will be 'Forging Partnerships for Growth'. ■

Bitzer Scroll Compressors for A2L refrigerants gets approval for serial production

Bitzer provides system manufacturers with the possibility of fulfilling the challenges associated with the F-Gas Regulation: the specialist for refrigeration and air conditioning technology has approved serial production of its ORBIT (model range VL) and ORBIT+ scroll compressors for use with refrigerants in the A2L safety group. The refrigerants concerned, R454B, R452B and R32 have a low global warming potential (GWP) and have only low flammability ratings.

ORBIT (model range VL) and ORBIT+ scroll compressors from Bitzer have been approved for serial production for use with the refrigerants R454B, R452B and R32 since February 2019 and are also suitable for operation with A1 refrigerants. This makes the specialist for refrigeration and air conditioning technology the first manufacturer in the world to supply scroll compressors with displacements of between 20 and 80 m^3/h (50 Hz) for use with A2L refrigerants. These have only low flammability ratings and a low GWP. The familiar ORBIT series in the VA model range will continue to be available for operation with A1 refrigerants. ORBIT and ORBIT+ were presented as a world premiere at the Mostra Convegno Expo comfort trade fair in 2018 and are already integrated into the BITZER software, ensuring that they can be quickly and easily configured by customers.

BITZER customers will particularly benefit from the A2L approval of the ORBIT (model range VL) and ORBIT+ compressors: both series provide several years of planning security due to the low GWP values of the refrigerants R454B, R452B and R32. Before they were approved for serial production, the ORBIT and ORBIT+ scroll compressors demonstrated their quality and future-proof compatibility in extensive tests. In addition, they have been successfully qualified by important OEM customers in their qualification programmes. ■

Carrier introduces fully revamped offering of Fan Energy Rating

Carrier's full line up of gas furnaces, gas or electric small package products (SPP) and SPP Hybrid Heat systems have been redesigned to meet the Department of Energy's (DOE) Fan Energy Rating (FER).

Carrier's products with new fan technology use less energy and achieve the goals of the new FER regulations, targeting a 46 per cent watt reduction over a standard furnace with a permanent split capacitor (PSC) blower motor. By reducing energy consumption, consumers can save money on energy bills and cut carbon pollution. "As an HVAC manufacturer, it is absolutely critical we comply with regulatory requirements and evaluate any new regulation from the DOE to ensure it is technologically feasible and economically justified," said John Gibbons, Executive Director, Regulatory Affairs, Carrier. "Carrier is more than ready with a fully re-engineered line-up of gas heating products and an outstanding network of Carrier distributors and contractors to reach consumers." Carrier innovated its entire product line in order to achieve compliance with the new FER regulations. ■

Danfoss sales grow 4% despite slowdown fears

Danfoss reports a sales growth of 4 per cent in the first six months of this year, with group sales reaching €3.2 billion. Growth was driven by demand for energy-efficient and low-emission solutions in Europe and North America, while China was impacted by economic slowdown – which also spread to Europe and North America towards the end of the second quarter. The figures were described as a strong performance in a toughening market by Danfoss President and CEO Kim Fausing.

"We provide a wide range of technologies and solutions, which play a crucial role in solving climate change. At the same time, energy efficiency and low-emission solutions have moved high up on the agenda in the green transition," he said. "However, the uncertainty created by the trade conflict between the US and China and other geopolitical conflicts have spread to the rest of the world, and we are prepared for the global economy entering a phase of little or no growth where market growth could turn negative in the most cyclical industries." ■

EPTA makes entry in North & Central US markets

Epta, a multi-national group specialised in commercial refrigeration, has acquired Kysor Warren - the third-largest US manufacturer of refrigerated display cases and compressorised systems for commercial refrigeration, which has been operating for more than 135 years - previously as a part of Heatcraft Worldwide Refrigeration, Lennox International Inc's refrigeration business. This acquisition will result in the creation of the new company Kysor Warren Epta US Corporation.

Kysor Warren operates with a team of over 500 employees, with operations in the US and Mexico. The core business of the company is the design, manufacturing and distribution of efficient and technologically advanced displays and systems used in grocery and convenience stores, with applications in other retail and foodservice sectors.

The transaction is in line with Epta's expansion strategy, which aims to grow through a combination of organic expansion on one side, supported by a broad product and service offering with continuous investments in innovation and efficiency, and M&A on the other with acquisitions of leading brands in their respective countries. Marco Nocivelli, President and CEO of Epta states, "The establishment of Kysor Warren Epta US Corp is a milestone for the Group. We have risen to the challenge and we are ready to enter a geographical area that is highly competitive, innovative and with significant numbers: North and Central America are worth over one third of the world refrigeration market." He continues, "This operation will allow us to accelerate our growth plans thanks to the reputation of the Kysor Warren brand that boasts a prominent role nationally, innovative natural refrigerant systems such as those operating with CO2, structured and efficient production facilities and a strong team of motivated experts."

Parke Adamson, General Manager of Kysor Warren states, "Epta and Kysor Warren have a shared vision and highly compatible cultures, founded on similar values, such as quality, sustainability, innovation, design and efficiency. The across the-board skills of the Epta Group and its know-how in the development of natural refrigerant systems will dovetail with our long-established experience serving North American Retailers. This is a synergy that will further strengthen the Kysor Warren brand, which will allow us to grasp, with renewed strength, the opportunities in a dynamic, continuously evolving market." ■

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LU-VE's Spirotech wins National Award for Export Excellence in India

LU-VE's Indian subsidiary, Spirotech, has confirmed its position of excellence in Indian exporting through its subsidiary company which specialises in the production of heat exchangers for domestic appliances, refrigeration and air conditioning.

Spirotech Heat Exchangers, based in Bhiwadi, Rajasthan, has received a National Award for Export Excellence for being one of the best Indian exporters in the engineering field. The participating companies are subdivided by their region, size and business sector: LU-VE Spirotech won in the North region, Large category, General Machinery sector.

The award is an initiative of the Engineering Export Promotion Council (EEPC), an Indian Government organisation set up in 1955 to promote exports. The award was presented at a ceremony in Shimla by the Chief Minister of the State, Jai Ram Thakur.

Matteo Liberali, CEO of LU-VE Group, said, "Absolute quality is the foundation of the extraordinary success of Spirotech, which supplies the major European and other manufactures of domestic appliances, especially tumble driers. In order to pass the most stringent acceptance tests for our products, they are subjected to the most severe checks at the end of every transformation process, using the very best evaluation instruments. However, product quality alone is not enough. The company and the production processes are certified in compliance with the most rigid international standards; last year, the Bhiwadi facility received coveted recognition from the Indian Green Building Council, with the IGBC Green Factory Building – Gold certification." ■

Johnson Controls AHUs recognised as a leading sustainability product for data centers

Johnson Controls announced the YORK Mission Critical Direct Evaporative Cooling Air Handling Unit has been named Sustainability Product of the Year in the business services industry by The Business Intelligence Group in the 2019 Sustainability Awards. The awards honour those who have made sustainability an integral part of their business practice. The YORK Mission Critical Direct Evaporative Cooling (DEC) Air Handling Units (AHUs) from Johnson Controls are specifically designed to meet the challenges and needs of data centres. By maximising cooling capacity per square foot and providing superior efficiency, the units optimise operational, water and energy usage in centres to achieve lower energy costs. While doing more with less from the environment, the MC DEC AHUs yield an ultra-efficient partial-power usage effectiveness (pPUE) of less than 1.1 for data centres.

"Data centres have traditionally relied on water and power consumption to operate and stay cool, but with two-thirds of the global population expected to face fresh-water shortages by 2025, it is imperative for mission critical environments to use water and energy resources more efficiently," said Michael Zarrilli, Executive Director of Data Centre Solutions at Johnson Controls. "We are proud to help facilities globally achieve their energy and efficiency goals, and eager to continue advancing sustainability in the industry."

A significant amount of data centre power consumption is cooling-related, which can make up to 40 per cent of a centre's total operating expense. Unlike other AHUs on the market, Johnson Controls MC DEC AHUs were designed with flexibility to meet phased data centre expansion strategies by offering lighter and compact sized units for a reduced physical and environmental footprint. Additionally, these units adjust cooling levels based on changing variables such as time, temperature and weather, enabling data centers to use only what they need and cut excess power and water usage.

"We are proud to reward and recognise Johnson Controls for their efforts and advances in sustainability in the data centers space," said Maria Jimenez, Chief Nominations Officer, Business Intelligence Group. "By enhancing overall efficiency for data centers across the globe, it was clear to our judges that their mission and innovative products will continue to deliver results that help drive a cleaner, more sustainable world." ■

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APAC Air Compressor

Market to Reach $15.2 bn by 2024

The growing demand from food and beverage industry, and increasing demand for energy efficient compressors are the primary drivers accelerating the growth of the market.

APAC air compressor market is poised to reach USD 15.2 billion by 2024, citing a CAGR of 4.1 per cent during forecast period. Factors including the growing demand from food and beverage industry, and increasing demand for energy efficient compressors are the primary drivers accelerating the growth of the market. Apart from this, increasing demand from industries such as oil & gas, and power are also supporting the growth of the market, according to P&S Intelligence.

Insights on market segments

Based on type, APAC air compressor market has been divided into positive displacement and dynamic, where dynamic category is further bifurcated into centrifugal and axial compressors. Of these, centrifugal compressors witnessed a higher market share in 2018, buoyed by an increasing demand from the oil & gas industry. Further in the forecast period, oil & gas industry in APAC is expected to provide lucrative opportunities for the centrifugal compressor market in the countries of APAC majorly from China. Moreover, China is expected to be a major contributor to the centrifugal compressor market owing to the Chinese coal-to-gas switch policy that focuses on decreasing the usage of coal.

Further, the positive displacement air compressor category is subdivided into rotary and reciprocating, of which rotary has become a preferred choice of the end-users in the region. Higher energy efficiency offered by these compressors is the primary factor for the increasing demand for rotary screw air compressors. Energy efficiency plays a significant role in overall cost, as more than 75 per cent long term cost arises from energy usage, resulting in increased adoption of screw air compressors.

On the basis of application, market has been categorised into construction, power, industrial manufacturing, HVACR, chemical and cement, oil & gas, automotive, food & beverage, textile, and others; wherein, others include healthcare, research laboratories, and agriculture. Of these, food & beverage industry is expected to grow with the fastest CAGR during the forecast period, owing to increasing demand for compressed air for applications including cleaning of food containers, cleaning extra food from machinery, and to sort, cut or shape food.

The Indian air compressor market is expected to witness the fastest growth during the forecast period, both in terms of volume and value, owing to the expected high growth in small businesses and construction industry in the country. The market demand is displaying a shift from reciprocating air compressors to quality screw air compressors, due to more inclination of companies toward quality products, as well as better efficiency and productivity offered by these compressors.

Launch of compressors with IoT technology to provide substantial opportunity

APAC is exhibiting increased demand for IoT-enabled compressors, due to rising need to operate compressors more energy efficiently. So, the major players in the compressor market are focused on launching compressors with IoT enabled technology and innovate energy efficient products. For instance, in January 2018, Elgi Equipments Limited launched compressors with IoT technology namely air alert, which is a SIM-card based communication system that tracks multiple data points such as volume of air delivered, pressure, operating temperature, and energy efficiency rating. By transmission of data to servers, it provides valuable insights such as changes in air consumption, service interval, and general compressor health. ■

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GOOD AIR QUALITY, BETTER PRODUCTIVITY

Employees in any office building tend to spend most of their time indoors. The office buildings are susceptible to poor Indoor Air Quality. Here is an analysis on how to maintain IAQ in office buildings.
- Supriya A Oundhakar, Associate Editor

Indoor Air Quality (IAQ) in office buildings has gained prominence as it directly affects well being and comfort level of its occupants, particularly, employees. According to US Environmental Protection Agency (EPA), people tend to spend around 90 per cent of their time indoors i.e. offices. The office buildings are susceptible to poor IAQ due to lack of proper ventilation system and faults associated with heating, ventilating and air conditioning (HVAC) systems.

In most office buildings, HVAC systems work with limited or complete lack of fresh air. As a result, HVAC systems circulate stale air or return air leading to high levels of carbon dioxide in the indoor environment. Moreover, these systems work at different efficiency levels and if there is extra load on them, the quantity of stale air increases in the environment (fresh air reduces) leading to multiple problems and even system failure, informs Kalidas Bhangare, Managing Director, Testo India. Further, this has an impact health of employees, leading them to suffer from sick building syndrome with symptoms like headaches, dizziness, eye irritation and excessive yawning due to lack of fresh air during long meetings in conference rooms. For these and many other reasons one needs to monitor the IAQ in the office buildings.

"Fresh air itself will not help in the absence of an efficient filtration system that keeps out particulate matter (PM10 and PM2.5) present in high concentration in ambient air, especially, in large Indian cities," informs Srinivasa Desikan, Sales Director – South Asia, UL. Elaborating he further says, filters must be rated minimum efficiency reporting value (MERV) 13 and higher and be changed periodically. Multiple studies prove a direct correlation between indoor air quality in an office and employee health, brain function, sleep, productivity and job satisfaction.

As a result, Bhangare from Testo India points out that the facility manager or the supervisors often try to ensure that the indoor work environment, be it air conditioning, temperature regulation or light etc., is controlled and comfortable for the people as it directly impacts their health and efficiency.

Giving importance to IAQ in office buildings, Gaurav Burman, VP & APAC Head, 75F specifically states, "Poor air quality makes the workforce sluggish, unproductive and sick directly, diminishing the

Poor air quality makes the workforce sluggish, unproductive and sick directly diminishing the business' bottom line.
- Gaurav Burman, VP & APAC Head, 75F

business' bottom line." He further exemplifies through research by Lawrence Berkeley National Laboratory and Harvard and Syracuse Universities informing that good indoor air quality can improve work performance by as much as 10 per cent and employees' cognitive abilities by 61 per cent.

"Investing in good indoor air quality for a workplace not only impacts employees' well-being but also makes business sense. A surge in revenues, greater productivity per worker and increased employee morale and retention are just some of the many pay offs," opines Burman.

What contaminates air

ISHRAE considers the indoor air as healthy when it does not contain contaminants in harmful concentrations and is acceptable when the majority of people feel comfortable. Lack of proper ventilation and filtration and improper distribution also leads poor indoor air quality.

