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# MODELING OF A MONOBLOC ROOM AIR CONDITIONER

## -SUMMARY-

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# 1. Introduction

A “reference” and a “simplified” mono-bloc room air conditioner models are proposed in this paper.

The mono-bloc room air conditioner functions only in cooling mode.

In nominal *cooling* conditions (indoor air temperature 27°C and indoor air relative humidity 47%), the capacity is 2257 W and the EER 2.6.
The part-load operating mode is ON-OFF.

# 2. Reference model

The main equations of the reference model are already described in previous reports on RAC modelling (VTJL061207 and VTJL070704). The only difference is that the air temperature at condenser supply is the indoor air temperature.

The following assumptions are made:

- Evaporator flow rate: 318 m³/h (at 20°C and atmospheric pressure);
- Condenser flow rate: 299 m³/h (at 20°C and atmospheric pressure);
- Superheating at the condenser supply: 38 K;
- Compressor flow rate: 1.55 m³/h;
- Compressor rotation speed: 3000 tr/min;
- Evaporator fan power consumption: 10 W;
- Condenser fan power consumption: 42W;
- Electronic devices power consumption: 6 W.

Information flow diagrams and simulation results in nominal cooling mode are given in **Figures 1**.

**Note:**

- The room air conditioner performances depend only on the indoor air temperature and indoor air relative humidity;
- In the global building-RAC system simulation model, the thermal gain associated to the air infiltration (0.1125 kg/s) imposed by the condenser fan must be taken into account.

