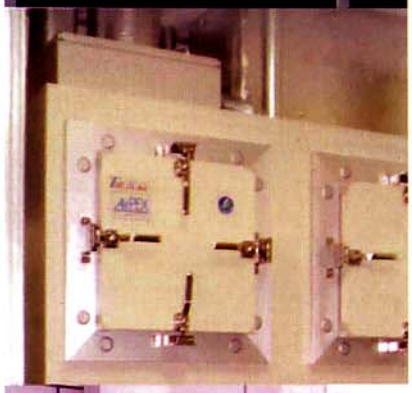
AirPEX®

Twin-ECO system

Special HVAC Air Quality, Maintenance and Conditioning System

- Up to 70% Reduction in Energy Usage and Costs
- More Accurate in Temperature and Humidity Regulations
- Much Faster in Reaching Set Humidity and Temperature



Excellent for:
Clean Rooms
Environmental Test Rooms
Green Houses
Hospital ICUs
Biological Research Growth Chambers
Computer Rooms
Art and Historical Museums
Storages
and other applications.

Air Conditioning Engineering
TSUBUKU
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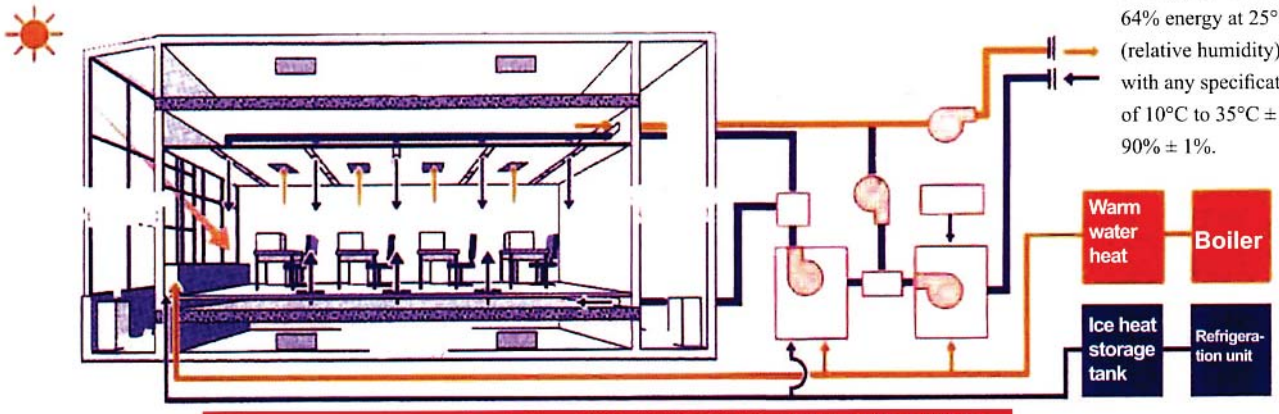
"Special Air-Conditioning Award Winner"

AirPEX® System was honored the Excellent Medal for Energy Saving of Environmental Room at the 22nd competition sponsored by Kitakyusyu University in Japan. It cut 64% energy at 25°C (77°F) and 60% (relative humidity). It could comply with any specification in the range of 10°C to 35°C ± 0.1°C and 35% to 90% ± 1%.



Temperature range and variation: 10°C - 35°C ± 0.1°C (50°F - 95°F ± 0.18°F
Relative humidity: 35% - 90% ± 1%

❑ The AirPEX® System is truly innovative to control temperature and humidity on demand complying the most severe standards despite only 30% energy usage compared to an inverter HVAC.

❑ The AirPEX® System with the lowest energy usage can;

- **comply with almost any specifications required in modern facilities,**
- **not compromise temperature and humidity, and**
- **very reliable and low maintenance system.**

In this age of high technologies, for example, in information and computer technology, biotechnology oriented agriculture and drug industries, and highly sophisticated ICU in modern hospitals, and leading research and development laboratories, their technical requirements and saving energy are discrepant and hardly coexist in most cases. Tsubuku's engineers have been challenging such controversial requirements in special HVAC fields over decades applying their own inherent refrigeration technologies since 1960s.