Particulate Matter PM2.5 and PM10, CO2, nitrogen dioxide (NO2), ozone (O3) and other volatile organic compounds (VOCs) also contribute to deterioration the quality of indoor air.

Indoor air pollution can originate from within the building or can be drawn in from outdoors. Contaminated outdoor air, pollen, radon, pesticides, etc. that enter the building from outside and pollution from within caused by occupants, smoking, cleaning supplies, motors, unclean ducts, improper ventilation or emissions from office equipment like printers, photocopiers, informs Gaurav Burman of 75F.

Modern commercial buildings are air-conditioned and insulated to regulate the temperatures. Burman of 75F says, through insulation, they also manage to keep pollutants and allergens locked in with cool air inside the building. Without fresh air circulation, the air becomes stale and gradually accumulates unhealthy levels of the above-mentioned pollutants.

VOCs constitute one of the major contaminants that pollute indoor air. Paints, furniture, doors, carpets, flooring, laminates, computers and laptops (due to printed circuit boards) release VOCs that can trigger asthma, allergies, headaches, respiratory diseases, reproductive and developmental defects, and eye, nose and throat irritations. Desikan from UL recognises some VOCs and formaldehyde as being carcinogenic and known to cause a few forms of cancer. He mentions Health of the Nation's States report by the Union Ministry of Health, which pegs the blame of 10 per cent of the nation's disease burden in 2016 to both indoor and outdoor pollution.

UL's Environment and Sustainability division has conducted pioneering studies in nearly 3,000 environments wherein it has analysed emissions from over 65,000 different materials and furnishings. It identified over 13,000 unique VOCs in product emission studies and found that many of these VOCs are present in buildings.

Bhangare from Testo India points out that humidity and moisture levels along with the presence of dust particles in the surrounding can also degrade the air quality in the office premises.

To maintain the balance of oxygen vs carbon dioxide, it is important that minimum air circulation or air changes need to be maintained as per CPCB National Ambient Air Quality Standard (NAAQS) for AC buildings. With increased pollution in the outside air is becomes more important to provide indoor treatment, suggests Akash Deep, Senior Programme Manager, GRIHA Council.

How to maintain indoor air quality in office building

In ISHRAE's opinion, controlling contaminants at source is the most important activity to improve air quality. Purification of outdoor air before being suppled into the building is important along with the equipment and material selection. Further, good construction and installation practices, low emission operation and maintenance practises are the need of the hour to improve IAQ in office buildings. When the outdoor air quality does meet the

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- Kalidas Bhangare, Managing Director, Testo India

national AQI, ISHARE gives emphasis on ventilation and filtration design.

According to Bhangare of Testo India, encouraging fresh air ingress in the areas will lead to lesser air contamination issues. Also, people need to take care of the building material as well so that the climatic conditions can be met much more efficiently. But the most ideal way to maintain IAQ is to measure and monitor the necessary parameters regularly and properly and based on that, update or maintain the HVAC systems. Testo provides a range of multiple instruments that assist building managers in maintaining the desired IAQ level.

The Testo 160 wireless LAN data logger that measures, monitors and documents temperature, humidity, light intensity, UV radiation and CO2 concentration in offices– automatically and without interruption – hence, all indoor climate monitoring parameters in one.

An individually designable cover is also available for each data logger which allows the logger to blend into almost any environment. Testo in its recent upgrade, combines everything which makes the air velocity and IAQ measurement technology so successful – intuitive operation, precise measurement values and an extensive probe range which can even work wirelessly via Bluetooth.

The new Testo 440 and Testo 400 constitute of a compact handheld measuring instrument with user-friendly measurement menus and wireless probes – for the versatile and convenient measurement of all air conditioning and ventilation parameters. The probes are available for air velocity, temperature, humidity, degree of turbulence, CO2, CO and light intensity.

As per Burman from 75F, by scanning the indoor environment throughout the day, HVAC systems that are enhanced by IoT controls and predictive analytics are better equipped to react to building needs on a real time basis. They factor in data such as occupancy rate, weather forecasts, angle of the sun, etc. ensuring that the outside air supply at any given point in time is adequate and optimal. 75F offers Indoor Air Quality Management solution, for example, that detects the level of CO2 and NO2 in each zone in the building and proactively adjusts the outside air dampers to maintain air quality at appropriate levels while ensuring optimal temperatures, humidity and moisture levels. At the same time, it also ensures to save energy.

Low VOC paints, adhesives and sealants are readily available in the market. Acceptable VOC levels, composite woods free from urea formaldehyde products can be as per Green Rating for integrated Habitat Assessment (GRIHA) standards India's national green building rating tool developed by The Energy and Resource Institute (TERI) and the Ministry of New and Renewable Energy (MNRE). CO2 levels can only be brought down by planting more and more trees/greenery both externally and internally.

In any AC space, CO2 levels shoot up drastically ranging from 1200 ppm to 1700 ppm, which is the way above acceptable limits. Also, we tend to close all-natural air infiltrations when using AC spaces, interestingly air leakages or air changes is important to maintain CO2 levels, suggests Akash Deep from GRIHA Council.

Solutions

In order to boost morale and comfort level of employees, it is necessary to invest in good indoor air quality for a workplace. It helps to generate better revenues by enhancing greater productivity per worker. Srinivasa Desikan of UL, says, the threshold values to maintain IAQ parameters for CO2 are ambient air (+) 700 ppm, less than 15 μg/m3 for PM2.5, less than 9 ppm for CO, less than 50 μg/m3 for PM10, and less than 40 μg/m3 for SO2 and NO2.

He adds, "To prevent outdoor contaminants from entering, filters compliant with necessary standards should be used. On the other hand, indoor air quality can be improved by using products that do not emit harmful contaminants and proper ventilation of buildings." ■

The threshold values to maintain IAQ parameters for CO_2 are ambient air (+) 700 ppm, less than 15 μg/m^3 for PM2.5, less than 9 ppm for CO, less than 50 μg/m^3 for PM10, and less than 40 μg/m^3 for SO_2 and NO_2.
- Srinivasa Desikan, Sales Director – South Asia, UL

Revolutionising Air Filtration Industry

AAF-Daikin offers comprehensive, innovative air filtration solutions designed to remove and control airborne particulates and gaseous contaminants in residential, commercial, industrial, cleanroom, automotive, railways, power generation and nuclear power applications. With their expertise, the company will continue to lead global initiatives that increase productivity, improve processes and protect public health for the next 100 years. **Rahul Uppal, COO for AAF-Daikin – EEMEA, CIS & SAARC Countries** outlines evolution of AAF in India, solutions and products offered by the company for India, demand for air filters and many more in an email interaction with Cooling India.

AAF was established in 1921, however, it entered the Indian market only in 2006. How has your business in India evolved over the years?

AAF International entered India in 2006 when the company recognised that clean air is critical in developing countries like India. The growing number of centrally air-conditioned buildings allowed us to invest and set up our first manufacturing facility in Bengaluru.

By the end of its first year, the sales team marked its presence in the pharma segment and the HVAC industry. After three years, AAF International gradually started projects in the automobile industry, IT industry and entered the power and industrial segment. The breakthrough year was 2011 when the company set up another manufacturing plant in Noida. It also introduced TMRSC products for cleanrooms and commenced equipment manufacturing in the same year. In 2013, we won the biggest telecom industry project for all its plants. With the introduction of FFU (Fan Filter Unit) in the Indian market, AAF International grabbed most of the hospital projects. By 2014, AAF International became the preferred partner for the healthcare and life science industries and started exploring other industries where clean air is crucial. AAF Flanders was formed in April 2016, when AAF International acquired Flanders Corp. The combined company offers comprehensive, innovative air filtration solutions designed to remove and control airborne particulates and gaseous contaminants in residential, commercial, industrial, cleanroom, data center, sewage treatment plant and nuclear power applications. AAF is the world leader in clean air solutions and always ahead of the competition. AAF is India's first and only filtration company who installed auto scan test facility to test HEPA and ULPA filters as per EN 1822 international standards.

Poor air quality has recently become an epidemic of sorts in India. How is AAF geared up for this challenge?

AAF understands the vital importance of clean air. That is why

we are committed to cleaning the indoor air quality not only in India but around the globe. We are committed to improve quality of life, increase productivity, protect critical processes and equipment and create products that advance the human condition. Some aspects that AAF always adheres to are:

- Sustainability is always a top priority in our R&D efforts.
- Provide sustainable and 'green thinking' solutions.
- Reduce energy consumption and the carbon footprint for ourselves, and our customers alike.
- Improvements in environmental management system.

AAF Flanders is committed to protecting people, processes and systems through the development and manufacturing of the highest quality air filters, filtration equipment and containment housings available today.

What are the products and solutions you offer in the air filtration category?

AAF supplies a wide range of filters for various industries from commercial buildings to industrial processes, from home applications to high-end cleanroom applications.

AAF provides solutions for:

- IAQ to protect people
- Cleanroom filtration to protect process.
- Gas-phase products for gaseous contaminants like VOCs and corrosive or toxic gases
- Air Pollution Control – Dust collectors and smoke collectors
- Gas Turbines - Auxiliary equipment, filters, repairs, refurbishment, retrofit and upgrades.

How do you see the demand for air filters in India?

People and governments are increasingly becoming aware of the hazardous effects of pollution on health and the environment. Incidences of respiratory related diseases are rising. 'Save the planet' has become a global slogan. These factors are driving growth of air filters in India and across the globe. Increased disposable income with people has enabled people to invest in health-related products. Stricter implementation of pollution laws is also contributing to the demand for technologically advanced air filters for the industry. It is estimated that the demand for filters will grow at a CAGR of nearly 30 per cent over the next five years.

Features of Sensor360

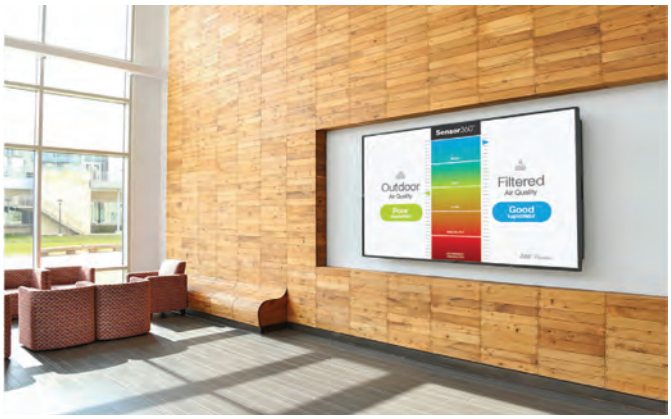
- First IoT with real-time filtration and TCO (Total Cost of Ownership) optimisation
- Predictive insights at-a-glance for each air handler unit
- Data driven: Intelligent data to improve operational efficiency
- 24/7 visibility into enterprise-wide performance.

Sensor 360 Making the Invisible Visible.

You have recently introduced the next generation facility management tool Sensor360. Could you tell us more about this product, features, applications etc.?

AAF is a pioneer in the air filtration industry. The latest invention which differentiates AAF from rest of the filtration companies is Sensor360, a next generation monitoring and facility management tool that enables the customer to understand and plan their air filter performance and maintenance in an entirely new way. It is the first IoT (Internet of Things) patented technology platform that demonstrates the effectiveness of a building's filtration system by monitoring particulate levels.

Sensor 360 is a battery-operated sensor which measures both indoor and outdoor particulate concentration (PM1, PM2.5, and PM10 levels). By monitoring pressure drop, the user can determine the changeout point for the building's filters that offers the best value and energy efficiency. With Sensor360, the user can optimise preventive maintenance scheduling, decrease deferred maintenance, save money, reduce risk, and gain time.



What are your strategies to place this Sensor 360 in Indian market?

We would place Sensor360 as a necessity for our customers for their filters maintenance and achieve their IAQ goals. Clean air solution with next-generation monitoring tool helps track filtration performance and maintenance by providing optimum filter changing data which helps reduce energy cost for late filter change and labour & filter cost for an early filter change. This, in turn, helps facility managers to know the excellence of our solution and their ROI on it.

AAF is committed to revolutionising air filtration with the opening of clean air innovation and research centre in Jeffersonville, Indiana. ■

BALANCING HVAC SYSTEM TO AVOID HOT OR COLD SPOTS

HVAC O&M team needs to have a process of Testing, Adjustment and Balancing (TAB) of the system in order to improve the comfort levels of occupants and to help lowering energy costs.

One of the most common problems that the building HVAC engineers face is the complaint from occupants that the place that they are working is either too hot or too cold. The problem of hot spots and cold spots in an air-conditioned space is an issue that the HVAC operations team has been grappling with for ages. Approximately 45 – 55 per cent of calls to the building helpdesk by the occupants in an office are related to requests of increasing the temperature at the workstation or complaints of the space being too hot and a requirement of the temperature to be lowered. HVAC systems are typically designed for space cooling and ventilation and do not typically cater to the individual user in the work space. Thus, catering to these requests and complaints can put the HVAC system in disarray and hence, the HVAC operator must have an in-depth understanding of the system to be able to cater to the end user requirements.

To ensure that a building's HVAC system works at the design point that was originally planned, a very crucial aspect of the process of commissioning as well as ongoing maintenance is the 'Testing, Adjusting and Balancing' (TAB) of the system. In common industry terms, this process is called air balancing but the process is more complex and covers various HVAC systems. There is a great deal of focus on commissioning of the main chiller and high side systems such as cooling towers and pumps as well as the AHUs. However, the process of testing the system if not robust enough in many cases which leads to the issue of hot or cold spots and other balancing related problems when the systems get operational.

What is TAB?

HVAC systems are designed on paper (electronically actually!) by consultants and specialist from various areas of the HVAC ecosystem. The testing of the components of the HVAC systems – fans, pumps, chillers etc are done at the factory and the ratings are as per standard test conditions laid down in various guides and codes. However, when the systems and components are installed and integrated into the overall HVAC system, the performance is no longer in an ideal factory environment or test conditions. There will

be deviations from the ideal operating parameters due to various factors such as ambient temperature, system design, component degradation etc. The TAB activity is a process to assess how the system is performing in the field, in the actual conditions where the system must deliver. ANSI/ASHRAE Standard 111-2008 (RA 2017) - measurement, testing, adjusting, and balancing of building HVAC systems is a comprehensive document covering all aspects of this important activity in the commissioning phase of an HVAC system as well as during operations. Some of the benefits that a structured TAB activity brings to the HVAC O&M team are:

- Availability of a baseline of the system at the time of installation or start of operations.
- The baseline enables the O&M team to check for deviations during operations and take corrective actions.
- Assess system efficiency and use the observations in energy conservation programs.
- Assess change in operating parameters whenever modifications to the system are carried out.

