

## TOOLS AND TECHNIQUES

### Personal Control Systems Still Bring Productivity Gains

Two of the recurring themes in indoor environmental complaints center on thermal comfort — trying to satisfy the different needs occupants have — and the idea of personal control. Johnson Controls, which introduced its Personal Environments® system nearly five years ago to rave reviews from the original users, has continued to develop the product, and still says it can improve occupant satisfaction and productivity.

Designed for either new construction or retrofit installation, the systems are designed for installation in modular workstations, allowing occupants to control air flow, temperature, under-desk heating, and to block some ambient noise. Dennis Miller, product manager, told *IEQS* that the original studies on how the system can improve productivity have been borne out by ongoing observations.

In the original study, conducted in 1992, researchers from Rensselaer Polytechnic Institute (RPI — Troy, New York) tracked productivity among office workers at West Bend Insurance Company (West Bend, Wisconsin) after the workers had moved into a new facility equipped with the personal environment systems. The researchers documented a 2% productivity gain, and company officials said they felt the actual gain might have been much higher (see *Indoor Air Quality Update [IAQU]*, November 1992).

#### Productivity

While Johnson Controls hasn't participated in any formal studies at West Bend since the original one, Miller told *IEQS* that West Bend officials have maintained their enthusiasm. "They have continued to do studies, as well as monitor ongoing productivity, and they've found that the acceptability of the environment is still very high," Miller said. "They've retained the same level they had when they moved into the building."

One factor that aided the original study was that West Bend had been tracking employee productivity for several years before the move and the introduction of the Personal Environments systems, giving them a baseline against which to measure results.

Productivity is an important issue because even a 1% increase — or decrease — in productivity can amount to significant money, especially since salaries often comprise the biggest single expense in an operation (see *IAQU*, October 1996).

#### How Do They Work?

Miller explained that the Personal Environments come in two models. One model is designed for new construction or renovation, in which supply air comes directly to the units in each workstation. This works well with a raised floor or with some other way to duct air supply to each workstation.

The other model, known as the circulated air system, is designed for retrofit into existing offices and recirculates ambient air, drawing it in from

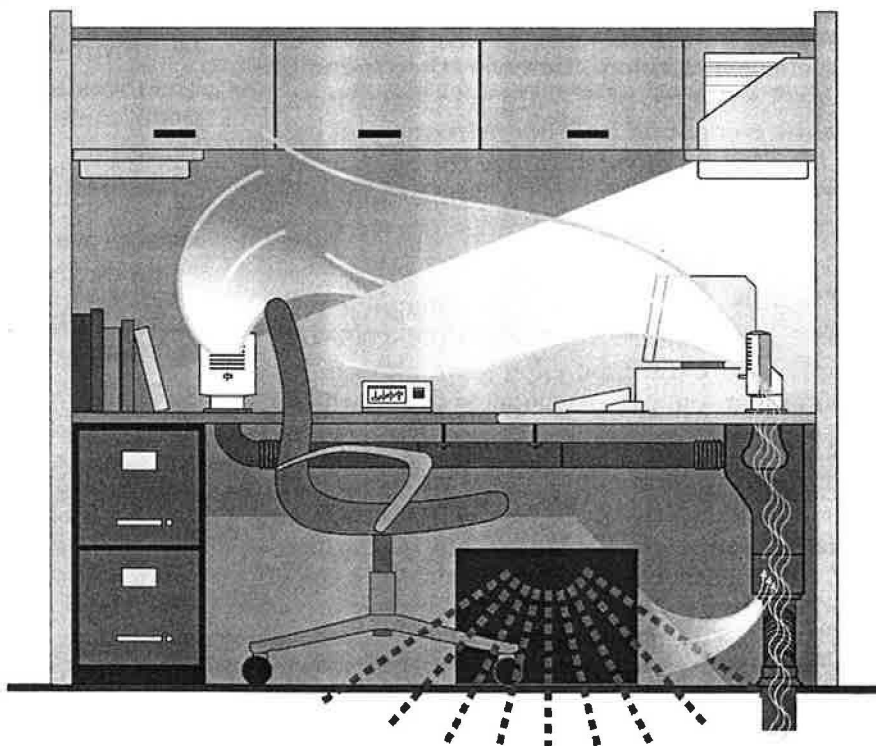


Figure 1 — Supplied Air Personal Environments® System. The supplied air system uses supply air and mixes it with ambient air to supply each workstation unit. (Drawing courtesy of Johnson Controls.)

under the desk, filtering it, and recirculating it into the space.