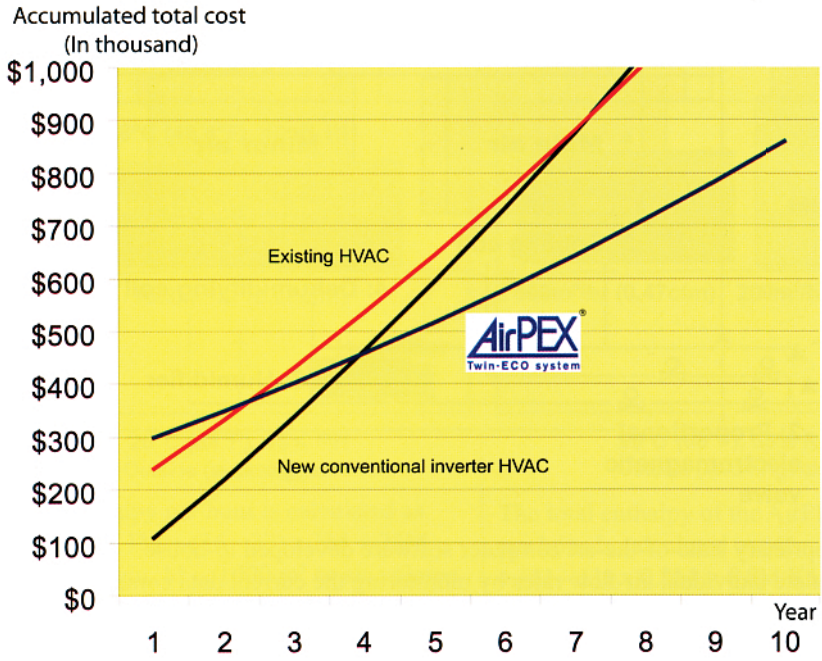
The ideas are well concentrated on computerized ultra precise air-flow control and an extra low pressure (vacuum) cylinder. They are quite simple but technically work unbelievably very well.

Special air-conditioning system for constant temperature and humidity

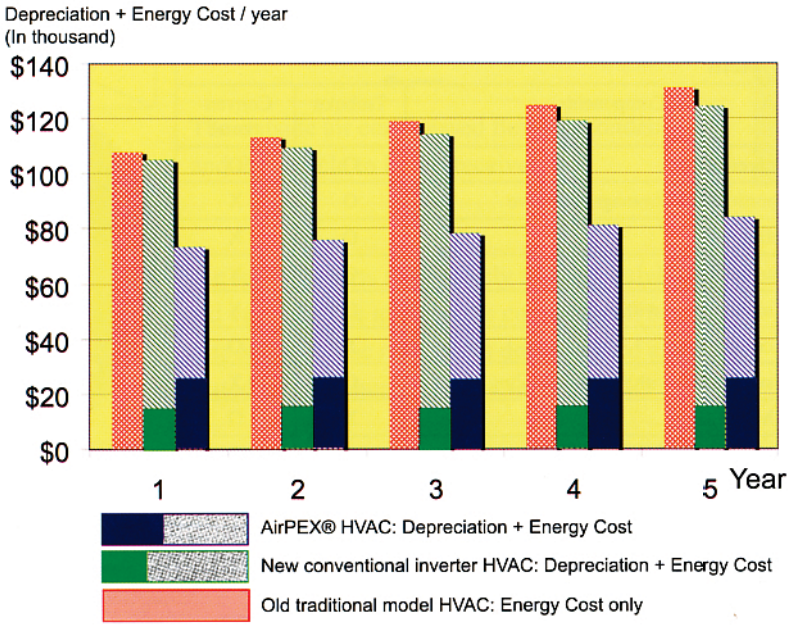
Terms	AirPEX Twin-ECO system	Over-cooling and re-heating (PID) System	
		Using inverter control motor	Using constant-speed motor
Proportional cooling control range (%)	0 - 100	30 -100	100
Energy usage index (energy cost) versus conventional HVAC systems	30 (70% less than inverter control type HVAC and 88% less than constant-speed type HVAC)	100	250

Terrific cost performance makes savings on budgets immediately.

❑ Total costs will turn over only within a few years. The AirPEX® System may pay back the equipment cost much faster than usual because of possible incentives by government organizations from receiving "green" certifications.



❑ Depreciation helps the company to be more profitable easily even in the first year.



❑ Total cost over years: Actual cost of energy is unbelievably high compared to the facility and HVAC equipment cost. For example, given $250,000 initial cost is for the AirPEX® System and $150,000 for a leading HVAC, and the electricity expense is $30,000 a year for the AirPEX® System and $100,000 for the leading HVAC.

In this scheme, the AirPEX® System (blue line) may turn over the initial cost of the leading new HVAC (green line) ***within only 3 years***. Even if compared to the existing obsolete HVAC (red line), it turns over ***within 3 - 4 years.***

❑ The AirPEX® System makes the company more profitable so quickly and easily because of the corporate accounting system.