While every system and component of an HVAC system needs to be tested and assessed for conformity to the original design specifications, it will be a very costly and time-consuming activity. Thus, the more efficient approach is to undertake the testing, adjustment and balancing of sub systems of the HVAC installation of a building. Typically, TAB is carried out for the following sub systems:

Air distribution system: The supply of the right quantity of air, at the right velocity and location is crucial for an efficient and effective HVAC system, one that can achieve the right temperature in the work space and provide a comfortable work environment for the occupants. Thus, a major focus of TAB activities is on the air supply system to the work space. Air balancing, as the activity is commonly called, is an important process in the commissioning of the HVAC system as the test of the system is at the delivery point. The air distribution system covers the ducting, air diffusers, supply and return lines and AHUs.

Hydronic system: A typical water-cooled HVAC system will have chilled water circulating through several Air Handling Units (AHUs) in a building. Hydronic or water balancing is the process of supplying the right amount of chilled water to the AHUs based on the load requirements at that point in time. Chillers consume the maximum amount of energy in the system and if the chilled water supply is not reaching the AHUs that need the desired heat load to be transferred, then there is a substantial loss of energy in the system. Thus, hydronic balancing is a very crucial aspect of the commissioning phase of the system and required specialist to ensure a correct balance of the system.

How to TAB? The processes and procedures involved in the carrying out TAB of air as well as Hydronic are quite exhaustive and detailed. There are established guidelines as per local codes such as ASHRAE 111 2008 (RA 2017) which TAB specialist use to assess the condition of the system, make necessary changes during the commissioning and then set the systems for an optimal balance of the system. A brief overview of the process of air and water TAB is as below:

Air side TAB: The aim of air balancing is to measure the air flow in the work space, use the ambient data along with the air flow and arrive at the heat transfer in that space. This is compared with the design values and where needed, changes to the air flow are made to bring the system as close to the design values. To obtain the air flow, the TAB engineer will install hoods on the supply grills of the workspace to assess the volume of air (cfm) passing through for a specified duration. The other parameters that the TAB engineer measures are the pressure difference between the supply and return sides of the AHU and the humidity in the area. The deferential air pressure is measured using a calibrated manometer.

Once the hot and cold zones have been identified through the testing process, changes to the air flow are made either by changing the fan speed or by adjusting the dampers for the selected areas. The air balance process is carried out again and through a series of iterations, the system is set to as close to design air flows as possible. There is a range of (+/-)10 per cent in the measurements due to the various system efficiencies which the TAB engineer needs to keep in mind while arriving at the final values.

Water Balancing: The aim of carrying out a check of the water flow at various points in the chilled water system is to see that the correct heat transfer occurs at the chiller as well as at the AHU coil interface. Water balancing is carried out after the air balancing has been completed. Prior to the water flow check, all system valves are opened fully, and the AHU bypass valves are closed. Thereafter, water flow (GPM) is checked at the chiller inlet and the temperature rise across the AHU coils are measured. The flow rate is adjusted at the AHU level to get the desired temperature drop and the process is carried out for all the AHUs. Once the adjustments have been done, the position of the flow values are marked, and the system is balanced.

Conclusion

An HVAC system that has been commissioned correctly will provide reliable and efficient service for a considerable duration of time if there are no changes in the HVAC system. However, in real life, there are hardly and steady state conditions. There could be a change in the use of the workspace, the occupancy may increase, meeting rooms may be concerted to work stations etc. Thus, the HVAC O&M team should have a process of TAB of the system whenever there has been a change in the HVAC system or if there are repeated complaints of hot or cold spots in the workspace. This will not only improve the comfort levels of the occupants but will also help lowering energy costs as the system is working at the design or close to the design point. ■

Aneesh Kadyan
Sr Director - Operations, CBRE South Asia

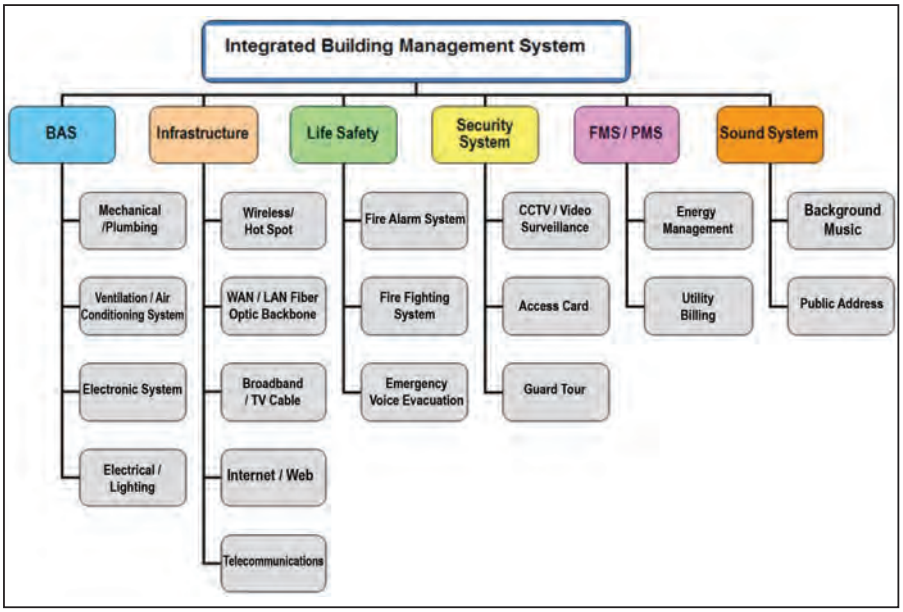
SMART AUTOMATION & CONTROAL SYSTEM

for Commercial Buildings

Any building can run for a longer time if its energy bill is minimum and its maintenance cost is less. This can only possible with proper installation of a smart automation and control system.

Background

Commercial usable space requirement in India has gone up in demand in India during the last few years. Commercial spaces can be defined as buildings used for commercial purposes such as office buildings, IT buildings, government buildings, banks etc. In any commercial building, occupants generally spend 8 to 10 hours in a controlled environment. People do different activity and use different equipment inside the closed premises. Hence, they need fresh air, domestic water, proper drinking water, toilets, electricity, work stations and finally comfortable air temperature. For finding out the number of people using a commercial building, national building code of India specifies as 80 to 100 square feet per person. Each square foot of comfortable space needs nearly 80 BTU of air conditioning load and nearly 11 watts of connected electrical load. For a building manager, maintaining these loads is always a challenge and manually controlling all these services is next to impossible.



Major Equipment in Commercial Building

In any commercial building, there are number of mechanical equipment such as chillers, AHU, pumps, valve, electrical equipment such as switchgears, generators, panels, transformers, PHE equipment such as pumps, STP, boilers, treatment plants can be seen in any building along with measuring devices such as BTU meters, DB meters and energy meters. When these equipment get connected with one central point for a common goal, it will be known as Smart Automation System (SAS). SAS takes care at each equipment for saving energy as below:

- LED fixtures.
- Proper DG Back up
- Water and power efficient chillers
- VFD in pumps, AHUs
- Temperature sensor for conditioned area
- Water saving fittings
- STPs with sensors
- CO and CO2 sensors
- Oil indicators

There are lot many mechanical and electrical equipment not listed above which are found in any building and have optimised by design engineer in terms of power and water saving. But the main object will fulfill only with the help of proper and adequate IBMS.

HVAC automation system

HVAC plays a major role in building automation as it consumes 65 per cent of total energy and 50 per cent of operation staff. Not functioning of HVAC, reduced performance of the staff and over using of HVAC increase electricity bills. Chillers, pumps and AHUs are the important parts of HVAC control system in case of a chilled water system. However, VRV system comes within built automation system which does not need any external system to guide. Following points of HVAC can be connected to SAS.

Cooling towers are generally controlled automatically by the chiller panel and no separate automation system is required. But pumps need to get connected in automation system. Following points of pumps to be connected with the SAS and BMS.

Air handling units play a key role in automation of any commercial building as it is responsible for providing comfortable atmosphere to the occupants. Following points of AHU to be connected with the SAS and BMS.

Electrical automation system

Along with the HVAC system, plumbing,

S.N.	DESCRIPTION	QTY	AI	AO	DI	DO	REMARK
A	**CHILLER PLANT**						
A1	Water cooled screw chiiler	1					
1	Chiller ON/OFF command					1	Command from PC/DDC to the chiller MCC panel
2	Chiller ON/OFF status				1		signal from potential free contact
3	Chiller Flow status				1		Paddle Type Flow switch
4	Chiller trip status				1		Signal from potential free contact
5	Chiller Auto or Manual status				1		Signal from A/M switch
6	Common chiller supply / Return header temperature.		2				Imm type temp sensor
7	Chiller isolation Motorised valves ON/OFF command & status.				2	2	ON/OFF motorised butter fly valve with limit switch for position status.

S.N.	DESCRIPTION	QTY	AI	AO	DI	DO	REMARK
A4	**Primary chilled water pumps**	**1**					
1	Chilled water pump ON / OFF Command					1	Command from PC/ DDC to the primary CHW pumps panel
2	Chilled water pump ON / OFF status.				1		Differential pressure switch across the CHW pumps for ON/OFF status.
3	Chilled water pump auto or manual status				1		Signal from A/M switch.
4	Chilled water pump trip status.				1		Signal from potential free contact.

B	Air Handling Units /FCU						
B1	Air Handling Units Shops Floor	1					
1	AHU ON/OFF Command					1	Command from PC/DDC to the AHU panel
2	AHU ON/OFF Status				1		Signal from potential free contact
3	AHU Auto or Manual status				1		Command from PC/DDC to the AHU panel
4	AHU VFD Control			1			Command from PC/DDC to the VFD panel
5	Filter status				1		Air differential pressure switch across the filter
6	Return air temperature sensor		1				Temperature sensor
7	Supply air Temperature sensor		1				Temperature sensor
8	CHW 2-Way Valve Control			1			Two-way CHW valve control
9	Fire trip status				0		Signal from potential free contact
10	Fire Damper output					0	Signal from DDC to fire damper

E	Electrical System						
E1	**Substation Area, Panels**	1					
1	HT Panel - Breaker ON/OFF Status				1		Signal from potential free contact
2	LT Panel I/c breaker ON/OFF Status				1		Signal from potential free contact
3	Synchronising Panel I/c & OG breakers ON/OFF Status				1		Signal from potential free contact.
4	Capacitor Panel - I/c breaker				1		Signal from potential free contact
5	Capacitor Panel - PF meter				1		Signal from potential free contact.
E2	**Transformer - 2 MVA**	2			4		
	Transformer ON / OFF Status				8		Winding temperature has to be monitored signal from WTO
	Transformer oil level monitoring				8		Signal from potential free contact

STP, electrical systems are also integral part of building automation and control. There are so many examples where HVAC system is controlled but other systems are left for manual operation. The point to be noted is that the only combined MEP automation can give the combined benefit.

Lighting Control System

A lighting control system is an intelligent network-based lighting control solution that incorporates communication between various system inputs and outputs related to lighting control with the use of one or more central computing devices. Lighting control systems are widely used on both indoor and outdoor lighting of commercial, industrial, and residential spaces. Lighting control systems serve to provide the right amount of light where and when it is needed.

Lighting control systems are employed to maximise the energy savings from the lighting system, satisfy building codes, or comply with green building and conservation programs. Lighting control systems are often referred to under the term Smart Lighting.

Lighting control strategies

- High-end trimming sets the maximum light level based on customer requirement in each space.
- Occupancy or vacancy sensing turns light on when occupants are in space and turn off when they vacant the space.
- Daylight harvesting dims electric light when daylight is available to light the space.
- Personal dimming control gives occupant the ability to set the light level.
- Scheduling provides pre-programmed changes in light level base on time delay.
- Controllable window treatments adjust shades to reduce solar glare and solar heat gain.
- Plug load control automatically turns off the load after occupant leaves the place.
- HVAC integration control heating, ventilation and air-conditioning system through contact closure, or BACnet protocol.

Advantages of lighting control

- Light control supports building operation staff by providing appropriate light for any task.
- Light control can also reduce the demand for building staff, allowing them to focus on the primary responsibilities with fewer distractions.
- With the use of the light control and having the ability to adjust light to a personal preference support staff to deliver the highest quality care.
- Light control has improved the staff performance by providing lighting levels that are the most appropriate for the task at hand.
- The lighting control has been able to provide biggest advantage of energy saving.

Conclusion

Commercial office spaces are the present requirement of the market. Any building can run for a longer time if its energy bill is minimum and its maintenance cost is less. This can only possible with proper installation of a smart automation and control system. Again, SAS and BMS help in getting 35 per cent of energy saving as compared to a normal building without the same. ■

Firoj Jena,
Chief Executive Officer, Clancy Global Consulting Engineers, Mumbai

Testo launches Smart Probes

New smart probes with advanced features have new functions and more convenience at work.

Measurement technicians in any facility or plant maintenance and HVACR maintenance are responsible for the smooth and cost-efficient operation of refrigeration systems, air conditioning plants and heat pumps, and are under a high level of time and cost pressure. Jobs using measuring instrumentation (functional testing and servicing) must be processed reliably, easily and quickly including documentation. In that regard, Testo extends its range of revolutionary smart measurement solutions with 3 new Testo Smart Probes. These innovative, pocket-sized pro-measuring instruments carry additional advantages with excellent innovative features and designs. Now measurement becomes easier and more efficient as the contractors and service engineer can address larger number. of application areas conveniently.

Testo had figured out the importance of smartphone in day-to-day life at a very early stage and even successfully integrated the feature of smart working into measurement tasks as well. The existing eight smart probes were the result of innovation in developing smart and compact measuring instruments which can be connected to the smartphone or tablet via Bluetooth, and conveniently and intuitively operated via app. They proved out to be a great development in the HVACR segment making on-site measurement and data sharing so simple. Taking a step ahead, Testo introduces 3 new smart probes in its basket namely new Testo 605i (thermo-hygrometer), new Testo 549i (high-pressure measuring instrument) and new Testo 115i (clamp thermometer).

