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IEA EBC Annex 87

Energy and Indoor Environmental Quality Performance of Personalised Environmental Control Systems (PECS)

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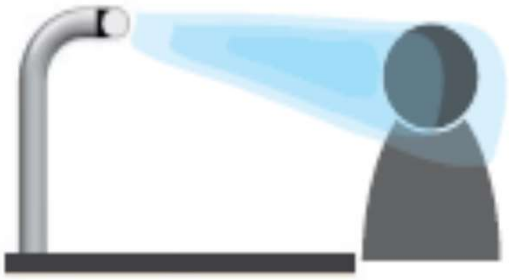
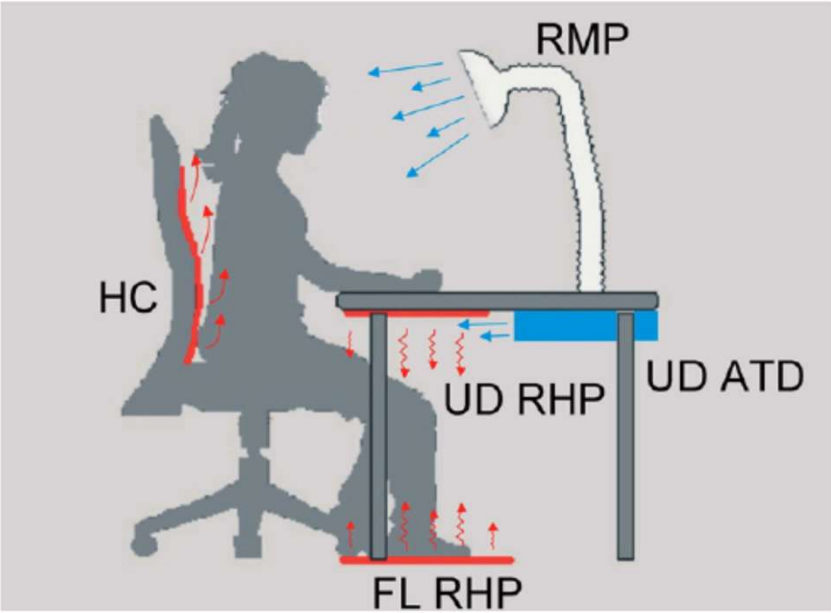
WHAT IS PECS?

- Personal Environmental Control System (PECS) with the functions of heating, cooling, ventilation, lighting and acoustic has advantages of controlling the localized environment at occupant's workstation by their preference instead of conditioning an entire room.
- This improves personal comfort, health and energy efficiency of the entire heating, ventilation and air-conditioning (HVAC) system substantially.
- Personalized ventilation will also protect against cross contaminations, which are critical in open plan offices and work places with close distance.



Source: Melikov 2010



Source: Watanabe et al. 2010

Source: Zhang et al. 2010

Why PECS?

- Has several benefits compared to ambient (total volume) conditioning systems
  - Improved comfort, health and productivity
  - Higher satisfaction with the indoor environment, due to
    - Improvements in the immediate indoor environment experienced by the occupants
    - Possibility of personalized control
  - Potential energy savings
  - Increasing focus on individual differences between people → PECS can address these individual differences
  - Even more relevant due to COVID-19 (pandemic-proofing)

Why PECS?

- Not entirely new – significant amount of research exists
- Despite the proven benefits
  - No design guide or manual for such systems and their integration in building HVAC systems
  - Far from ”solved”, still several issues to be addressed
  - Not at the level of a common solution in buildings
  - Very limited ”real world” and commercial examples

Meetings

- 2022 Preparation phase
  - May 20th, 2022 Rotterdam
  - October 17-18th, Copenhagen
- 2023-2025 Working Phase
  - 1. meeting of the working phase of IEA EBC Annex 87, 19th and 20th of May 2023, Tokyo
  - 2. meeting in September 11-12, 2023 (Lausanne, Switzerland, before CISBAT2023 Conference)
- 2026 Reporting Phase

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OBJECTIVES

- Establish design criteria and operation guidelines for PECS
- Quantify the benefits regarding health, comfort and energy performance.
- Control concepts and guidelines for operating PECS in spaces with general ambient systems for heating, cooling, ventilation and lighting.