In actual corporate balance sheet, the company can depreciate, for example, only 10% every year but the electricity expense is 100% deductible. The bottom line cost of the AirPEX® System will be only $55,000 but the leading HVAC will be $115,000 a year. Provided AirPEX System is installed now, the company can make the profitable difference ($60,000) that is more than the expense. Compared to the obsolete system, the profit will be even higher than $55,000 because the obsolete HVAC will eat up substantially much more electricity than $100,000 a year.

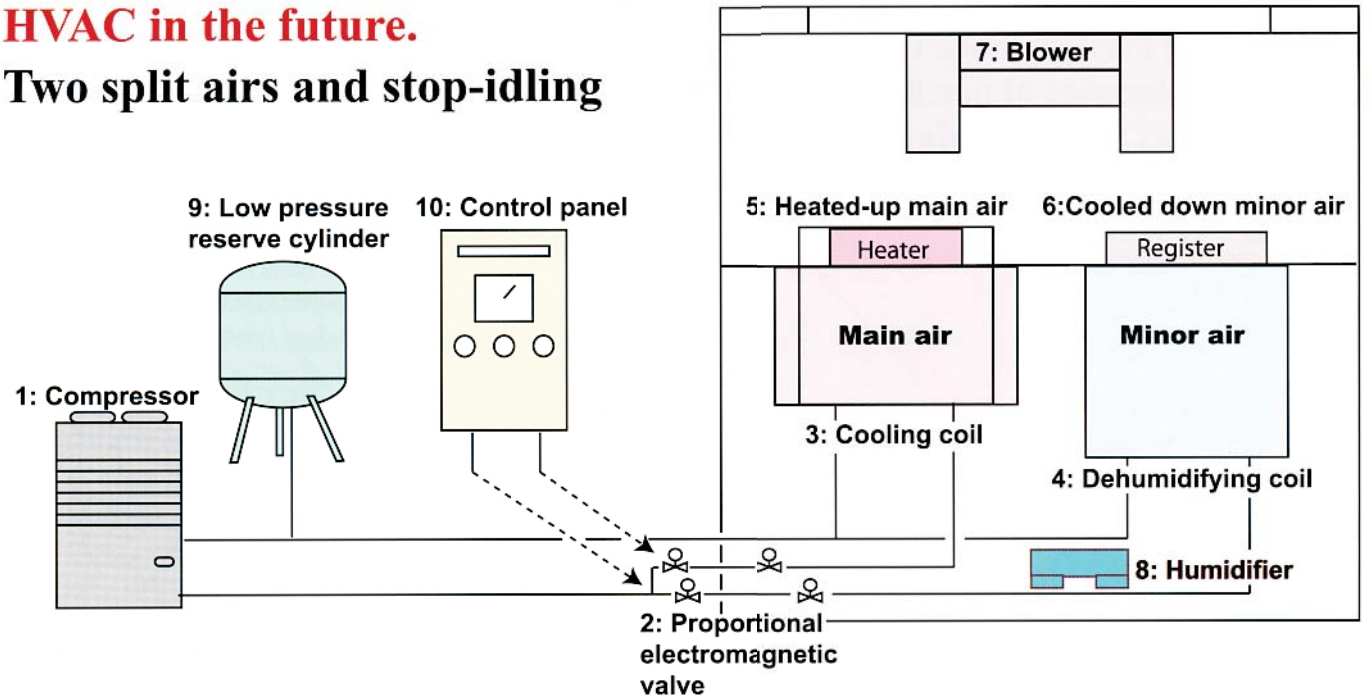
❑ Immediate analysis for installation can have you up and running in a short time.

- ◊ ***Only a few months of the installation lead-time of the new AirPEX® System despite custom-made figures.***
- ◊ ***No operational interruption required to replace the existing HVAC system.***

REVOLUTIONARY HVAC SYSTEM

❑ The AirPEX® System configuration will change the standard of HVAC in the future.

Two split airs and stop-idling



- ❑ The AirPEX® System is fully controlled by proprietary state-of-the-art computer software developed in-house.
- ❑ The software is completely customized to modulate individual air-flow rates by monitoring the current data complying the preset specifications.
- ❑ Other components including air filter, lighting, sterilizer, panel board, work benches and sealing devices that can be optionally installed on request.

❑ AirPEX® System and conventional HVAC

Components of the AirPEX® System and a conventional HVAC to control temperature and humidity.