In the supplied air system, ambient air is drawn into the unit through a gross particle filter and mixed with supply air. The workstation occupant can determine the mixture by using a control box in the cubicle. This allows the occupant to vary the temperature of the air by several degrees. The combined air passes through another filter and discharges through louvered outlets that allow occupants to control the amount of air flow as well as its direction — much like the dashboard louvers in an automobile allow similar control.

In the circulated air system, the air comes in under the desk and is filtered and discharged through the same types of outlets, also allowing the occupant to control air flow and direction. Figure 1 shows the supplied air system, while Figure 2 shows the circulated air system.

The units also include a radiant heat panel that fits under the desk and allows the occupant to warm his or her feet and legs, something that adds to thermal comfort. A “white noise” generator allows some control to mask ambient noise in an open office space.

### Varying Temperatures

Miller said that observations of how occupants actually use the system indicate that they do vary temperatures from workstation to workstation, sometimes by as much as five degrees. This will not be a surprise to anyone who has tried to please all — or even a majority of — office occupants with a single thermostat setting.

“When we visit and talk to people,” Miller told *IEQS*, “they are, in fact, selecting conditions acceptable to them. They are changing control position over the course of time — with some people reacting more than others — to achieve the conditions they need.” However, Miller said Johnson Controls hasn’t done any studies on how the units affect measurable IAQ parameters.

In the original West Bend study, the researchers had initially intended to randomly disable certain units to use those workstations as research controls. The occupants in the workstations with the disabled units noticed the effects almost immedi-

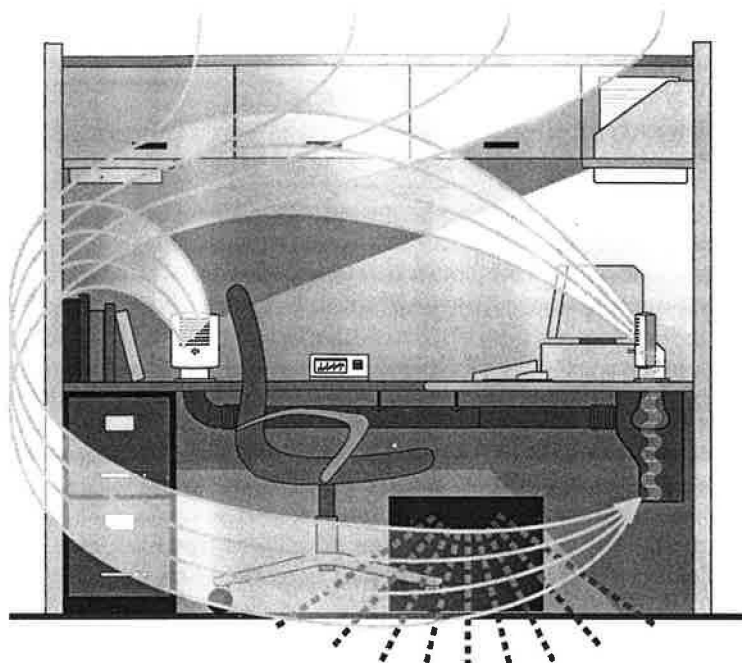


Figure 2 — Circulated Air Personal Environments® System. The circulated air system draws ambient air and recirculates it according to the wishes of the workstation occupant. (Drawing courtesy of Johnson Controls.)

ately, according to the researchers, and demanded that the units be reattached.

### Minimum Flow

In an installation with the supplied air system, the space would have no regular ceiling diffuser air supply as in other buildings. To do so, Miller said, would work against the Personal Environments system. Consequently, all supply air to the space enters through the units. With this in mind, each unit is designed to provide a minimum of supply air — 15 cubic feet per minute — when the workstation is unoccupied.