New Designs & Improved Operations

The new Testo 605i has thinner probe tip which is ideal for smaller measurement apertures and openings to measure humidity and temperature. It also has a stable magnetic holder given at the back for secure attachment. Not only that, the new Testo 605i has a bendable probe feature which makes measurement more comfortable at the outlets, vents or at any other difficult to access locations. The new Testo 549i pressure measuring probe is redesigned and its connection is angled at 45-degree for easy mounting. The new Smart Probes Testo 115i, Testo 605i and Testo 549i have an extended Bluetooth range of upto 100 metres. With the telescope of the Testo 405i, the reach is extended by 400 mm in ventilation duct measurements.

Operationally, these probes are much advanced as they can perform additional functions. In addition to the cooling and heating performance of these probes, they are capable enough to conduct functional testing of refrigeration and heating systems. For example, for an air conditioned ambience, there is no need to measure the ambient parameters and duct outlet parameters separately, instead they can be measured at the same time even if the vent is placed outside the room. This feature is possible due to the increased Bluetooth range of these probes.

Mould detection can be carried out using the Testo 605i and infrared thermometer Testo 805i.

Smart sets for smarter technicians

In order to facilitate refrigeration, air conditioning and ventilation contractors with all the measuring instruments necessary for their daily jobs, Testo offers tailor-made sets which are better, focused and kits including Testo Smart Case for Heating, VAC, RAC, HVAC applications. Respective technicians can conduct their on field measurement tasks, record and share the data by using his smart phone. Multiple probes are available in these kits at special prices, which enables safe storage and comfortable transportation of instruments. They are suitable for all important temperature, humidity, pressure and flow velocity measurements. ■

For more details, contact info@testo.in

ENERGY SAVINGS POTENTIAL FOR COMMERCIAL BUILDINGS HVAC

Energy consumption has been growing exponentially over the years. Today, more than 4.7 million commercial buildings consume more energy than the transportation or industry sectors, accounting for nearly 40 per cent of total energy use as shown in Figure 1. The total energy used by commercial buildings topped in 2004-05.

This increase in energy use is caused mainly by growing commercial floor space, which drives other buildings like schools and hospitals. Economic growth (GDP), which drives demand for floor space is shown in figure 2. Commercial buildings consist of various sectors like public utility buildings, hospitals, schools, malls, retail, restaurants and floor space as shown in figure 3. Among these, floor and retail occupy the major percentage. Commercial energy intensity has grown (Figure 4) and understanding the primary energy use (Figure 5) will help with energy cost saving measures.

It is not surprising that heating and cooling are the predominant consumers of energy in a commercial building followed by lighting as shown in Figure 6. Here we take a look at some of the energy cost saving measures one can implement in order to meet the annual energy goals of a building.

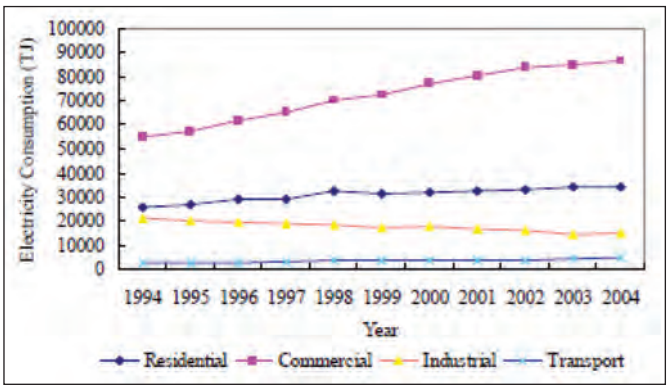


Figure 1. Increase in HVAC energy use in different applications over the period of time

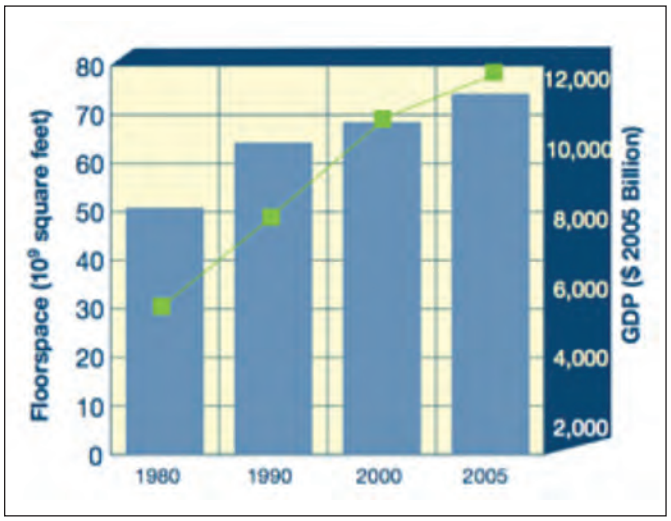


Figure 2. Growth in HVAC energy consumption in commercial floor space.

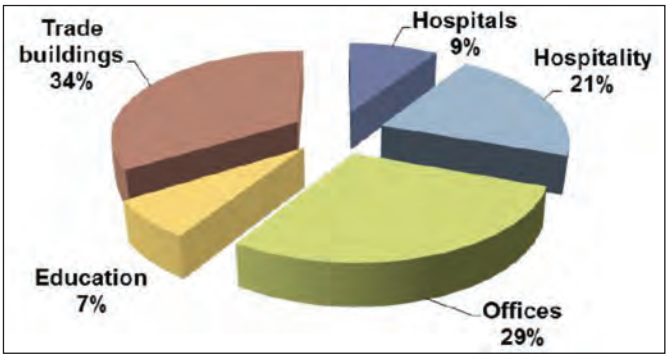


Figure 3. Energy consumption in commercial buildings in India.

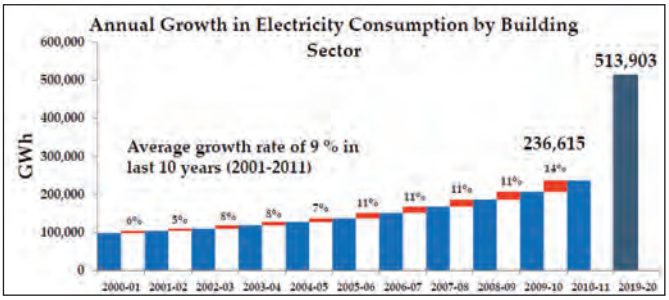


Figure 4. Electricity consumption growth in commercial buildings in India.

Energy saving techniques in HVAC for commercial buildings

Smart building concept

Smart building is the term used for buildings that have complete automated controls and systems in place. These controls comprise of sensors and actuators that are integrated together to form an intelligent data collection application. A smart building has an annual growth rate of 22.6 per cent and has the potential to reach USD 20 billion by 2020.

For optimal operation of utilities in buildings and avoid energy wastage as well as save energy costs, it is essential to collect extensive data and use it for operating various systems. For example, one can use the data to see how his or her HVAC is performing and control the temperature set points based on outside weather. One can also use a centralised command center to transmit any commands to change settings, adjust values and thus, save energy.

Smart building systems save energy costs because they provide visibility into the entire building even if the facilities are spread across a large area like a university. The data that these systems collect can be used for analysing, tracking and communicating.

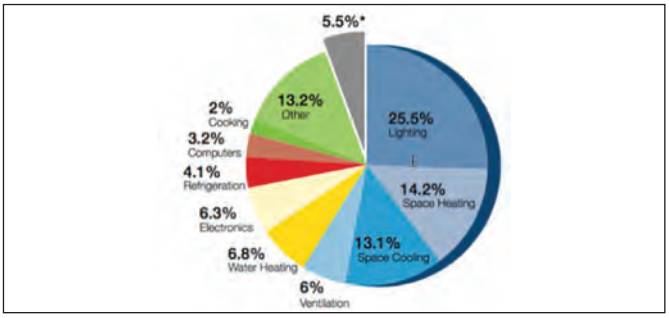


Fig. 6. Commercial primary energy end use.

Table 1. Summary of energy savings by use of alternate cooling technologies in commercial building.

Sr. No.	Space heating/cooling Technology	Energy savings (%)
1	Desiccant cooling	20%
2	Magnetic cooling	17%
3	Solar cooling	90%
4	Thermoelectric cooling	33%
5	Thermo-tunneling cooling	9%
6	Solar ventilation pre-heating	11%

Table 1 summarises the some of the advanced technology options that fall under alternate heating and cooling options to the conventionally used vapour compression based traditional air conditioners. Figure 7 shows energy saving potential for the technology options.

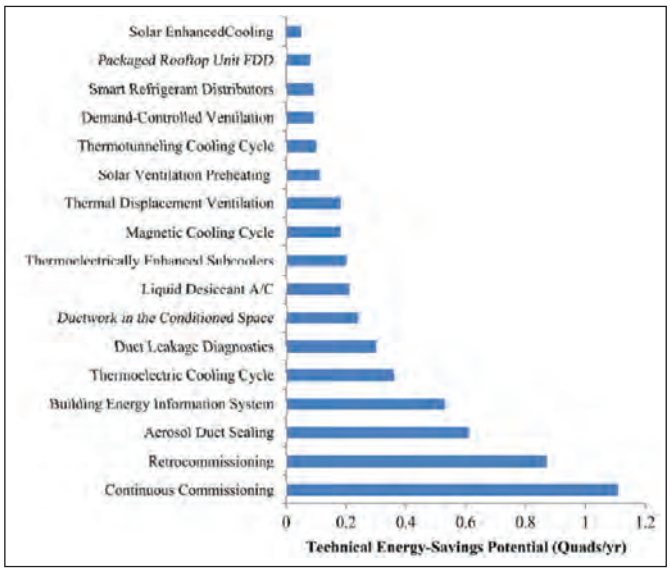


Figure 7. Comparison for energy saving potential in the different technology options.

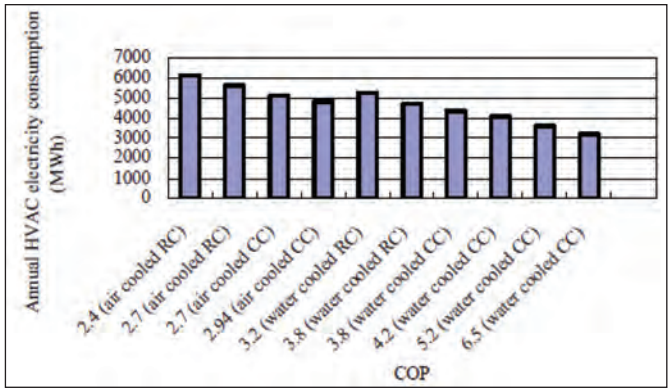


Figure 8. Annual HVAC electricity consumption against COP.

Low cost techniques

Employing quick low-cost techniques can save substantial energy bills. For example, turning off office equipment like printers, monitors, computers and copiers into sleep mode when not in use will cut energy costs by approximately 40 per cent. Performing

regular maintenance of HVAC system (Figure 8) is another low-cost way to ensure that the largest consumer of energy in building is efficient. Regular cleaning of coils and vents such as condenser and evaporator coils can produce energy savings of USD 0.10 per kWh.

IoT systems

The Internet of Thing or IoT is the latest technological innovation that is being increasingly used to manage energy efficiency. IoT uses the Internet to connect information gathered from various devices like sensors and actuators that are embedded within systems. IoT is typically used to collect information such as motion, air pressure, light, and temperature or water flow. When integrated with a Building Management System (BMS), it enables autonomous monitoring, control and provides advanced analytics where the data can be used for predictive modeling. This allows for higher cost savings, increased productivity as well as revenue benefits, especially with the data.

Advanced insulation

Adding layers of insulation around your HVAC, heating and cooling pipes, and electrical outlets will help with maintaining efficient energy levels and reduce wastage of energy. Insulation provides resistance to heat low and lowers the heating and cooling costs (Figure 9) and increases the comfort of the occupants. Another way to improve the energy efficiency of buildings is to reduce heat loss through the building envelope by internal or external wall insulation. By external wall insulation, the building will also benefit from aesthetic improvement besides improving the thermal comfort. Other advantages of installing the insulation on the outside include the reduced disturbance of the occupants, the disappearance of mold and reduced maintenance.

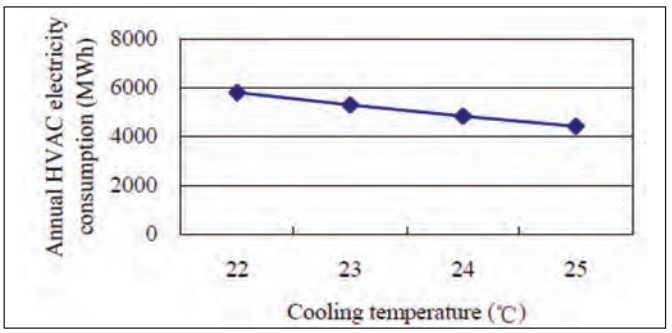


Figure 9. Annual HVAC electricity consumption against cooling temperature.

Building design

- Using general cooling measures and 'green' designs help in reducing energy costs. Some of them are:
- Natural lighting and opening interiors to daylight.
- Use of landscaping and trees to provide shaded areas and reduce local temperature.
- Solar power panels can be installed on rooftops and can be used to power lights in parking spaces or even for water heating.
- Designing a water collection system for irrigating landscaping in and around the building.

Energy efficient lighting

Lighting makes up a significant portion of energy consumption after heating and cooling as shown in Figure 10. Hence, focusing on efforts to use energy-efficient lighting can help to cut down energy costs. Some of the ways one can do that is using occupancy sensors to operate the lights only when occupied. The other very successful way is to use a low energy consuming lights such as fluorescent, incandescent, halogen, LED or HID. The choice of type of lighting will depend on the specific lighting needs.

Fluorescent lighting is the most commonly used type of lighting: 93 per cent of commercial buildings use standard fluorescent lights, and standard fluorescents illuminate 78 per cent of lit floor space. Compact fluorescent (CFL) has become the second most common lighting type, providing light to 13 per cent of all lit space in commercial buildings. The remaining lighting types—incandescent, high-intensity discharge, halogen, and light emitting diode (LED)—each light less than 10 per cent of floor space across all commercial buildings.