The differences between both systems are additional components 2, 5, 6 and 9. **In the AirPEX® System,** the outside air is split into main air 5 and minor air 6, but **in a conventional system,** it is modulated as one huge mass of air. The main air might be heated to slightly higher temperature than incoming air temperature and temperature of the minor air might be substantially lowered. Tow airs are remixed to comply with required specification by opening and closing computerized proportional electromagnetic valve 2. Further, a unique component of the AirPEX® System is the low pressure cylinder (or tank: photo) 9. The cylinder 9 plays a role to further cut energy as if a stop-idling property in an automobile. See later section for further detail.

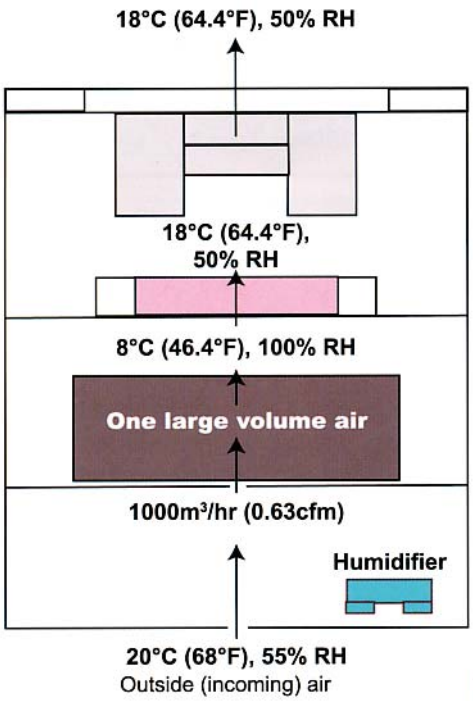
Components of AirPEX® System and Conventional Air-conditioning System

	Components	Tsubuku	Conventional
1	Compressor	O	O
2	Proportional electromagnetic valve	O	X
3	Cooling coil	O	X
4	Dehumidifier coil	O	X
5T	Air main portion with heater	O	X
5C	Air cooler	X	O
6T	Air sub portion with register (cooling)	O	X
6	Air heater	X	O
7	Air blower	O	O
8	Humidifier	O	O
9	Low pressure reserve cylinder	O	X
10	Control Panel	O	O

Low pressure cylinder (tank)

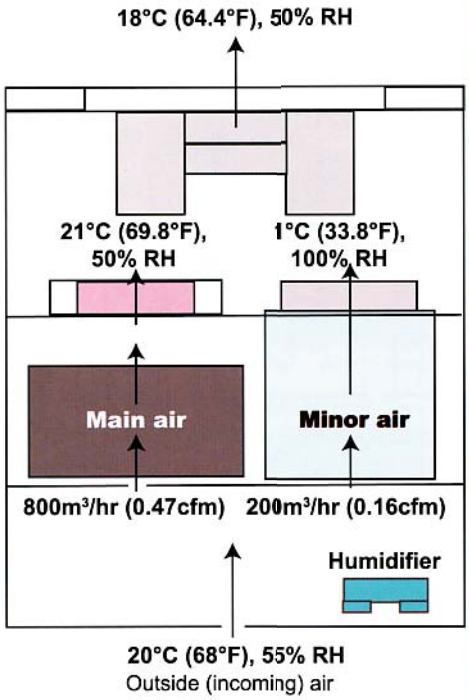
Calculation of energy cut by AirPEX® System

❑ AirPEX® System



Total enthalpy per hour is calculated as (41 - 27) x 1M + (36 - 27) x 1M = 23M KJ/hr. Herein, M is 1000 m³ as air volume and each number is obtained from air temperature and humidity diagram.

