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**IEA HPP Annex 28**  
**«Test procedure and seasonal performance calculation of residential heat pumps with combined space and domestic hot water production»**

**Participants**

There are 10 countries participating in Annex 28. However, the TU Dresden, Germany, is no longer participating in the IEA HPP Annex 28 due to financial problems.

**Results Task 1**

In Task 1 an analysis for systems on the market and the actual state of the art in standardisation was to be analysed. Further on data source for the boundary conditions of the calculation method should be investigated. The survey delivered the following results:

Systems analysis

The most common systems are presently alternately operating systems. Two general configurations are found on the market:

- One condenser/intermediate circuit  
 The domestic hot water (DHW) storage tank is in parallel to the heating circuit. The heat pump is switched from the heating to the DHW operation by a switching valve.
- Two condensers  
 The two condensers are in parallel configuration, one condenser connected to the heating circuit, the other condenser connected to the domestic hot water circuit. The heat pump operation is switched by a switching valve.

This basic system configuration can be distinguished as well by the type of storage and the hydraulic integration of the storage. Configurations found on the market include the following configurations:

- Intermediate circuit with external refrigerant/water heat exchanger for the DHW circuit
- DHW water/water heat exchanger around the storage tank (mantle storage tank)
- Condenser inside the storage tank or around the storage
- Combi storage: a smaller DHW storage is integrated in a bigger heating buffer storage

Moreover system configurations can be distinguished by the integration of storages in the heating circuit in serial or parallel and the number of heating circuits connected to the heat pump.

Newer concepts apply a simultaneous operation to produce the space heating and DHW requirement at the same time. These systems use heat exchange by desuperheating or condensate subcooling to extract the heat at different temperature levels from the heat pump process either to supply it directly to the load or as input to another cycle. However up to now not many of the simultaneous operating systems are available on the market.

Switzerland: cascade type heat pump using condensate subcooling

France: system with desuperheater and condenser arranged in serial

Austria: systems with desuperheater with a combi storage tank / desuperheating lance

Germany: integral compact unitary systems for heating, domestic hot water and ventilation are actually introduced in the market for ultra low energy houses called “Passive House”. Moreover system with desuperheater, condenser, condensate subcooling and internal suction gas preheating are under development, as well in Norway.

## **Standardisation**

### Europe

In Europe actual standardisation in the field of heating and DHW systems is driven by the implementation of two directives. In the framework of the Energy Directive on the Performance of Buildings (EPD) calculations methods are developed as prEN 14335 in CEN/TC 228/WG 4. The implementation of the council directive 92/75/EC on energy labelling for domestic hot appliances has been mandated to CEN/CENELEC in the mandate M/324. Testing methods for all kind of domestic hot water appliances are to be revised to develop comprehensive testing methods. Testing of heat pumps is performed according to the standard EN 255 which deals with either single heating (part 2) or single DHW (part 3) operation. Combined operation can only be treated in alternate operation, where the system is either in heating or in DHW operation. EN 255-2 has been revised as prEN 14511, which is before formal vote (3 month voting, editorial comments possible). In CEN/TC 113/WG 10, which is currently in constitution the revision of EN 255-3 for the testing of heat pumps is treated.

On the European level, neither a test procedure nor a calculation method for simultaneous operating systems exists.

Further test procedures and calculation methods exist on the national level in European countries, e.g. in Sweden a test procedure for simultaneous operation of heat pumps using exhaust air is in use while in Germany calculation methods for the seasonal performance of alternate operation of heating and domestic hot water systems like the VDI 2067-6 or short cut methods contained in the EnEV 2002 are introduced in national guidelines.

### Liaison

A liaison of CEN/TC 113 and the IEA HPP Annex 28 is established and members of the national teams of IEA HPP Annex 28 are participating in the CEN/TC 113/WG 10. A liaison to the CEN/TC 228 is to be established. The operating agent of IEA HPP Annex 28 is member of the CEN/TC 228/WG 4

### America

In the American standardisation more comprehensive test procedures as well for the simultaneous operation exist. ASHRAE 116 deals with testing and calculation of single heating or cooling application of air-to-air heat pumps, containing calculation methods for fixed speed and variable speed compressors. ASHRAE 137 describes test procedures and calculation methods for simultaneous operation of air-to-air heat pump systems with desuperheaters. The testing includes approaches for part load operation, which are not contained in the European standardisation.

### Japan

In Japanese standardisation test procedures for combined floor heating and domestic hot water do not exist. In 2001 the standard JRA 4045 dealing with single domestic hot water systems has been issued.

## **Data sources for boundary conditions**

All the data for boundary conditions for the calculation method, e.g. meteorological data and the energy requirement of the building and requirements for the domestic hot water, are available as interfaces to other standards or national regulations. The most problems are expected by the evaluation of ground temperature.

## **Resolution 2<sup>nd</sup> Annex meeting at CETIAT, Lyon**

### Test procedure:

- For highly integrated systems, e.g. heat pump and domestic hot water storage are assembled as a unit, a system test is required.
- For other systems a component based testing should be allowed, where system results can be derived with adequate computational tools.
- Standard should be open for approaches of dynamic testing, where test sequences are shorter and test results are derived by parameter identification.

### Calculation method

- Participants agree on a “bin”-approach for the basic calculation method
- Proposal: Standard should be open for the calculation of more complex systems based on simulations

For simulation programs introduced in standardisation a validation tool is required, e.g. comparable to “BESTEST” in the building simulation sector.