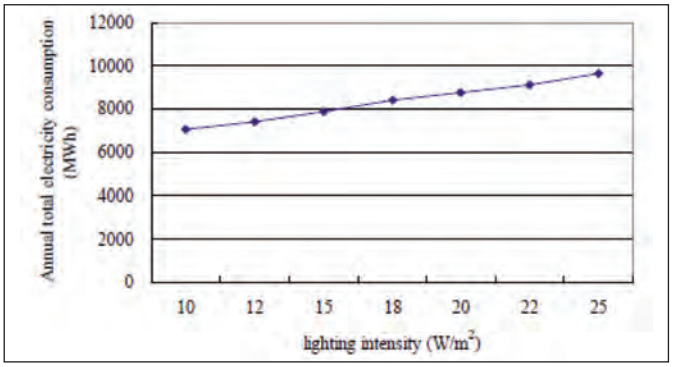


Figure 10. Annual total electricity consumption against lighting intensity.

Barriers to energy efficiency

- Lack of information about comparative energy use.
- Risk due to lack of confidence in performance of new technologies.
- Higher initial cost of EE technologies.
- Asymmetry in sharing of costs and benefits (especially in building sector).

Conclusion

Energy cost savings is on top of mind of every commercial building owner, operator or facility manager. There are many solutions available that can help you with energy cost savings. These range from implementing sophisticated technologies like IoT to low cost energy efficiency strategies like using natural light and finally using energy star rated equipment for long-term energy savings. Whatever is the solution, ensuring that you implement at least one or two frequently would ensure that your energy costs are considerably reduced and your energy savings substantially increases. ■

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Government Engineering College, Dahod, Gujarat Technological University – GTU, Ahmedabad, Gujarat, India.

Self-Repairing High-Speed Doors for Food Industry

Gandhi Automation's Prime Food flexible and self-repairing doors are similar to High Speed Doors except its structure manufactured from polyethylene.

The ease of cleaning and the anti-crash control system guarantees the highest standards of hygiene and safety, making these high-speed doors the ideal solution for companies operating in the food industry.

These doors are apt for retail food and beverage operations due to its reliability and rugged performance. There are options available for proper handling and environmental control at every stage of cold chain logistics, balancing costs with efficient operations. The innovative high-speed, high-performance operational abilities built into Gandhi Automation's rolling doors provide the dependability that clients require.

Gandhi Automation's rolling shutter, overhead door, or counter shutter reliable and suitable for a food service that is only open for a few hours a day or provide 24-hour service in an institutional environment.

Prime Food High Speed Doors are designed to meet the specific needs of food companies requiring a high level of hygiene. This is a rapid self-repairing high-speed door for internal use that has a flexible curtain without rigid elements and extreme opening speed.

Prime Food self-repairing doors are extremely easy to clean to meet the high hygiene standards in the food and retail industry. The polyethylene frame is designed to be sanitised in all its parts, without removing or disassembling any profiles or covers with related problems in assembling again all screws and external elements.

In addition, the anti-crash control system reduces the risk of impacts and accidents to a minimum, while the special sliding system lets the curtain come out from the guides in case of impact.

Prime Food is entirely manufactured from stainless steel material, easy to clean and resistant to oxidation. In Rapid Door Prime Food, stainless steel is equipped with powerful engines capable of opening and closing the door very quickly, and especially in great security, thanks to a security monitoring system with a photocell out of the cloth.

A full width clear vision window is included providing brilliant vision through the roll door panel. This is important when combinations of pedestrian and forklifts use the openings. The columns are clear anodised aluminum, and in some cases, can be powder coated to enhance their protection.

In food industry facilities, distinct areas need isolation without affecting the overall flow of business. Preventing contaminants from entering various areas is also of great importance.

That is why high-speed doors specially designed for the food and farming industry are safe, functional and characterised by a beautiful design. The most important they ensure rapid and safe opening and closing operations, thanks to a special photocell monitoring system, as required by current regulations.

Roll-up doors are the ideal solutions in this case, since they ensure high speed, durability and insulation. They are extremely easy to clean. They are also designed to ensure high resistance to chemicals and saline solutions. ■

For more information, visit: www.geapl.co.in

Modern Under Floor Air Distribution Costs Less

Underfloor air distribution continues to gain popularity among building and facility owners across the globe. This article explains the advantages of an UFAD system over a traditional overhead system.

The combination of a Raised Access Floor (RAF) and a well-designed Under Floor Air Distribution (UFAD) system, is one of the best environmental control systems for many types of commercial buildings. These are becoming more popular around the world and particularly so in India. It is a surprising fact that these systems were in use 30 years ago in Europe. For those unfamiliar with UFAD, many times, the use of UFAD is associated with computer rooms and accompanying once. Today that is not the case at all. Systems from a variety of major manufacturers are popularly used in all sorts of commercial buildings including: office buildings (particularly corporate campuses), university buildings, churches, casinos, elementary and high schools, libraries and government buildings.

These systems are in their 4th generation of improvement. Modern products are completely reliable, low cost and easy to apply. ASHRAE completed a widely read "UFAD Design Guide" in 2013. There have been thousands of projects installed in every corner of the planet. It is from this body of work that the author represents that many of the core requirements to implement this technology are really settled science, really no longer debatable. The cost relationships have been demonstrated and the user benefits documented.

New technology?

New technologies: VRF, variable speed pumping, ECM motors, etc., have wide adoption and growing market share but are

taking many years to reach their full potential. This often occurs because popular forces oppose change. Even when the new technology is adopted, some design influences want to resist the change and apply old habits and methods to implement the new systems.

If you were accustomed to building bridges with wood timbers, and then galvanised steel came along, would you use the same design with the new material? Certainly not. Something like that has been happening with the UFAD business, particularly in North America and other places, and to a lesser degree in India. Several old habits from overhead VAV systems are being used in UFAD designs to the significant detriment to system effectiveness and first cost. These include:

- **Using large ductwork under the raised Floor.** This mistake has an interesting consequence. The cost of that large ductwork (instead of multiple small ducts that ft between the pedestals) saves the mechanical contractor Rs 210 per metre of duct. But the wider duct adds the need for "bridging" across that duct to support the raised floor every 600 mm. These bridges cost about Rs 2,700 for every 600 mm of duct length. So, the mechanical contractor saves Rs 210 per metre, but the raised floor contractor has an increase of Rs 4,500 per metre of duct. Since these two trades (access floor and sheet metal) are part of different specifications, different contractors and different designers; this mistake still happens today. The raised floor supplier won't complain because his contract is larger, and he has little to no interest in ductwork! See figure 1.
- **The use of fan powered boxes in cooling only perimeter zones.** Sometimes designers say they need fans because they need "a lot of capacity" in a certain location. Huge capacity is easy to accomplish without a fan. 840 CMH per running metre of perimeter window is easily accomplished with plenum pressure of only 12.5 pa. Using fan powered products has a higher first cost, requires high voltage power (installed by an electrician) and branch circuit overvoltage protection. See figure 2. Fans make noise, they vibrate, require maintenance and (according to the ASHRAE guide) use about 5 per cent more energy.
- **The use of deck to deck walls.** This mistake is mostly made by acoustical consultants who may have no connection whatsoever with the General Contractor who is responsible for the RAF budget. When a few of these consultants are asked why they think the wall below the floor contributes to the better acoustics of the room, they seldom have an answer! It is a seriously costly mistake. It is advised that all walls except demising walls, core walls, wet walls and perimeter walls should be built on top of the raised floor. An independent third-party testing of such situation shows that the deck to deck wall, (particularly the part that is under the floor) do not add to acoustic isolation until you are building a wall above STC 51. That seldom happens in an ordinary project. The negative effect to the job of the wall protruding into the floor plenum is to dramatically increase the cost of delivering services to the isolated room. Voice, data, power, air all must penetrate two layers of sheet rock and require lots of extra sealing. Flexibility for adding services or reconfiguring walls is hindered for the life of the building. The other consequence is that the raised floor cost and construction time will dramatically rise. 25-50 per cent is probable. Much more field measuring and cutting are required. Once again, the access floor contractor gets a bigger contract, as do others. The only loser is the building owner trying to bring his project in under budget.
- One of the worst mistakes is to install a perfectly good raised floor plenum and then not put the air under the floor. This one will be the focus of the balance of this article.

The author has been on several design and construction teams where the installed cost of the RAF is justified by

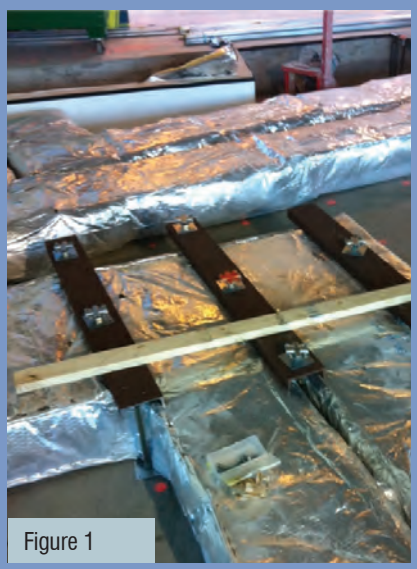

Figure 1

Figure 2

UFAD Systems

- Lower life cycle cost, lower first cost, lower operating cost
- 20-50% better ventilation as recognised by ASHRAE 62.1
- Better productivity by workers = big payback
- State-of-the-art user adjustable HVAC systems
- Faster construction, occupy space sooner
- Very low maintenance
- Possibly something new, contractors have to learn.

reductions in other trade costs, particularly the reduction in ductwork cost. Then the owner receives all the benefits of a raised floor and UFAD for the price of a conventional system. The facility will feature better indoor air quality, lower operation cost, better worker health and productivity and greater flexibility to make changes through the life of the building. The RAF is the largest incremental cost to deploy an UFAD system. If the project already has a RAF in the design, it makes very little sense to pay a higher first cost for an overhead air distribution system.

Of course, there are many kinds of buildings and widely varying build quality that will change these estimates, but both columns will change similarly. The relationship will remain. Once the raised floor is considered as a part of the plan, the use of UFAD will save first cost and provide a significantly better HVAC system.

Additionally, a logical argument can be made for designers to consider the financial cost of the workers or occupants in the spaces they are designing. The LEED guidelines, and now the Well Building Standards, give good empirical evidence on the effect of the thermal environment on productivity. This value is many times greater than any first cost saving or energy cost expense related to the HVAC system itself.

	RAF with Overhead VAV	RAF+UFAD
Cost of Raised Access Floor	180	215
Cost of diffusers and VAV boxes	125	185
Cost of ductwork	220	25
Cost of wiring phone, data, power	250	215
Total installed cost (verify by MTR)	Rs 775	Rs 640

In summary, it is recommended to consider using Underfloor Air UFAD as a way to reduce your first cost and improve the work environment for your clients. ■

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Managing Partner and Chief Engineer,
Airfixture, LLC, Kansas, USA

Foodpro showcases latest trends & innovations

The 13th edition of Foodpro 2019 - an exclusive initiative on food processing, packaging and technology was organised from 23 to 25 August at Chennai Trade Centre, Chennai. Coinciding with Foodpro, the 2nd edition of ColdStoRe India 2019 – a focused initiative on cold storage and refrigerated transportation and T-Food 2019 - an exclusive showcase on traditional foods were organised.

The food industry in India comprises the food-producing and processing industries. The food processing industry is one of the largest in India - it is ranked fifth in terms of production, consumption, export and expected growth. The food processing industry is of enormous significance for India's development, as it has efficiently and effectively linked the nation's economy, industry and agriculture. The linking of these three pillars has synergised the development process and promoted the growth of the nation to a great extent.

Foodpro 2019 Exhibition and Conference focused on the latest trends, innovations, R&D, equipment & technologies and provided the platform to various stakeholders to learn the best practices and deliberated on the growth in the sector by fostering new business opportunities and technology adoption.

The one-day conference discussed about the present status of the food processing industry in India and identified the challenges in the sector as well as the future prospects. The proposed session provided a perspective on the food industry in India - the opportunity factor, technology and emerging trends. The conference highlighted the steps being undertaken to alleviate technology, processing and R&D functionalities in different areas within the agro food processing industry.

Rameswar Teli, Minister of State for Food Processing Industries, Government of India was the Guest of Honour at the inaugural session of Foodpro 2019 Conference. Banwarilal Purohit, Governor of Tamil Nadu was the Chief Guest for the exhibition inaugural.

Other key speakers included R Kamaraj, Minister for Food & Civil Supplies, Govternment of Tamil Nadu, Dr K Ellangovan IAS, Principal Secretary, Department of Industries and Commerce, Government of Kerala; S Gagandeep Singh Bedi IAS, Agricultural Production Commissioner and Principal Secretary to Government of Tamil Nadu, Sanjay Jayavarthanavelu, Chairman, CII SR, Navas Meeran, Chairman, Foodpro 2019 among others. ■

Foodpro 2019 Highlights:

- 310 exhibitors with 10,200 square meters display area.
- Government of Tamil Nadu participated as the 'Host State'.
- Government of Kerala participated as the 'Partner State'.
- International representation from Germany, Italy, Malaysia, Netherlands, Spain, Turkey, UAE and USA.
- This initiative was supported by NSIC and 21 sectoral associations.
- 3 days sectoral conferences on food processing, dairy technologies, traditional foods.
- 23,000 business or trade visitors and 600 delegates.
- Release of report on 'Indian Food Processing Sector Trends and Opportunities'.
- 800 B2B meetings.

FOOD CONSUMPTION TRENDS & HVACR

Industry veteran N Srinivas explains how shift in food consumption is driving the HVACR industry.

The expression 'food' covers many items of consumption belonging to the 'perishable' category. At normal ambient temperatures, perishable food products like vegetable and fruits need to be transported speedily from the

farm to the customer to be good enough for consumption. Such speedy transportation is possible when the producer and the consumer are located near to each other.

Today, rapid urbanisation of India with fast changing situation and needs of the Indian consumer have changed the dynamics of logistics substantially. Conventional practices of collection, transportation and retailing at ambient temperatures still persist, albeit with a severe strain on the supply chain to reach these products to the points of sale without spoilage. Distress selling by farmers, spoilage and wastage are common occurrences today. Challenge to maintain hygienic standards in the case of other food products like dairy, poultry, fish and meat with conventional practices are serious indeed.

Consumers today demand ready-to-cook and ready-to-eat items that require processing of food. Facilities that carry out this operation need hygienic temperature-controlled halls and cold storage for raw materials and finished goods.

It is now recognised that we need a cold chain – a complete logistics system consisting of refrigerated storage of various sizes and refrigerated transportation to face fast changing demand pattern.