❑ Conventional Inverter HVAC



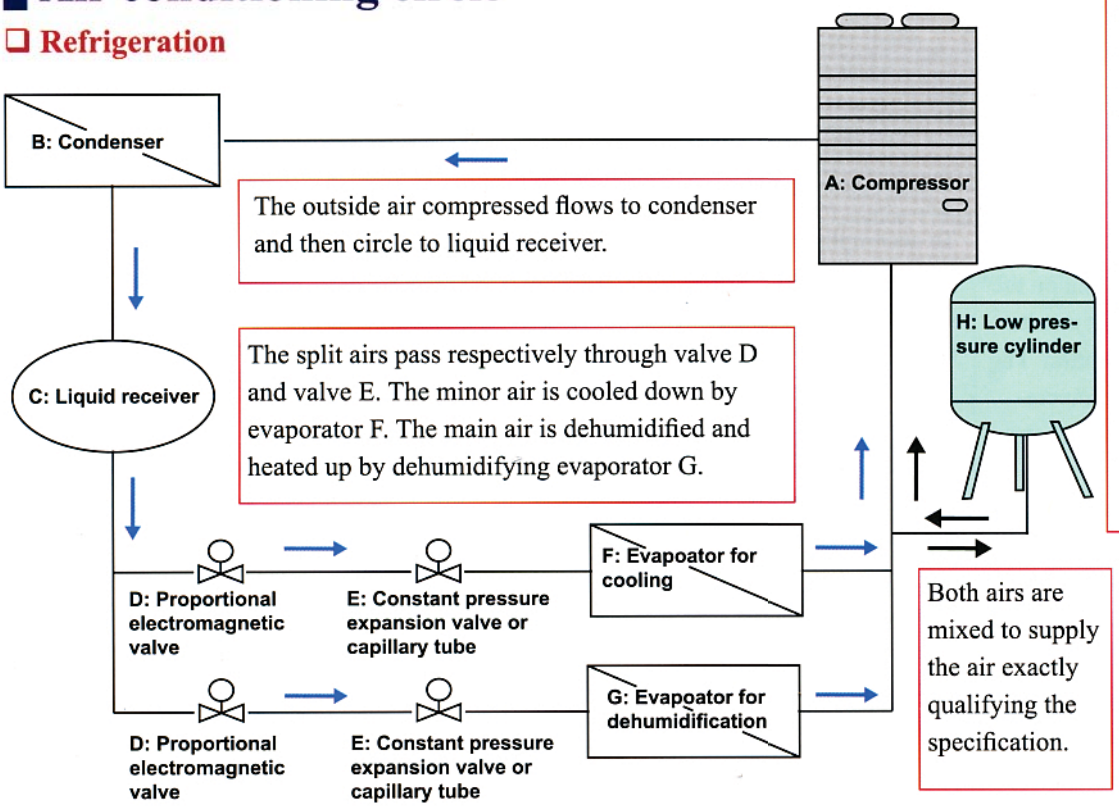
The total enthalpy of the AirPEX® System per hour is calculated as (42 - 41) x 0.8M + (41 - 11) x 0.2M = 6.8M KJ/hr.

❑ **Calculation confirms that the AirPEX® system theoretically requires only (6.8/23) x 100 (%) = 29.6% of the conventional inverter air-conditioning system.**

❑ **The AirPEX® System may cut the energy bill up to 70% compared to the current dominant inverter special air-conditioning system in the market.**