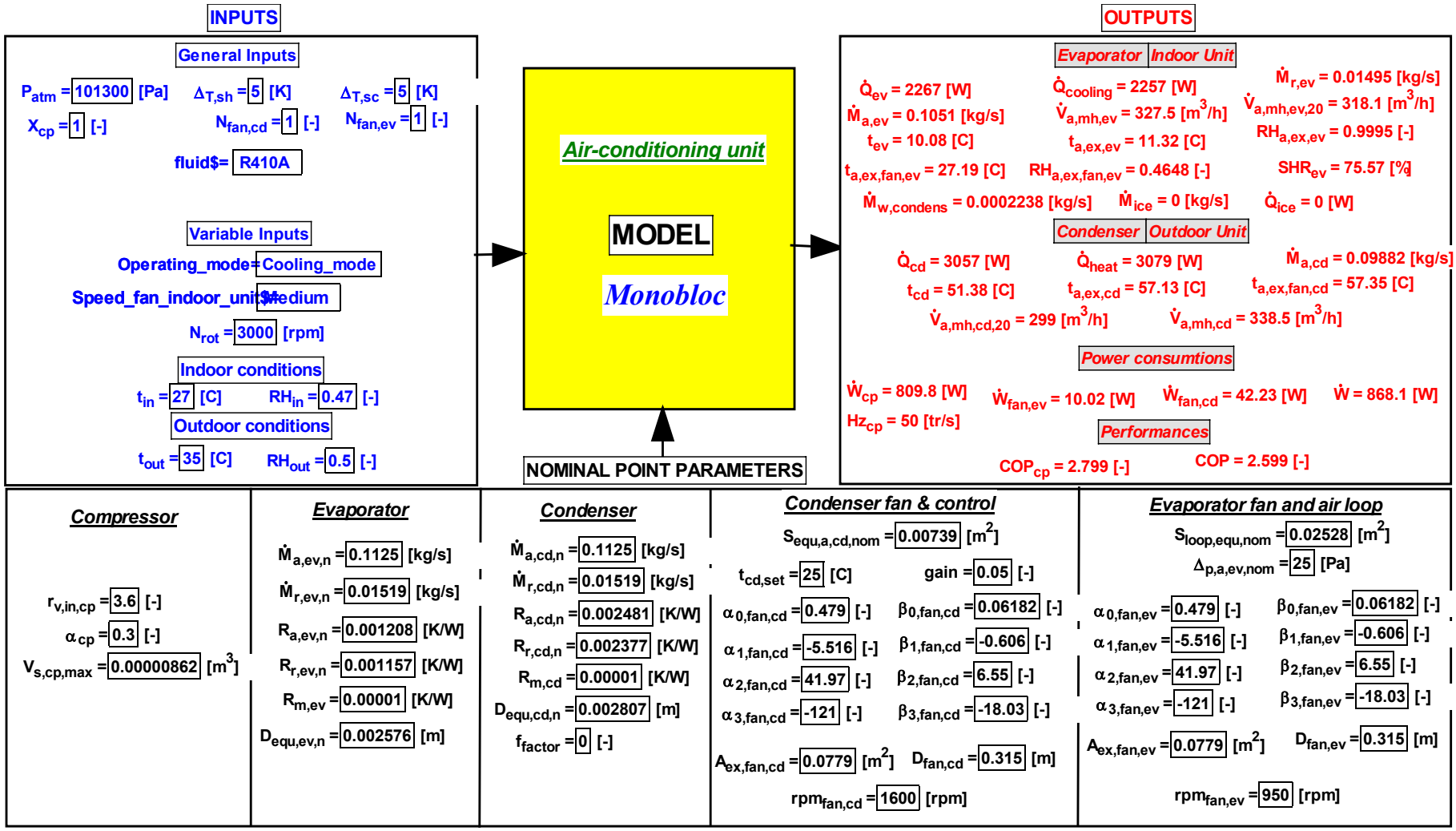


**Figure 1:** The mono-bloc room air conditioner model results: nominal cooling mode

## 3. Simplified modelling in cooling mode

The simplified model use the same set of equations and hypotheses as before (VTJL061207 and VTJL070704).

The nominal cooling capacity and the corresponding electrical consumption in full load are expressed as polynomial functions of one independent variable:
The indoor air temperature, associated to a reference relative humidity (50%).
These functions are corrected in the same way as for other RAC's, in order to take into account of the actual relative humidity.

*Part load correction factor*

In part load, we suppose that the RAC is working in ON-OFF. This control mode generates some performances losses due to:

- frequent start-up of the compressor;
- system instabilities at the start-up (the steady-state condition are generally achieved after 5 – 10 min);
- (small) auxiliary power consumption (6W for the electronic device).

On the basis of literature information gathered in **Task 4,** we suppose that the system performance degradation can be described by the curves given in **Figure 2**.