Cold chain consists of temperature (and humidity) control at the points of collection with 'pre-cooling chambers'. Pre-cooled product is transported in insulated trucks where distances to be covered are short. Refrigerated trucks are necessary for longer journeys. To reach the product to various points of retail sale in time, Distribution Centres are needed at strategic locations. These centres feature refrigerated Cold Stores for fruits and vegetable and frozen chambers for poultry, fish and meat. Other facilities like temperature-controlled processing halls, ripening chambers etc may also be featured.

Points of sale like large supermarkets feature refrigerated chambers and display cabinets.

HVACR industry is today at the centre of food logistics activity in the country with these changes in lifestyle of urban India. In the process, the industry is helping to prevent enormous quantities of food from spoilage and waste.

Apart from the cold chain, cold stores to store imported products like fresh and dry fruits and export commodities like turmeric, chillies, tamarind, raisins, fresh flowers are widespread for scientific storage to international standards.

Innovative insulation solutions for F&B sector

Refrigerated enclosures like cold stores and other components of the cold chain need very efficient envelopes to prevent ingress of heat through a scientific and efficient insulation system. Unwanted heat in-leak caused by poor insulation adds extra load on the refrigeration machinery causing extra power consumption. Maintaining the chambers at the desired temperature, even when there are interruptions in supply is a role played by good insulation.

Lloyd Insulations has specialised in the field of thermally efficient envelopes for the cold store industry, providing solutions for over five decades in this country. Its high-quality insulating materials and dedicated infrastructure of engineers and skilled installers country-wide are what have given its leadership in the market.

The company's LLOYDPANEL system featuring pre-insulated sandwich panels with highest efficiency insulating core qualify to cater for all required internal temperatures going down to (-) 40-degree C. These structurally strong panels are self-supporting and need minimum structural support and have made it possible to construct cold stores ranging in size from very large chambers down to small walk-in facilities. Over 5 million square metres of panels are produced in three plants to cater to any project located across the country.

Lloyd's design teams have interacted with users and specialist consultants to meet every operational requirement of a cold store facility forming part of a cold chain, food park or a distribution centre project. Special needs as called for including Controlled Atmosphere (CA) stores, stores with irradiation facility, projects with washing, cleaning and packing lines, ripening chambers, frozen cold stores with quick freezing units have all been met with specific and relevant offerings.

Lloyd Insulations has identified the need for farm level cold store to prevent spoilage at the source and also to help the grower to avoid distress selling when faced with delay in arrival of the buyer. Since power supplies are erratic in these rural centres, they were powered them with solar panel systems with sufficient storage capacity. The robust and rugged design with plug-in modules took care of reliability and easy maintainability. Lloyd SolerCool units were placed in service in farms for extended periods to get a measure of long-term reliability. These units are now fully operational in various parts of the country as well as in many overseas locations like Africa, South America etc. ■

N. Srinivas
Director,
Lloyd Insulations
(India) Limited

DIRECT HUMIDIFICATION IN ROOM OR IN DUCT?

In commercial environments, such as offices, hotels, libraries and museums, special attention is placed on humidity control not only for comfort, but also to avoid the spread of bacteria, especially in winter.

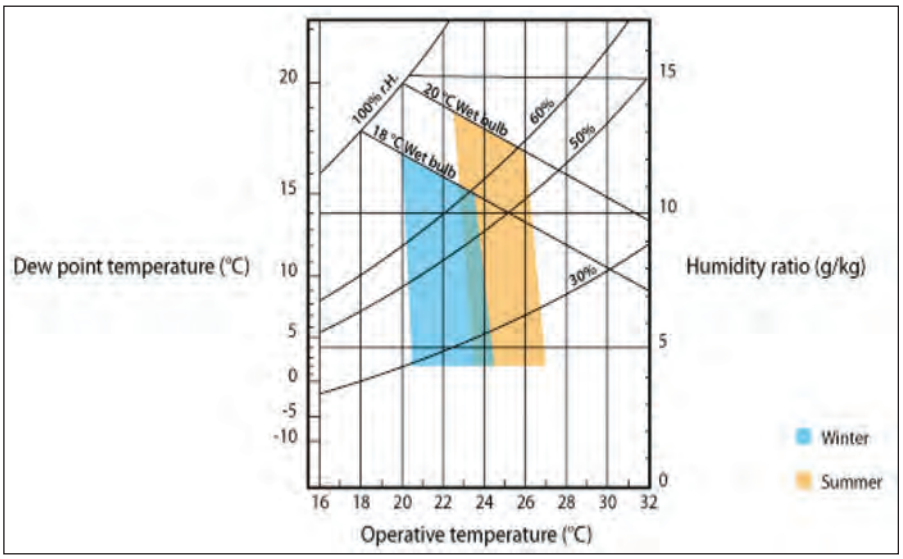
Air is a mixture of gases, comprising nitrogen (78%), oxygen (21%) and others (1%), including water vapour which, despite only being present in small quantities, plays a fundamental role in the earth's ecosystem.

Heat is continuously exchanged between human being and the environment, and this can cause situations of comfort or discomfort, depending on how hard the body has to work to maintain heat balance. As regards, convection heat exchange is mainly affected by the air temperature and speed, while evaporation is also affected by the relative humidity. The difference in partial pressure between the moisture content on a given surface, for example, human being skin, and the humidity of the air, tends to balance itself naturally, in accordance with the principles of physics. As a result, we perceive dryness of the skin when the air humidity is too low, or a damp feeling when it is high.

Feeling comfortable does not correspond to a precise humidity and temperature value, rather it is subjective and depends on other aspects, including physical activity and the amount of clothing worn, which substantially affect heat exchange.

The following representation on the psychrometric chart, taken from ASHRAE Fundamentals (2001, 8.12), shows the comfort zones in winter and summer, for sedentary activity.

To create and maintain a situation of comfort, mechanical systems are used to manage indoor temperature and humidity values. In commercial environments, such as offices,



hotels, libraries and museums, special attention is placed on humidity control not only for comfort, but also to avoid the spread of bacteria, especially in winter.

While on one hand humans are more sensitive to changes in temperature than in relative humidity, on the other, the hygroscopic materials used in industrial processes are more sensitive to changes in humidity than in temperature. In such cases, humidity must be kept within a tight range, so as to preserve the products' properties and workability. In many industrial environments, including printing, tobacco, processing of plastics and textiles, the production capacity and final product quality are strongly affected by relative humidity and the possible formation of electrostatic discharges. Hygroscopic materials naturally tend to absorb or give off moisture, so as to reach equilibrium with the surrounding air; consequently, even small variations in relative humidity can lead to considerable production waste and jamming of production lines.

To solve this problem, mechanical systems are needed to control humidity. An HVAC system consists of several subsystems, including humidification control, which can be managed in two ways:

- Ducted humidification
- Direct humidification

To better understand the difference between these, it is worth looking at the main stages in the design of an HVAC system:

- Project initiation
- Requirements definition and planning
- Project execution
- Performance monitoring
- Project closeout

When the problems due to low relative humidity are known in advance, a ducted solution is generally the simplest choice to manage, and can be correctly sized during the second stage of design, called requirements definition and planning. In order to accommodate a humidification system that meets the requirements of high efficiency, the ducting must have suitable features, determined in the design stage, when it is still possible to adapt the configuration of the AHU. Ducted humidification allows easier management and maintenance than direct humidification.

When relative humidity is underestimated or neglected in stage two of AHU design, problems will occur in the fourth stage, called performance monitoring. A retrofit solution will thus, be required. In these cases, it is usually advisable to opt for an in-room humidification system, so as to reduce the cost of investment and avoid having to carry out major work on the existing HVAC system, which moreover may often not be suitable for traditional ducted humidification.

All in-room humidification solutions feature a distribution system for delivering steam (isothermal system) or droplets of water (adiabatic system), which may include the use of blowers or be directly incorporated into the humidifier. In both cases, suitable free space must be provided near the distribution system to avoid condensation. The design stage is crucial for correct evaluation of the humidification load, the choice of the humidifier and the position of the distribution system in the points where most required. The chosen solution is always a compromise between technical performance, surrounding conditions and return on investment. Special attention must be paid to the specific application, to the free heights available, to the presence and location of people in the air-conditioned space and to the existing air-conditioning and distribution system.

CAREL offers different in the room humidification solutions, both isothermal and adiabatic. Isothermal humidifiers (heaterSteam, gaSteam, humiSteam, compactSteam) feature high energy

CAREL Heatstream Titanium

CAREL Humifog Direct

consumption, however, can be installed in spaces with low free heights, as the steam generated is easily absorbed by the surrounding air. Furthermore, hygiene is guaranteed without the use of additional systems.

Adiabatic solutions (humiDisk, MC, humiSonic, humiFog Direct, humiFog Multizone Direct), on the other hand, require on average more free space to guarantee complete evaporation of the droplets of water, however feature lower energy consumption and can partially cool internal thermal loads (1 l of evaporated water has an equivalent cooling capacity of 690 W), thus saving on the air-conditioning system.

In the industrial applications mentioned above, where cost reduction, time to market, final product quality and energy saving requirements are increasingly demanding, humidity control is essential to ensure continuity of the business. In older facilities that undergo renovations and upgrades to meet market requirements, direct humidification plays a key role. In commercial applications, on the other hand, in-room humidification is adopted to ensure comfort for a limited investment. ■

Massimiliano Maistro
CAREL Application Specialist – HVAC Industrial

FanGrid Solutions for High Air Performance

To achieve high air performance in ventilation technology, several smaller fans are combined to create a FanGrid. ebm-papst now has FanGrid modules with RadiPac centrifugal fans in its product range – with automatic resonance detection for more operating reliability.

Many applications require high air performance. Data centers, large industrial building complexes, hotels, residential complexes and hospitals are all typical examples.

Cubes prevent installation loss

At ebm-papst, fans for a FanGrid are installed in a support structure. The cube has extra-generous dimensions to prevent the undesirable installation loss that arises when fans are positioned too close together and can influence each other.

Automatic resonance detection for more operating reliability

Depending on the installation situation, resonance can cause vibrations within specific speed ranges. Such vibrations can damage the bearing system of electric motors and lead to fan failure. This is why ebm-papst has developed automatic resonance detection that minimises the effects of vibration – vibration velocity – for its RadiPac centrifugal fans.

Energy-efficient EC technology with convenient closed-loop control

The driving force behind the fans installed in the fan grid are modern EC motors, which are highly energy efficient in both full- and partial load operation. The FanGrid line is rounded out by a new controller that easily activates fans operated in parallel. It requires minimal wiring work. ebm-papst FanGrid modules are available as plug and play compatible units or as complete kits consisting of the fans, air inlet grill, support plate, corner connectors and spacer profiles for direct installation on site.

Smaller, lighter, better FanGrid

In practice, FanGrids have many benefits. The individual fans can be arranged next to or above each other to save space. They significantly improve air distribution and ensure a more even airflow through upstream or downstream components such as filters or heat exchangers. Their redundancy also increases operating reliability, since the other fans compensate for missing air performance. The relevant redundancy requirements can be taken into account during the selection process. ■

For more info, contact sales@in.ebmpapst.com

New Ultrasonic Flow Sensor

Belimo's inline flow sensors utilises ultrasonic transit-time technology to provide accurate, repeatable measurement for any HVAC application. The innovative measurement method features patented glycol compensation logic to automatically detect, monitor and compensate the glycol concentration in the system at all times.

- Trusted flow measurement with (+/-) 2 per cent accuracy and (+/-) 0.5 per cent repeatability
- Multi-point wet calibrated to ensure accuracy and repeatability

- Only one flow sensor is required for all glycol concentration up to 60 per cent
- Low pressure drop for pump optimisation provides energy savings
- Low power consumption of 0.5W saves energy and transformer capacity
- Accurate results without drift
- Ease of installation and energy efficiency. ■

Email: info.india@belimo.ch

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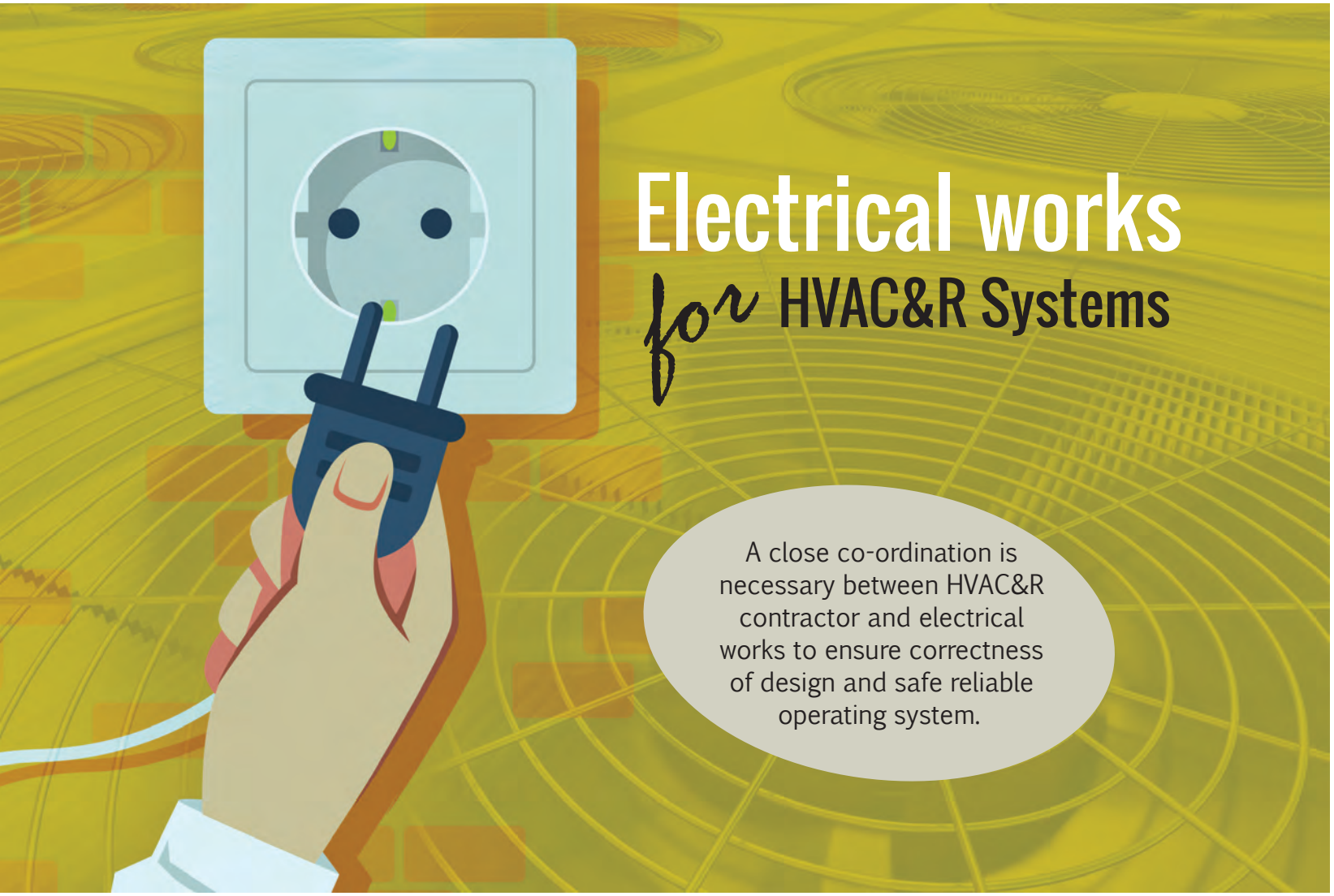


Electrical works for HVAC&R Systems

A close co-ordination is necessary between HVAC&R contractor and electrical works to ensure correctness of design and safe reliable operating system.