Air conditioning circle

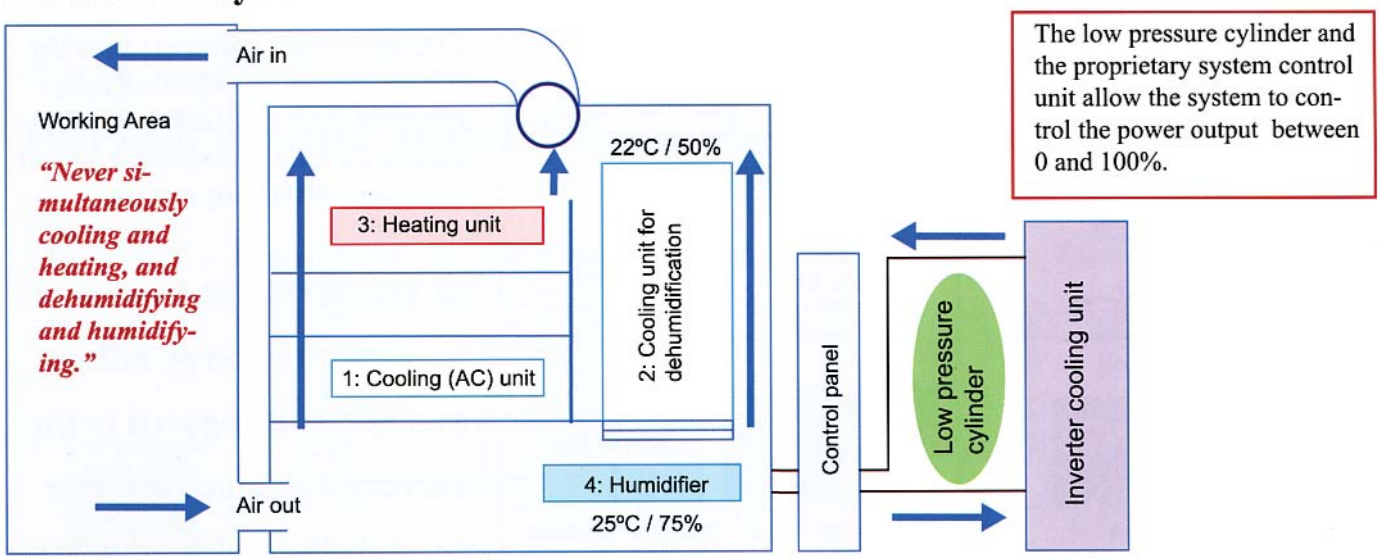
❑ **Refrigeration**



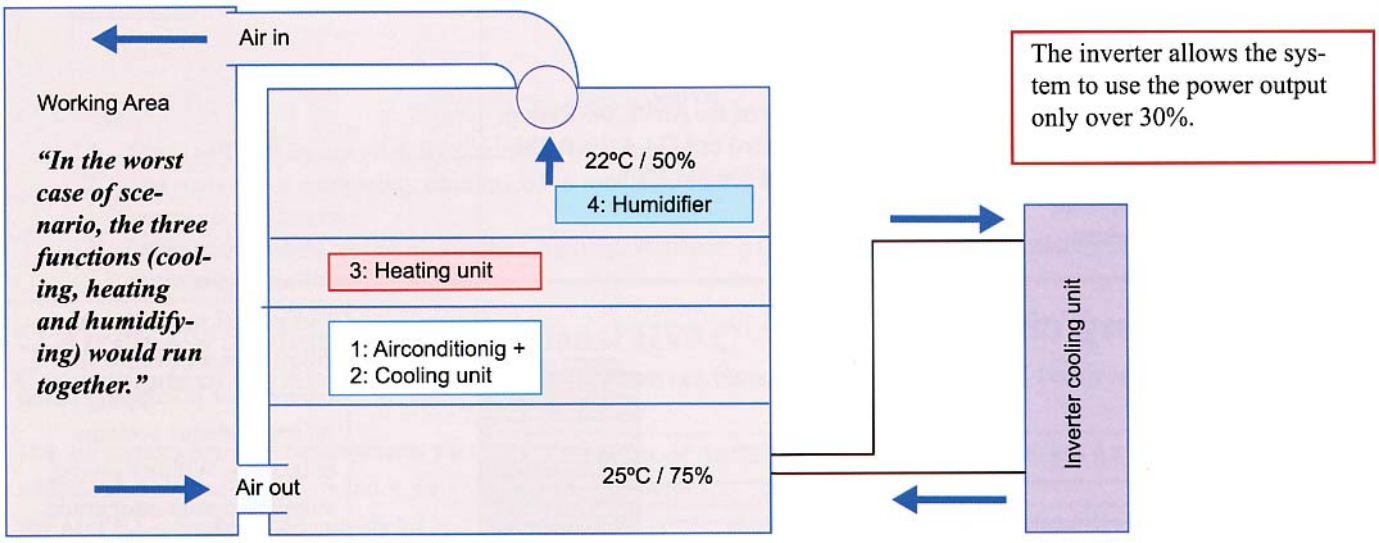
Cylinder H naturally circulates the air even while compressor is stopping based on spontaneous pressure balancing. Without saying, stopping compressor could save significant energy. (**"No-idling"**). Another benefit of the cylinder allows the inverter to output power from 0 to 30%, which is not achievable as in the conventional inverter HVAC that is the most "advanced" technology for HVAC at present.

DETAIL OF THE AIRPEX® SYSTEM

❑ AirPEX® System



❑ Conventional HVAC



The Story: The R&D team in Tsubuku Engineering, have been focusing on the most idealistic special HVAC that results in extremely low energy consumption. The idea is very simple. The higher temperature and humidity should be lowered, the lower should be risen. However, in fact, the procedure is very complicated for such special HVAC to exactly control temperature and humidity at the same time.

AirPEX® System:

"Never simultaneously cooling and heating, and dehumidifying and humidifying"

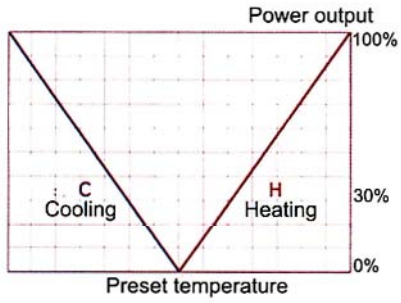
To accomplish the mission, Tsubuku invented the AirPEX® System in which the outside air is split to the main air and the minor air. For example, the ratio of main and minor is 8 to 2. In addition, it is equipped with an original and unique low pressure cylinder, by which the air naturally circuits with no energy even while the compressor is intermittent.