SCOPE

- Includes all types of PECS for local heating, cooling, ventilation, air cleaning, lighting and acoustic.
- Includes desktop systems, which are mounted on desks or integrated in a furniture
- Chairs with heating/cooling and ventilation.
- Wearables, where heating/cooling and ventilation are included in garments or devices attached to occupants' body.
- Not including cars

TARGET AUDIENCE

- Manufacturers (who need design guidelines)
- Building owners and consultants (who need information on performance, advantages, problems, operation, how PECS is operated together with other building systems)
- Users (need same info as building owners and for home workplaces)
- Standardisation Bodies (revision of standards for indoor environmental quality).

Activities

- Seminar in CLIMA2022 (ca. 30 people attended)
  - https://clima2022.org/extra_content/seminar-new-iea-ebc-annex-on-personalized-environmental-control-systems-pecs/
- Topical session in AIVC2022 (ca. 45 people attended)
  - https://aivc2022conference.org/topical-session-08/
- AIVC Webinar on Monday, 12th of Dec 2022
  - Registration link:
  - https://inive.webex.com/inive/j.php?RGID=rd4ce219c23589874419137a1bff98911

Subtask A: Fundamentals

- **Leader**
  - **Mariya P. Bivolarova, Technical University of Denmark, Denmark**
- **Co-leader:**
  - **Dolaana Khovalyg, EPFL, Switzerland**
- **Activity A1:** Definition and identification of the requirements of PECS in terms of localized and background Indoor Environmental Quality (IEQ) i.e., thermal, air quality, lighting, and acoustics.
- **Activity A2:** Outline the benefits of PECS regarding comfort, health and productivity based on literature and new research.
- **Activity A3:** Outline the minimum energy cost requirements for PECS.

Subtask B: Applications and Technologies

- **Leader:**
  - **Kai Rewitz, RWTH Aachen University, Germany, pending**
- **Co-leader**
  - **Joyce Kim, University of Waterloo, Canada**
- **Activity B1:** Summarize the working principles, capabilities and limitations of existing PECS, based on literature.
- **Activity B2:** Identify future development and improvement suggestions for PECS for optimal energy, IEQ and cost performance.

Subtask C: Control, operation and system integration

- **Leader:**
  - **Joon-Ho Choi, University of Southern California, USA**
- **Co-leader**
  - **TBD**

- **Activity C1:** Identify and summarize existing methods for controlling PECS (including sensors used for control).
- **Activity C2:** Develop guidelines on integrating PECS with ambient conditioning systems in buildings.

Subtask D: IEQ and Energy Performance evaluation

- **Leader:**
  - **Douaa Al-Assad, KU-Leuven, Belgium**
- **Co-leader**
  - **Marco Perino, Politecnico di Torino, Italy**
- **Activity D1:** Collection of existing methods of studying and testing PECS.
- **Activity D2:** Identification of generic power requirements for PECS to achieve energy savings compared to ambient conditioning systems.
- **Activity D3:** Development of universal and standardized ways of evaluating and reporting performance of PECS.

Subtask E: Policy and advisory actions

- **Leader:**
  - **Rajan Rawal, CRABSE, CEPT University, India**
- **Co-leader:TBD**
- **Activity E1:** Summary of national and international building codes and standards regarding PECS.
- **Activity E2:** Develop ways of overcoming current barriers for a wide implementation of PECS in buildings.
- **Activity E3:** Provide input to existing national and international standards about requirements, characteristics, and performance of PECS.

DELIVERABLES

1. Guidebook on requirements for PECS
2. State-of-the-art report on PECS
3. Guidebook on PECS design, operation and implementation in buildings (including integration of PECS with ambient conditioning systems)
4. Report on test methods for performance evaluation of PECS
5. Universal criteria about requirements, characteristics, and performance of PECS to be used in national and international standards

Participating countries

- Australia, Belgium, Brazil, Canada, China, Denmark, Finland, France, Germany, Italy, Netherlands, Republic of Korea, Singapore, Switzerland, Turkey, USA

Further information

- www.iea-ebc.org/projects/project?AnnexID=87