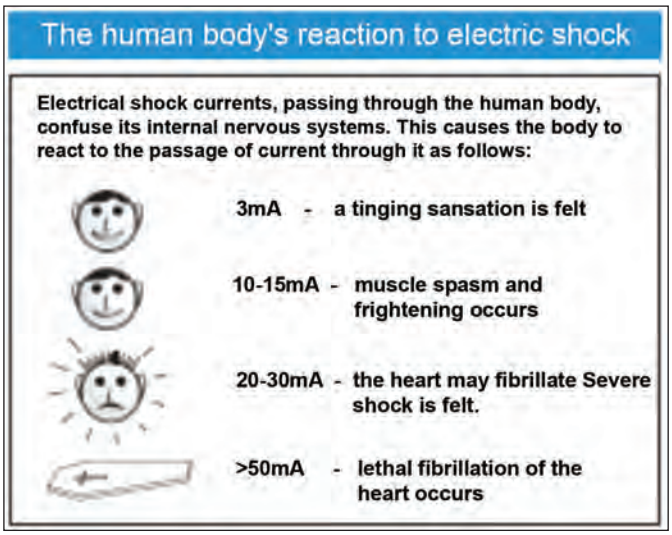
In many contracts, the HVAC&R scope of work includes the electrical work related to HVAC&R system as a part of its contracts. Electrical power supply is generally arranged at a single point, terminated in an isolator or circuit breaker by electrical contractors as a part of their scope of works. All further works from this point to various equipment or components are to be arranged or provided by HVAC contractor.

It is quite possible that specialist electrical engineers are not their full time and regular employees and in those instances this part of electrical works is sub-contracted to an electrical sub-contractor. An effort has been made in this article to understand design considerations and precautions from electrical engineer's point-of-view.

Electrical energy happens to be one of the most versatile forms of energy. Transmission or conveying this energy is easy and converting this energy to rotational or heat or other forms required for specific application is performed by respective appliances.

Being a form of energy, it has an effect on a human body, and results in flow of current through human body if the human body comes in contact with live parts or wires of electrical installation. The human body has a definite resistance to this passage of current

(which is dependent on the weight and composition of the individual) and the current is based on the potential or voltage difference between the live parts contacted. This aspect makes it necessary to have a safe to operate electrical system design and installation.

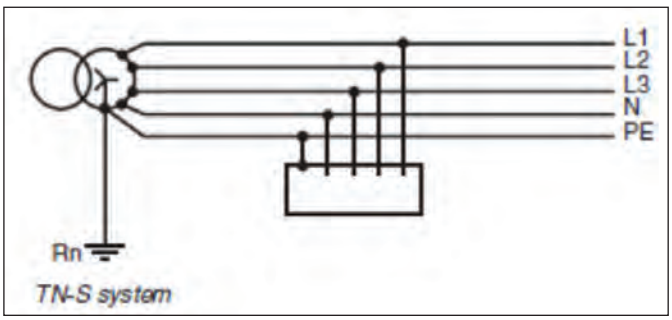


Parameters commonly referred in electrical energy transmission, distribution and consumption are voltage, current, power factor, energy, harmonics etc.

In most of the HVAC&R systems, the power supply is arranged as 415 volts three phase or 230 volts 50 Hz (cycles/sec) frequency, and alternating current (AC).

In few large systems, the chiller packages in particular may be selected to operate at higher voltages like 3.3 or 6.6 kV.

The power supply is arranged in a three phase, five wire system, which includes neutral and protective earth conductors apart from the three lines or phases. This arrangement allows taking a single-phase power supply between any of the lines and neutral, when required.



TN-S system (see **Fig. E5**)
The TN-S system (5 wires) is obligatory for circuits with cross-sectional areas less than 10 mm² for portable equipment.
The protective conductor and the neutral conductor are separate. On underground cable systems where lead-sheathed cables exist, the protective conductor is generally the lead sheath. The use of separate PE and N conductors (5 wires) is obligatory for circuits with cross-sectional areas less than 10 mm² for portable equipment.

Design Considerations

The electrical power has to be distributed to various equipment, appliances, controls etc at the specified location, at appropriate voltage, and has to carry the design current. It is important to

NEED FOR EARTHING

Earthing is of utmost importance for safety of plant,equipment,property and human as well as animal life.In the absence of a well designed effective earthing system,earth fault conditions may lead to tremendous loss of property and lives.The main objectives of earthing are as follows :

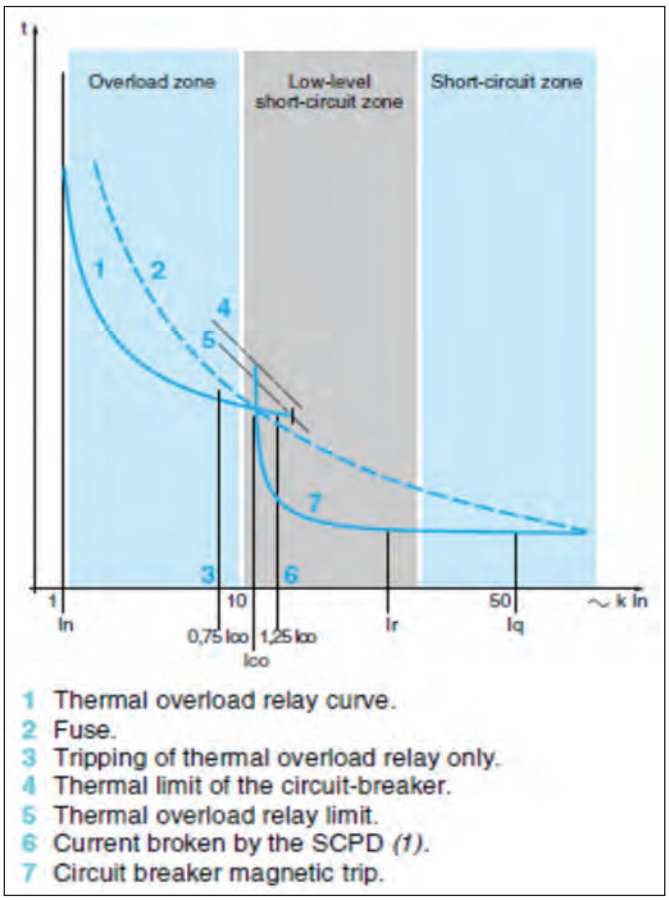
- To ensure safety of life and property from hazards of electric shock and electric fires.
- To ensure that system voltages on healthy lines remain within reasonable limits under fault conditions thereby prevending insulation breakdowns.
- To provide a low impedance path to facilitate the satisfactory operation of protective devices under fault conditions.
- To minimize arcing burn downs as in an earthed system arcing fault would produce a current in ground path thereby providing an easy means of detecting and tripping against phase to earth arcing fault breakdowns.
- To provide an equipotential platform on which electronic equipments can operate.
- To provide an alternative path for induced current and minimize the electrical noise in cables.

remember that every electrical component performance is dependent on the surrounding ambient temperature and de-rating factors have to be applied for actual anticipated ambient temperature conditions.

The installation has to be designed to ensure a safe operation and provide protection against abnormal operating conditions. It is necessary to protect the equipment or apparatus as well as the cables.

Circuit Breakers: One of the most important protection is protecting the installation against short circuit. In most installations, circuit breakers provide this protection. The circuit breakers have a time – current characteristics, which allows continuous operation when the current is normal, allows operation for short duration under overload condition but trips the circuit or isolates the equipment power supply instantly under abnormal high current conditions.

It is a common practice to express the current on unitary basis, and generally these performance curves are on logarithmic scale.



Other protections include single phasing or loss of phase protection, under-voltage protection, over load protection, high temperature of winding, earth fault protection etc.

For the purpose of protection, monitoring current, voltage and other relevant parameters becomes necessary.

Cables: Sizing of cables has to be done carefully as they will be getting heated continuously when energised or carrying currents.

Voltage drop has to be within limits – specified by local electricity authorities – and in some cases like cooling tower or pumps at roof or terrace cable size is dictated by voltage drop rather than the load current.

Some of the cable manufacturers provide data on voltage drop in millivolts per meter length per ampere current flowing and using this data, the anticipated voltage drop for a particular feeder can be calculated. If the voltage drop exceeds the acceptable or specified limit, the calculation has to be repeated using the next higher size cable.

The cables have to be applied with a suitable de-rating factor, depending on the surrounding ambient temperature, spacing between cables, grouping etc.

BASIC ASSUMPTION FOR CURRENT RATINGS

i) Maximum permissible temperature -90C for XLPE insulation, 70C for general purpose PVC, 85C for HR PVC
ii) Ground/Duct temperature -30C
ii) Ambient temperature - 40C
iv) Thermal resistivity of soil - 150C cm/W
v) Thermal resistivity of Dielectric 650C cm/W for PVC, 350C cm/W for XLPE
vi) Depth of laying - for 1.1 KV cable - 750mm, 3.3KV to 11KV-900MM, Above 11KV-1050mm
vii) Single core cables installed in one circuit in following arrangement
OR
viii) Multicore cables installed in sibgle circuit

i) Rating factors related variation in ambients air temperature

Air temperature in Deg. C		20	25	30	35	40	45	50	55
	Normal PVC	1.32	1.25	1.16	1.09	1.00	0.90	0.80	0.80
Rating Factors	HRPVC	1.22	1.17	1.12	1.06	1.00	0.94	0.87	0.80
	XLPE	1.20	1.16	1.11	1.06	1.00	0.95	0.88	0.81

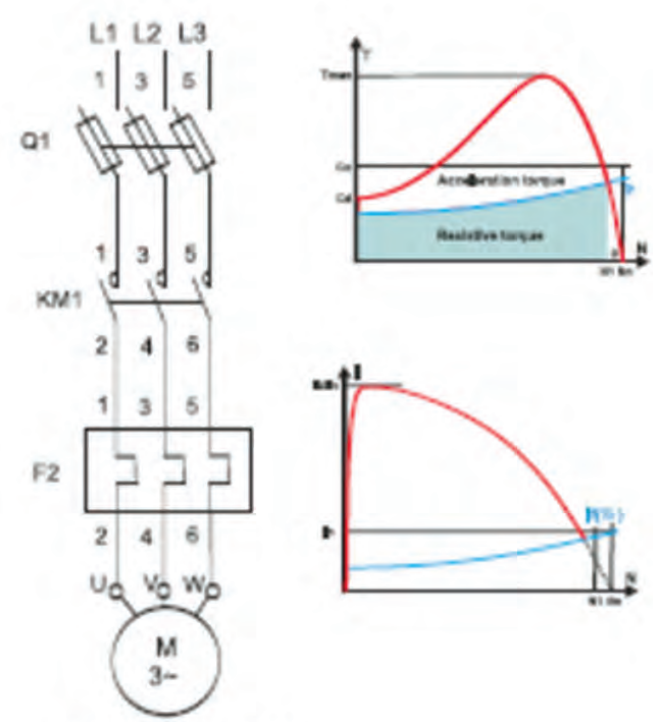
In many cases, cables are accommodated on cable trays which are bundled together, and the derating of the cables is not considered while selecting cable size.

The derating of cable will be associated with over-heating of cables, leading to failure of insulation followed by short circuiting and eventually fire condition.

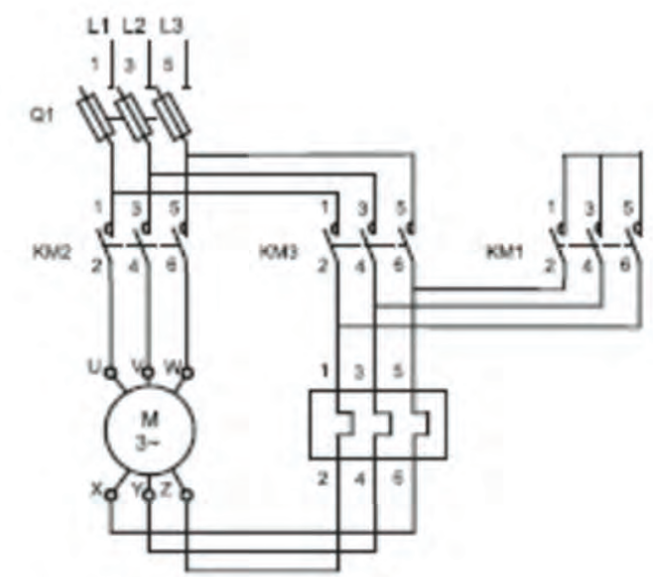
Starters: The starting current for drive motor is much higher compared to its full load or operating current and the starting in-rush current requires to be regulated.

Many electricity boards and design consultants specify highest starting current acceptable, and the starters for drive motors have to be selected considering these specified limits.

In some cases, the compressors have a facility to start in un-loaded condition, but the motor still has higher starting current required.



Direct on-line starting



Star-delta starting

Different types of starters are available – direct-on-line (DOL), start-delta, soft starter etc.