Conventional HVAC:

The air-conditioning of the special HVAC system must be run all the time to control temperature and humidity in a narrow range. Firstly, the air is rather cooled down, and then the air is heated up on a constant basis. Firstly, the air is cooled down to dehumidify the air and then the humidity is increased using humidifier to comply with the specification.

In the worst case of scenario, the three functions (cooling, heating and humidifying) would run together. Undoubtedly, such operation requires mandatorily huge energy usage. Of course, it is not only environmentally friendly but also the user incurs a vast expense.

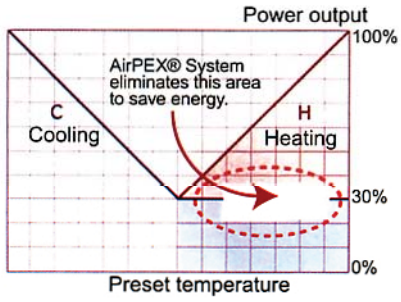
The AirPEX® System is an actualization of a proven theory.



(1) Direct air expansion by proportional control.

a: Revolutionary new proportional temperature and humidity control system allows cooling and heating, and dehumidifying and humidifying to work individually and independently. All components never work at the same time.

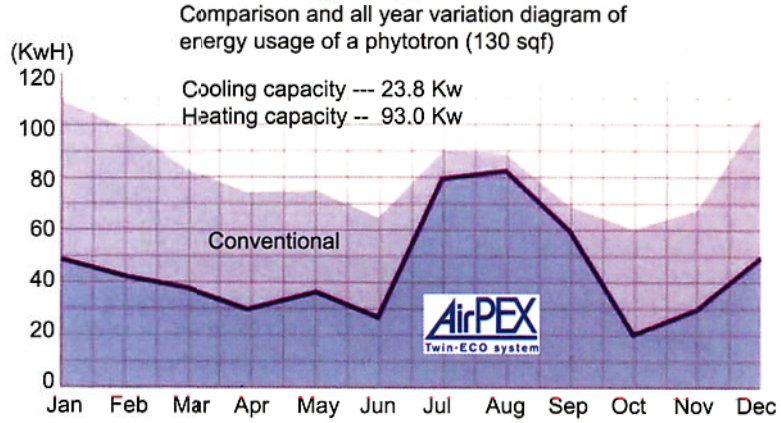
b: Control the refrigerant flow rate in the range of 0 to 100% by electromagnetic valves that are individually turned on/off every 10 seconds to exactly control the flow rate. Further, the valves are opened or closed for between 0 (closed) and 10 seconds.



c: In contrast, the conventional inverter refrigerator can modulate only over 30% of power output. On the other hand, Addition of the low pressure cylinder as a phantom refrigerator allows its power output to be from 0 to 100%. In other words, the AirPEX® System can cover all range of the power output because the refrigerant in the high pressure region generally flows to the lower to balance overall pressure in the circle. Thus, the cylinder allows the system to flow the refrigerant from high to low pressure region without energy.

d: The capacity of the cylinder is designed, for example, as 100L for 2.2 Kw or 200L for 4.5 Kw, to compensate the time lag, generally 3 minutes, until restarting the refrigerator (compressor).

❑ Seasonal variation of energy usage



All year around the AirPEX® HVAC requires significantly much less energy than a conventional HVAC. The actual results of the plant growth chamber phytotron using natural light source is shown in below photo. Despite summer time when sunlight was very strong and temperature and humidity was very high, the difference was significant. In winter time, the difference was more dramatic and the energy cost was saved over 60% every month.

This is one example of facilities that are located in severe weather conditions like outside and direct sun exposure. The more practical data is available on request.

Users and Applications of the AirPEX® HVAC System

❑ ***Since Tsubuku introduced AirPEX® Twin ECO System into the market, the new or replaced AirPEX® System was installed in more than 40 industrial and academic research, and production facilities including agriculture, electronics, chemicals, and pharmaceuticals in Japan.***

		
Constant temperature and humidity room Location: Osaka, Japan	Clean room Location: Fukuoka, Japan-	Phytotron: Location: Shizuoka, Japan
		
Plant Growth Chamber Location: Fukuoka, Japan	Weight measurement room and stabilized laboratory: Location: Ohita, Japan	Storage Location: Miyazaki, Japan

❑ **Constant temperature and humidity room** like environmental test room, semiconductor production facility, precision machinery, storage and display room of art and natural historical specimen in museum and other specialized fields require very specific temperature and humidity control.