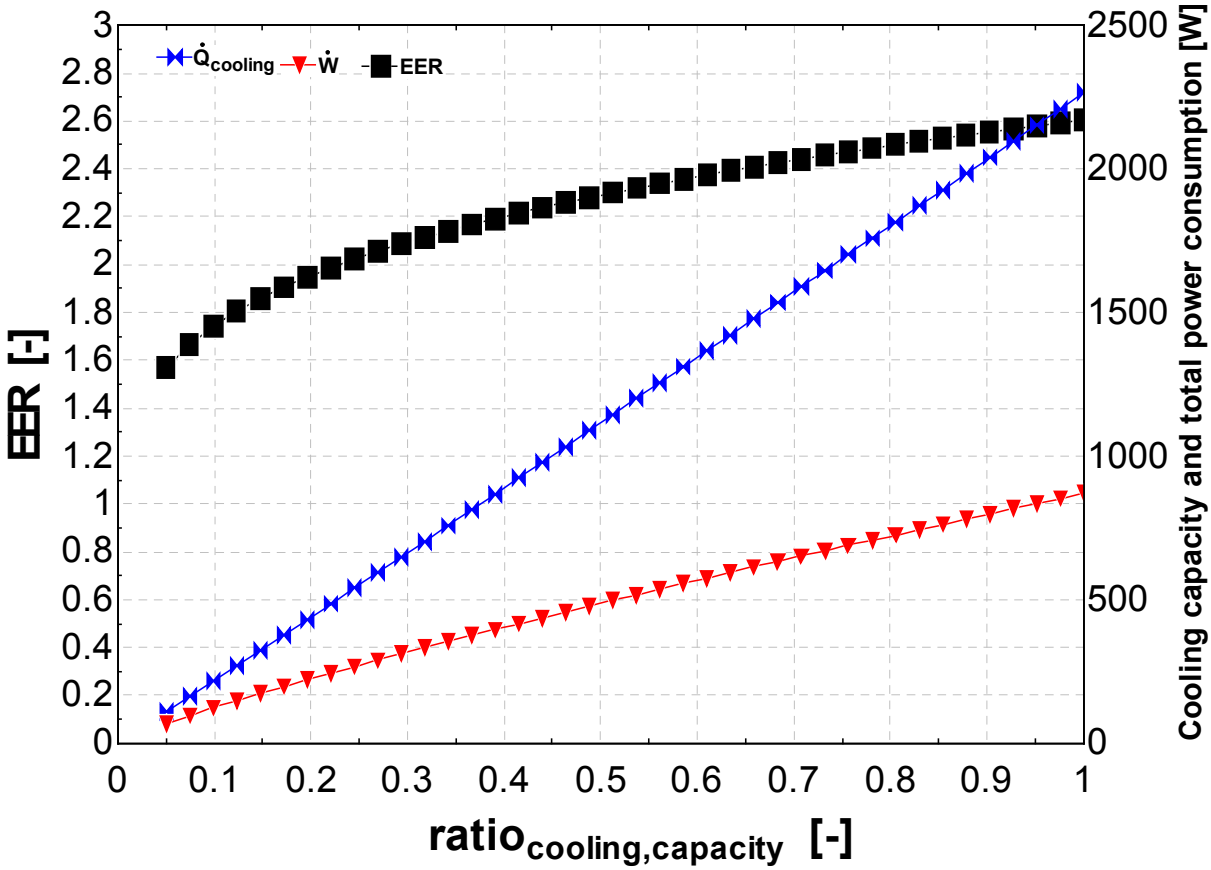


**Figure 2:** Part load system EER

The empirical model flow chart is presented in **Figure 3**:

