Q&A to 'Current and future testing methods of heat pump, problems and solutions to approach actual energy performance' by Prof. Niccolo Giannetti

1. This study has been conducted on how many Heat Pumps?

As the Emulator-type load-based testing methodology has been investigated by the main groups involved for over 5 years, we can say that Waseda has conducted tests on tens of heat pumps and air conditioners, and I would estimate that the total number of tested units by the 5 main groups involved in the project overcomes 100 units.

2. Did you consider various producers? Which of them?

Units from different producers have been tested, and some of them have participated in interlaboratory tests to verify the results reproducibility across different facilities. In the case of Waseda, units from different Japanese manufacturers have been tested.

3. How can testing labs adapt to HiL (Hardware in the Loop) tests, what is needed?

Testing labs, in principle, already have the equipment required for running such tests. The only additional features come from the software and the communication between software and testing facility. So, provided that the reconditioning unit of the psychrometric/calorimetric room is equipped with a reasonably effective control of the indoor temperature and humidity, HiL tests and Load-based tests can be conducted by installing the emulator on a pc and interfacing it (in real time) with the measurement data and the control of the reconditioning unit.

4. Did you also calibrate the emulator with experimental data?

The emulator was not directly calibrated with experimental data, but empirical values of the thermal (and moisture) inertia of the virtual building that is simulated by the "emulator" are being referred to reference building characteristics reported in literature. Additionally, the groups involved in the projects are carrying out representativeness tests in the field to verify how well the present formulation of the virtual building represents the thermal interaction of installed units with actual building features.

Q&A to 'Monitoring methods and data of heat pump. Problems and solutions to approach actual energy performance' by Prof. Baolong Wang

1. Could you give us the information on the accuracy of field monitoring compared with lab test methods?

Compared with lab test methods, different field monitoring methods have different accuracy. The air enthalpy difference methods have the relatively low accuracy (deviation>15-20%). The refrigerant flow rate meter has the highest accuracy (deviation<5%). The methods based on the catalog data (Compressor performance curve method, Compressor volumetric efficiency method, Throttling model method) have the high accuracy for the new products (5%<deviation<10%) but will degrade to the lower accuracy in months (deviation>15-20%). The Compressor energy conservation can reach accuracy 10-15% during the whole life of the HP.

2. When measuring/calculating refrigerant mass flow rate using one of the methods, do you assume a constant refrigerant mass flow rate in all components in the heat pump? Or do you always run these tests under steady state conditions?

About the monitoring accuracy under the dynamic processes, the refrigerant enthalpy difference methods show some degradation during state change. But for the normal control of the HP (except starting and stopping), the time to reach a new stability is quite short, the refrigerant enthalpy difference methods still show a better performance than air enthalpy difference methods.

3. What parameter do you use to determine the refrigerant mass flow rate?

For the Compressor performance curve method and Compressor volumetric efficiency method, the refrigerant flow rate is decided by performance curve of mass flow rate or volumetric efficiency, condensing temperature, evaporating temperature and suction temperature. For the Throttling model method, the refrigerant flow rate is determined by the flow curve of the valve, inlet pressure, outlet pressure and subcooling degree. For the Compressor energy conservation method, you need input specific enthalpy at the inlet and outlet of the compressor, which can be decided by local temperature and pressure, and the power input of the compressor.