❑ **Clean room** requires not only exact temperature and humidity control but also complying with the specific severe standard as to particles and/or microorganisms. Tsubuku can additionally provide the advanced one for a variety of industries and academics, electronics, pharmaceuticals and biotechnology.

❑ **Phytotron** used to study environmental conditions on plant growth is a kind of greenhouse that it is completely closed so that the production and consumption of a variety of gases can be also monitored. The variation allowed was ± 0.2°C in fair-weather day and ± 1°C in occasionally cloudy day. The conditions can be modulated using a personal computer.

❑ **Plant Growth Chamber** with the AirPEX® Systems can be installed as prefabricated or walk-in type built at the location. Standard, limited space and continuous light-shielding models are available. A model complying with biohazardous materials is optional..

❑ **Environmental test rooms** for electrostatic make breakdown testing possible. The apparatus simulates the low temperature and humidity condition, in which static charges are common. The dehumidifying air-conditioning system can provide the lowest relative humidity at 5% with saving space because the system requires no dry dehumidifier.

❑ **Weight measurement room and stabilized laboratory** where the wind speed must be lower than a specified level as slight wind. The system can control temperature between -20°C ± 0.1°C and 80°C ± 0.1°C and relative humidity between 30% ± 1% and 60% ± 1%.

❑ **Quality testing room for papers** need no longer defrost because it has no dry dehumidifier. The lowest relative humidity control is 5% in the prolonged operation.

❑ **Storage:**

☆ **Seeds storage room needs** no longer defrost because it has no dry dehumidifier. The system's long run can be trouble-free at temperature between 0 and 20°C and relative humidity between 10 and 40%.

☆ **Seed tuber storage room** with a new system consisting of individual installments of air-conditioning and dehumidifying refrigeration units allows to control higher humidity with less humidification. For example, it allows controlling relative humidity of 90% at 20°C, meaning lower temperature even in very humid condition..

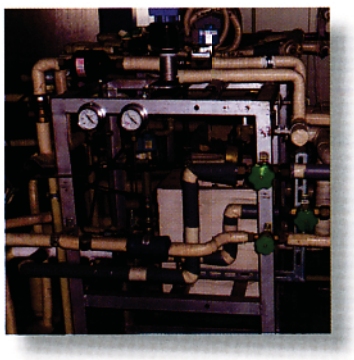
Specification

A: Control methods

1. Air-conditioning control: Time proportional ON/OFF control by the electromagnetic cooling valve
2. Heating control: Time proportional ON/OFF control by the heater
3. Dehumidifying control: Time proportional ON/OFF control by electromagnetic dehumidifying valve
4. Humidifying control: Time proportional ON/OFF control by electric humidifying heater

B: Dual chambers air-conditioner

1. The cooling coil is set as the passing flow rate is between 2.5 and 4.5 m/sec or over. The dehumidifying coil is set the rate is approximately 0.5 m/sec by the register.
2. While over 2.5 m/sec of the rate of the cooling coil decreases dehumidifying effect because the small temperature difference between before and after the coil, the large flow circulation rate increases temperature modulation effect.
3. Approximately 0.5 m/sec of the rate increases the dehumidifying effect but temperature modulation effect is not significant because of its low flow rate.
4. The chamber temperature is controlled by mixing the modulated air passed from the cooling coil and the humidifying coil before the blower.
5. The dual chambers structure allows the re-heating load to be decreased without over or excess cooling for dehumidifying.
6. The calculation results in the air-conditioning system are available on request.



Air Conditioning Engineering TSUBUKU

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Corporate information

Tsubuku Engineering Corporation

Tsubuku Engineering Corporation as Tsubuku Steel and Tsubuku Refrigeration Co. Ltd. has been manufacturing and marketing refrigeration units for industrial and commercial HVAC since 1920s.

Late 1960, Tsubuku started to supply special air control units and air-conditioning system for such as pharmaceutical, health care hospital, agricultural, and IT industries. Not only a hardware manufacturer and supplier, but Tsubuku has also know-how and resources to design and build special controlled air facilities. Since we invented and developed the new AirPEX® System, Tsubuku is appreciated as a leading engineering company for Revolutionary Energy Saving HVAC. We believe there are no competitive systems to save huge energy is like this.

Further detail information is available on request.

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