In main equipment like chiller package, the starters required for compressors, condenser fan motors etc are generally incorporated as a part of unit mounted unit panel.

However, the starting current limits specified in the contract documents and specifications have to be communicated to the equipment supplier.

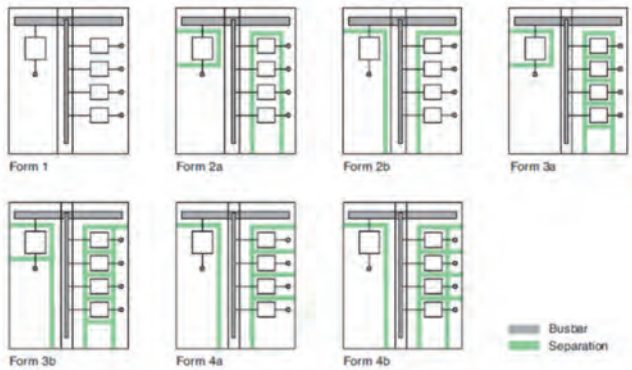
Starters is generally a combination of main power contractors, over-load protection, under voltage protection as a minimum, and allows the control wiring to facilitate sequential operation.

Electrical distribution boards or panels – accommodate the incomer circuit breaker with metering like voltmeter, ammeter, PF meter, energy meter, bus bars and outgoing feeders with metering as specified. These power distributions are assemblies of various switchgear fitted within sheet metal cabinets or enclosures.

Sub-distribution and final distribution switchboards are generally distributed throughout the site.

[a] A main LV switchboard - MLVS - (Prisma Plus P) with incoming circuits in the form of busways - [b] A LV motor control centre - MCC - (Okken)

Various forms or configurations are available, and design consultants specify the type to be provided.



Representation of different forms of LV functional distribution switchboards

Motor Control Center (MCC): It is similar to the distribution panels, and will also incorporate the starters for drive motors as well as interlocking for sequential operation of various motors.

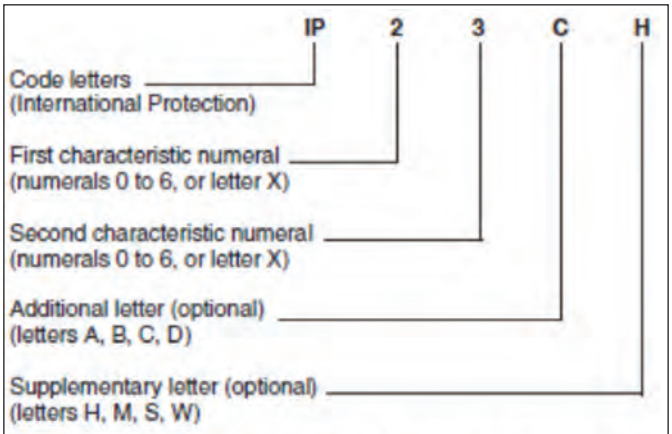
It is a standard or common practice to provide the feeders for the packaged chillers, starters for various pumps namely condenser water pumps, chilled water primary pumps and cooling tower fan motor in the main HVAC MCC, which is installed within the main plant room.

In some installations, individual equipment like air handling unit is controlled with a dedicated AHU control panel, located within the respective AHU room. This control panel will accommodate the incomer, duty selection switch, starter or VFD as well as control transformer and control wiring.

When the secondary chilled water pumps are located in separate plant rooms, panels will be provided to cater to these pumps, including the standby pump as applicable. This panel is fed from the main MCC. Sizing of the feeder is based on actual working pumps, and the pump control has to be with a duty selector switch to ensure that the stand-by pump would not start or operate any time.

Cabling and wiring: The cables or wires are used for interconnecting the electrical panels and equipment or controls or drive motors or actuators as well as earthing.

Space required for terminations of large cables and transition from field-cabling to main equipment – aluminium conductor field cables to copper studs on imported equipment has to be identified and allowed in space planning.



Where a characteristic numeral is not required to be specified, it shall be replaced by the letter "X" ("XX" if both numerals are omitted). Additional letters and/or supplementary letters may be omitted without replacement.

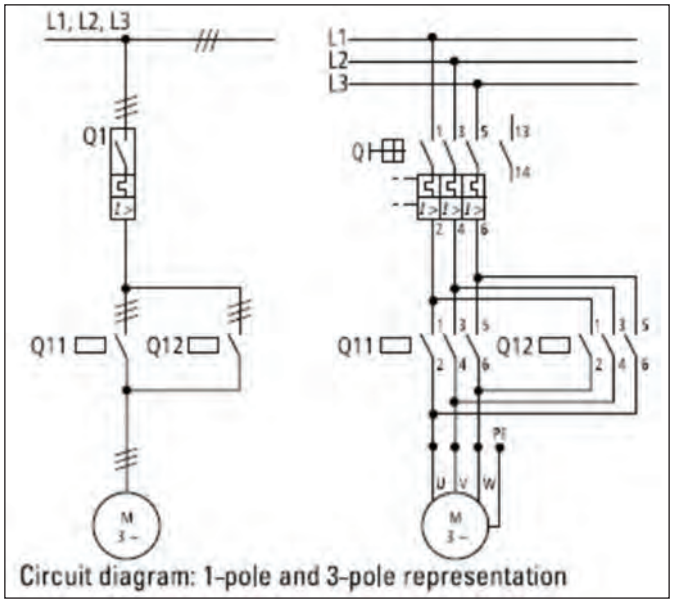
IP Code arrangement

Elements of the IP Code and their meanings

A brief description of the IP Code elements is given in the following chart

Element	Numerals or letters	Meaning for the protection of equipment	Meaning for the protection of persons
Code letters	IP		
First characteristic numeral		**Against ingress of solid foreign objects**	**Against access to hazardous parts with**
	0	(non-protected)	(non-protected)
	1	≥ 50 mm diameter	Back of hand
	2	≥ 12.5 mm diameter	Finger
	3	≥ 2.5 mm diameter	Tool
	4	≥ 1.0 mm diameter	Wire
	5	Dust-protected	Wire
	6	Dust-tight	Wire
Second characteristic numeral		**Against ingress of water with harmful effects**	
	0	(non-protected)	
	1	Vertically dripping	
	2	Dripping (15° tilted)	
	3	Spraying	
	4	Splashing	
	5	Jetting	
	6	Powerful jetting	
	7	Temporary immersion	
	8	Continuous immersion	
Additional letter (optional)			**Against access to hazardous parts with**
	A		back of hand
	B		Finger
	C		Tool
	D		Wire
Supplementary letter (optional)		**Supplementary information specific to:**	
	H	High-voltage apparatus	
	M	Motion during water test	
	S	Stationary during water test	
	W	Weather conditions	

Elements of the IP Code



Circuit diagram: 1-pole and 3-pole representation

IP Rating

Requirement of power supply: In HVAC&R installations, power supply is necessary for various equipment, controls, actuators and the like.

Single line diagrams (SLD) is similar to scheme drawings in HVAC and help understand the overall arrangement.

Some equipment requires three phase power supply while few equipment is suitable for operation on single phase power supply. Generally, control system components are selected to operate on low voltage power like 24 volts to minimise risk of shock to the technicians working on the circuitry.

It is advisable to prepare a full matrix for power supply requirement with comprehensive list of equipment, location, power required in kilowatts, whether three phase or single phase, controls operating voltages, identifying stand-by equipment if any, equipment which needs to be fed from back-up or generator or UPS being emergency support system.

A close co-ordination is necessary between HVACR contractor and electrical works to ensure correctness of design and safe reliable operating system. ■

Govind Mahadeo Lele,
Associate, C V Raman College of Engineering, Bhubaneshwar

Tata Power announces association with Voltas AC

India is a well-established consumer durables market. It is, thus, crucial for brands to create energy efficient products. With an aim to promote energy conservation and provide consumers with green and efficient choices, Tata Power has announced an exclusive offer for its consumers in Mumbai where they can save up to 50 per cent on the purchase of Voltas 5-Star Inverter AC. Moreover, consumers can also avail a special package of five-year comprehensive warranty on the entire range of Voltas ACs. The offer will be limited till 31st December.

Voltas' 5-Star Inverter ACs ensure higher energy saving with distinctive advantages.

Praveer Sinha, CEO & MD, Tata Power, said, "Tata Power has always been advocating energy conservation and sustainability, a feature which Voltas' 5-Star Inverter ACs offer. We are glad to collaborate with them and look forward to offering our consumers with an

efficient product that ensures substantial savings on their monthly bill and leaves a minimum carbon footprint without compromising on their comfort."

Pradeep Bakshi, Managing Director & CEO, Voltas Limited added, "We are delighted to partner with Tata Power and provide consumers in Mumbai with 5-Star Inverter ACs that offer more savings in terms of cost and energy. As a Tata Group company and a market leader in the AC industry, Voltas is always at the forefront of technological innovation and strives continuously to provide its customers with relevant, customer centric, technologically superior, green and environment friendly energy efficient solutions."

"Tata Power Solar and Voltas connected through their ethos of bringing the best for its consumers. Joining hands with Voltas, Tata Power Solar is enlarging its horizon of promoting solar rooftop in the country. With this initiative, we are strengthening the usage of solar energy and making India sustainable energy efficient. Making this venture more beneficial for consumers, existing Tata Power customers will be able to save up to 50 per cent by purchasing a Voltas 5-Star AC. Our focus is to make our country renewable energy dependent. We are pleased with this association as Tata Power Solar and Voltas look at cleaner energy future and considerable reduction in the electricity bill for the next 25 years," added Ashish Khanna, President-Renewables, Tata Power and MD & CEO, Tata Power Solar. ■

Forthcoming Events

ISK-SODEX Istanbul

Venue: TÜYAP Fair Convention and Congress Centre
Date: 2nd to 5th October 2019
Website: www.sodex.com.tr/en

Refcold India

Venue: Hitex Exhibition Centre, Hyderabad, Telangana
Date: 21st to 23rd November 2019
Website: www.refcoldindia.com

India Cold Chain Show 2019

Venue: Bombay Exhibition Centre, Mumbai
Date: 4th to 6th December 2019
Website: www.indiacoldchainshow.com

Global Logistics Show

Venue: Somaiya International Convention Centre, Mumbai
Date: 20th-22nd February 2020
Website: www.globallogisticsshow.com

ACREX India 2020

Venue: IEML, Greater Noida, Delhi Ncr
Date: 27th to 29th February 2020
Website: www.acrex.in

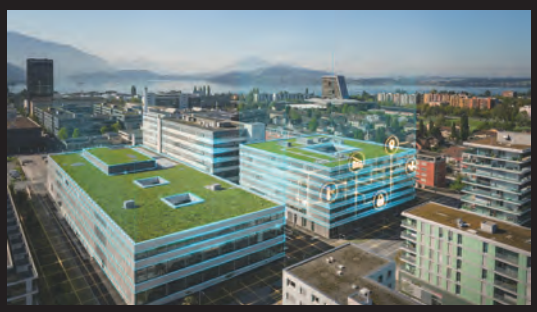
Energy efficient food industry in Sweden

Born out of a merger in 2014, Orkla Foods Sverige is Sweden's leading food company, it boosts many popular brands including Felix ketchup which is produced in Fågelmara. The factory employs around 75 people whose job it is to prepare and taste the ketchup along with other sauces and dressings.

Orkla Foods Sverige prides itself on its innovative and quality, in addition, it has focused on developing processes which allows it to be sustainable in the food industry. Parallelly to its internal production, Orkla Foods Sverige was interested in reducing the carbon footprint of its buildings, factory included.

Thus, the company invested in a new efficient cooling system for its process cooling. The system is based on 1 FOCS3-W 3002 water cooled chiller, Climaveneta branded, for a total cooling capacity of 1020 kW. Thanks to the high performing components, the FOCS3-W units are characterised by highly competitive efficiency levels both at full and part loads, which ensure minimum running costs and a quick return on investment. ■

Siemens Campus, Zug, a perfect place to work



Headquartered in Zug, Switzerland, Smart Infrastructure at Siemens intelligently connects energy systems, buildings and industries, enhancing the way people live and work to significantly improve efficiency and sustainability.

In May 2016, construction works started on the new Siemens Campus in Zug. From the beginning, it was clear that the consolidated site and the new buildings would have to contribute to Siemens' overall goal to become climate neutral by 2030. Furthermore, aside from being an example of best environmental practice, the campus would also be a technological beacon. And if that isn't enough, the company also wanted to create a space that could be adapted to new forms of work.

Next to the new campus building measuring 18,400 square metre over seven stories is a new three-story-high production hall. From 2021 on, an existing office building at the site will also be refurbished.

Efficient heat pumps and water from Lake Zug are used for cooling and heating of the building and photovoltaic installations provide electricity, with vegetated rooftops providing an extra layer of insulation. Optimal room comfort is ensured with advanced cooling and space conditioning capacities and LED lighting solutions. An integrated building automation system including energy optimisation based on Desigo CC integrated building management platform has also been installed. Additionally, a sustainable waste management concept has been created for the entire campus. ■

World's first LEED zero building

A rooftop solar array and onsite constructed wetland have helped the Petinelli headquarters, housed in a converted warehouse, to achieve net-zero energy and water. Petinelli Platinum used to be the ultimate LEED rating but not anymore. A new program, LEED Zero, asks project teams to show a year's worth of data proving zero impact in at least one of four categories: energy, carbon, water, or waste. The U.S. Green Building Council (USGBC) has now awarded its first LEED Zero certification, for net-zero energy, to engineering and consulting firm Petinelli for its headquarters in the Brazilian city of Curitiba.

"We've been bugging USGBC about net-zero energy for a while now," commented Guido Petinelli, Managing Director at the firm. "It was a pleasant surprise to hear about the launch of LEED Zero just before Greenbuild Chicago."

Petinelli immediately jumped at the chance to certify its headquarters, which has been net-positive energy for more than a year and also recently achieved Platinum under LEED v4 for Existing Buildings: Operations and Maintenance (O&M) using the Arc platform. Petinelli said, "It was always a dream to have a net-zero-energy and -water HQ."

The building itself is a converted two-story warehouse, roughly 4,700 feet, originally built in the 1980s. A 15kW rooftop solar array provides 25 per cent more energy than is needed to operate the 25-person office space. "We didn't understand this at the time, but LEED Platinum was a stepping stone toward LEED Zero," said Petinelli. ■

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