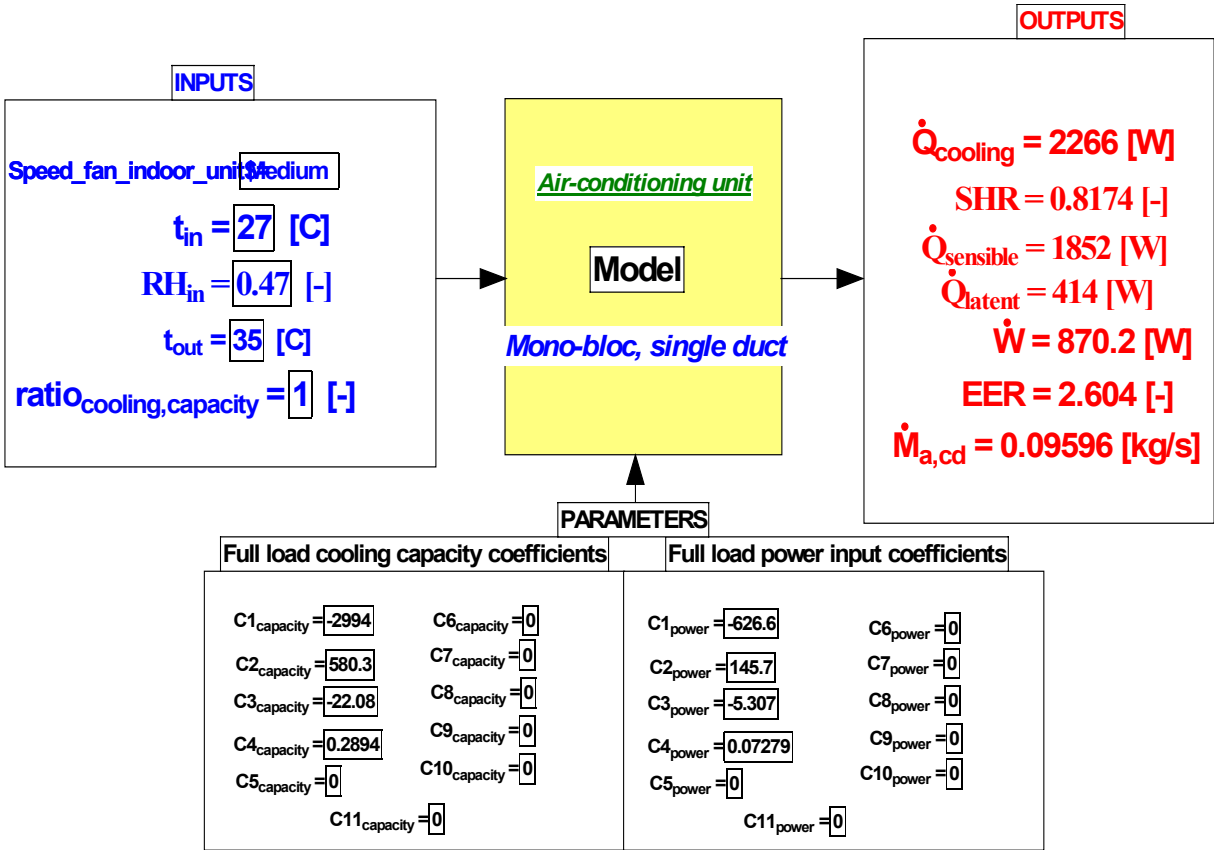


**Figure 3:** Empirical model flow chart (nominal cooling mode)

### *3.1 Simulation results*

The simulation results are shown in **Figure 4** to **6**.