This minimum air supply is important because the units include an occupancy sensor that shuts the unit down when the workstation space is unoccupied for more than a specified length of time. This is intended as an energy-saving feature.

If the office space contains large areas without workstations, some arrangement would be necessary to provide supply air to those areas, Miller said. He indicated the best arrangement would be something that sweeps supply air from floor to ceiling to correlate with the patterns set up by the Personal Environments systems.

### Maintenance

If case studies show anything it is that ongoing maintenance is critical to the success of even the

best system. One problem with unit ventilators, for example, is the fact that their maintenance — especially in a building with hundreds of units — is often spotty, if they are maintained at all. The difference here is the maintenance level and complexity required.

According to Miller, normal maintenance consists of simply changing the unit's filter, a task for either the occupant or building maintenance staff, depending on how the building operates. It is a simple matter of pulling out the used filter and inserting a new one.

The circulated air unit uses an electret fiber filter (0.4x4.5x4 inches) and both units use an electret charged fiber filter (2x9x4.5 inches). Both are standard industry filters, but designed and manufactured by Johnson Controls to fit into the unit.

The company expects the units to last about 10 years and has calculated a mean time between failure (MTBF) for that period or longer, although it has no data on actual MTBF. Failures in current installations, according to Miller, usually involve the fan unit. Because the units are modular, repairs consist of removing the old fan unit and replacing it with a spare — something that takes a matter of minutes and little effort.

Johnson Controls currently has an installed base of about 2,500-3,000 units. The units cost about \$800-\$1,200 installed, depending on the features — for example, the units can be ordered in special colors to coordinate with office decor. The filters cost \$4-\$5, depending on the volume.

For more information, contact Dennis Miller, Johnson Controls, P.O. Box 423, Milwaukee, WI 53201, USA; (414) 274-4774.

## Indoor Air Parameters Show Little Variation Among Workstations

Taking IAQ measurements at one or even several locations within a building may not always give an accurate picture of conditions due to variations between and within occupants' workstations. Some researchers have shown that outdoor air (O/A) rates measured at the air handlers may bear no relation to the air that actually reaches occupants.

A group of Canadian researchers attempted to determine whether IAQ conditions varied among and within workstations in a sealed building that was served by nine air handling units (AHUs). They found that the conditions varied little, except for the air velocity at the neck and ankles, which was low, but variable.

The building under study had nine constant air volume HVAC systems that operated with O/A rates of at least 15 liters/second/person and which ran from 7:30 am to 5 pm. Relative humidity was maintained above 25% and temperature was controlled within a range of 23°C-23.5°C. Air from high pollutant areas, such as photocopier rooms and smoking areas, did not recirculate.

The researchers monitored IAQ parameters in 120 randomly selected workstations. They measured carbon dioxide (CO<sub>2</sub>), temperature, and humidity before work hours and three times during work hours. They also measured air velocity at the neck and ankles once a day.

In 14 workstations, the researchers measured volatile organic compounds (VOCs), formaldehyde, and total particulates over a 24-hour period.

Of the selected workstations, 82% were open areas, 97.6% had at least one cloth partition, 73.3% had at least one supply duct within one meter, and 98.2% within two meters. The carpets and cloth partitions appeared clean in 99% of the workstations.

Table 3 shows the variability before and during work hours between the workstations, and Table 4 shows the variability within the workstations over a period of three days. The researchers concluded that the conditions within and between the workstations were stable during the measurement periods and attributed this to a properly designed and operated HVAC system.

Table 3 — IAQ Variations Between Workstations

Parameter	AHUs 1-7		AHUs 8 & 9	
	Before Work	During Work	Before Work	During Work
CO <sub>2</sub> , ppm	402 ±54.7	571 ±68.6	384 ±18.6	508 ±58.0
Temperature °C	22.9 ±0.7	23.2 ±0.5	23.1 ±0.4	23.4 ±0.4
Humidity %	25 ±4	30 ±4	15 ±2	20 ±1
<b>Air Velocity m/sec</b>				
Neck	0.04 ±0.03	—	0.05 ±0.03	—
Ankles	0.03 ±0.03	—	0.03 ±0.03	—

Source: Bourbeau *et al*