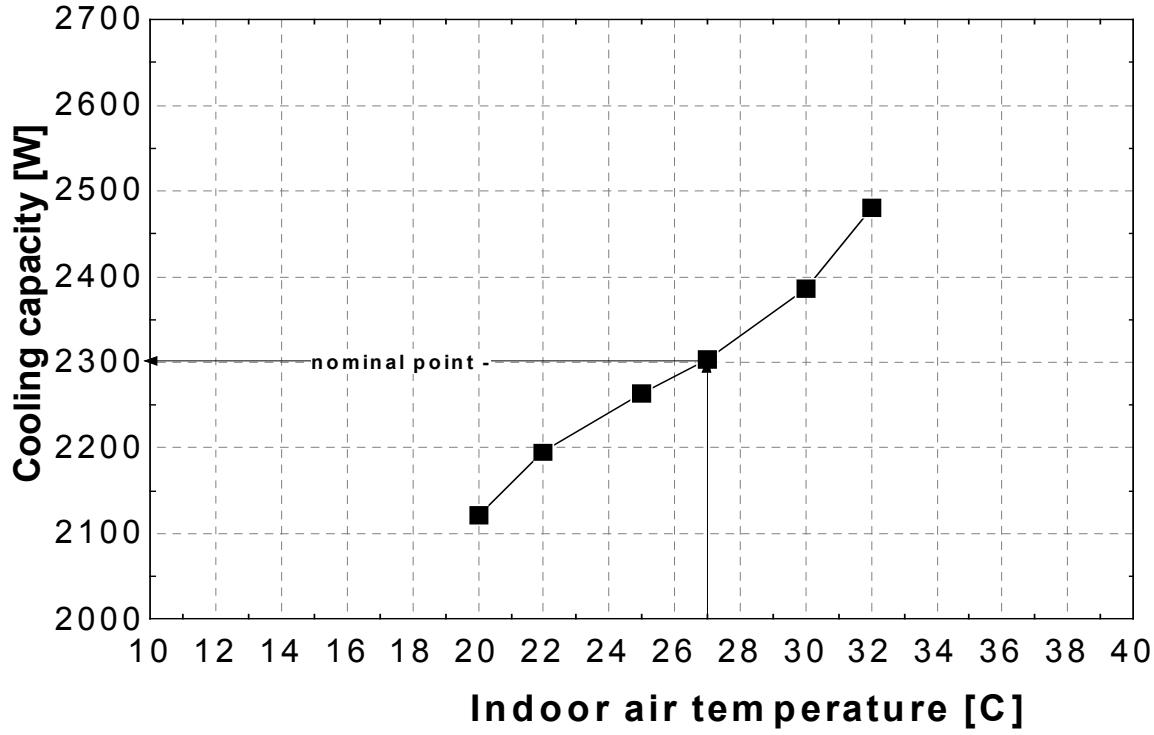


**Figure 4**: Cooling capacity as function of indoor air temperature (medium fan speed; RH_in= 47%)

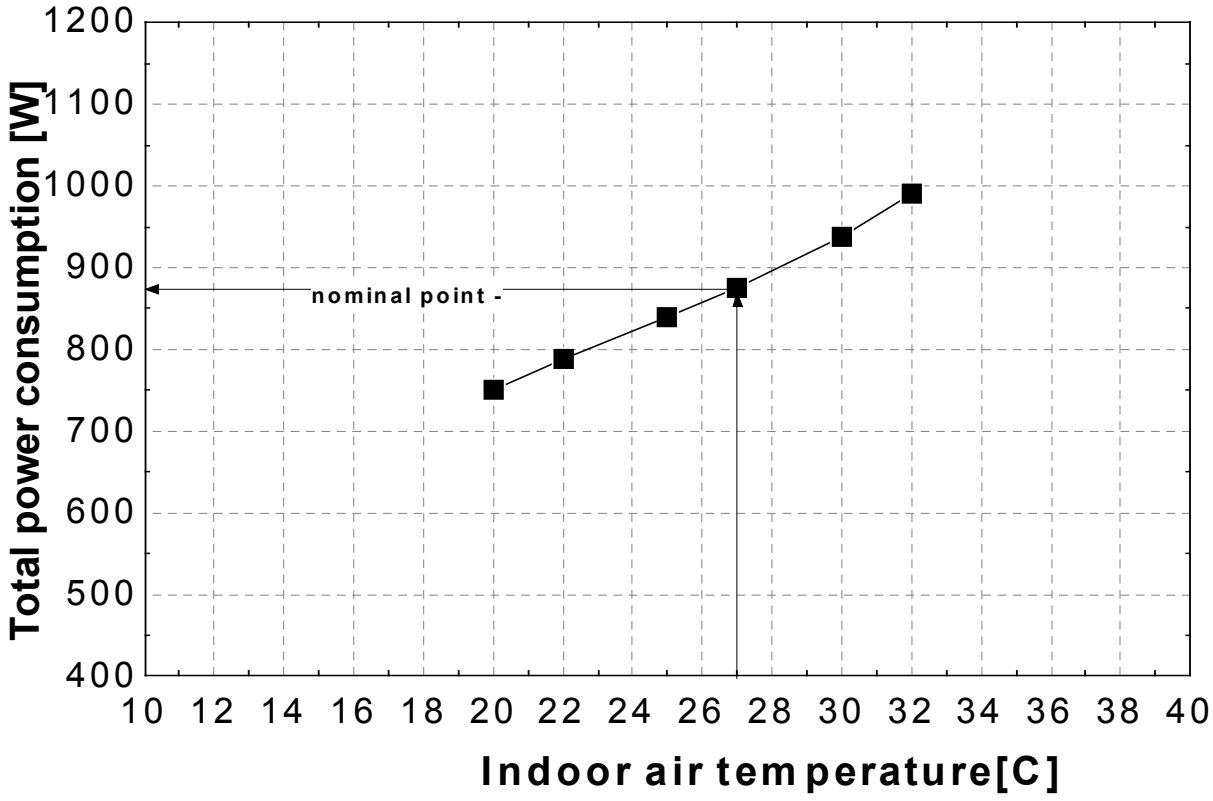


**Figure 5**: Total power consumption as function of indoor air temperature (medium fan speed; RH_in= 47%; full load)

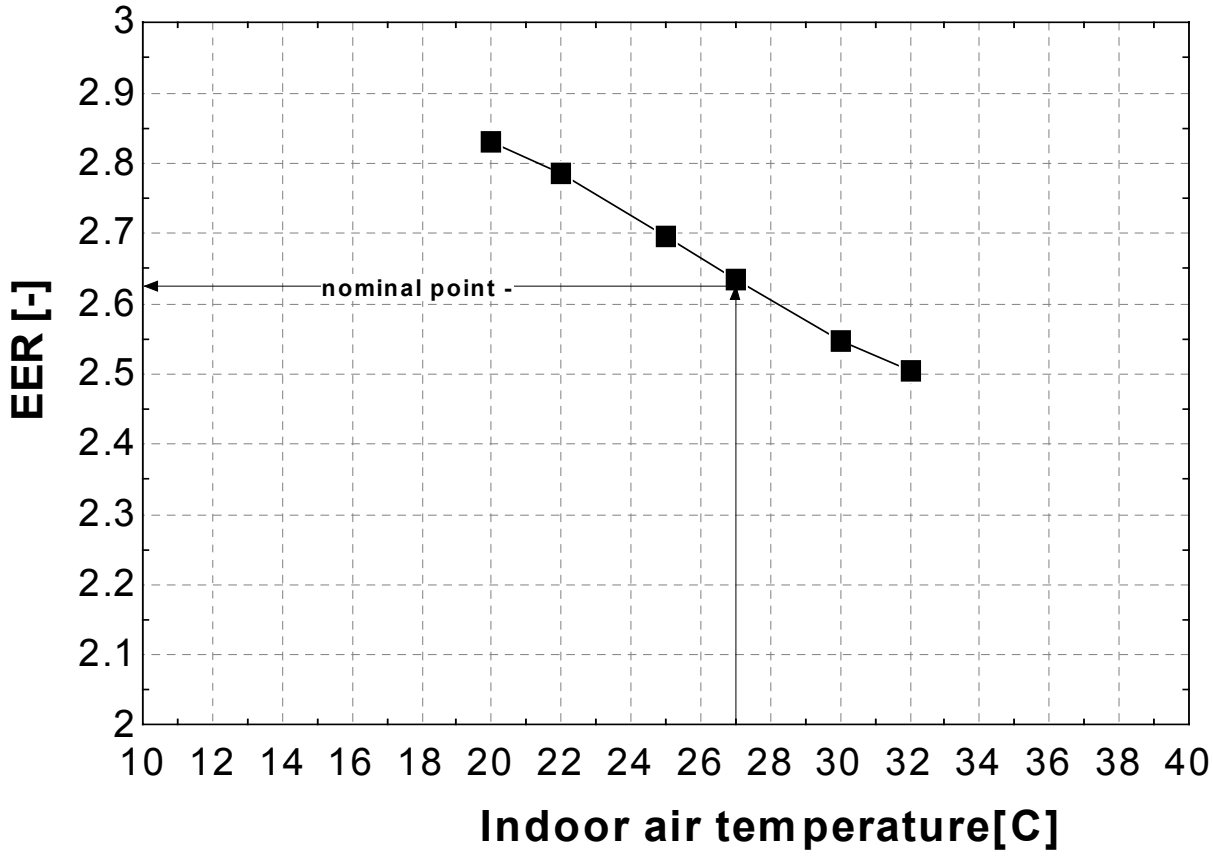


**Figure 6**: RAC EER as function of indoor air temperature (medium fan speed; RH_in= 47%; full load)