

EN ISO 52016 and 52017: Calculation of the building's energy needs for heating and cooling, internal temperatures and heating and cooling load

EN ISO 52016-1 presents a coherent set of calculation methods at different levels of detail, for the (sensible) energy needs for the space heating and cooling and (latent) energy needs (de-)humidification of a building and/or internal temperatures and heating and/or cooling loads, including the influence from technical buildings systems, control aspects and boundary conditions where relevant for the calculation. EN ISO 52017-1 contains a generic (reference) hourly calculation method. Extensive explanation and justification is given in the accompanying CEN ISO/TR 52016-2.



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EN ISO 52016-1

EN ISO 52016-1 presents a coherent set of calculation methods at different levels of detail, for the (sensible) energy needs for the space heating and cooling and (latent) energy needs (de-)humidification of a building and/or internal temperatures and heating and/or cooling loads.

The effect of specific system properties can also be taken into account, such as the maximum heating or cooling power and the impact of specific system control provisions. This leads to **system-specific energy loads and needs**, in addition to the **basic energy loads and needs**.

EN ISO 52016-1 contains both **hourly** and **monthly** calculation procedures. These are closely linked as explained further on.

Link between EN ISO 52017-1 and EN ISO 52016-1

EN ISO 52017-1 is not needed for the actual calculation of the energy performance of buildings. EN ISO 52017-1 contains a generic (reference) hourly calculation method for (a thermal zone in) a building.

The reference method in EN ISO 52017-1 is based on and replaces EN ISO 13791. EN ISO 52017-1 contains no specific assumptions, boundary conditions, specific simplifications or input data that are not needed to apply the generic calculation method. Compared with EN ISO 13791 the energy needs for heating and cooling are added to increase the application range. This standard does not include validation cases (unlike EN ISO 13791). For validation, specific assumptions and input data would need to be given that only apply to the validation cases. To keep a clear distinction between the

generic method and a specific application, verification and validation cases are adopted in EN ISO 52016-1.

EN ISO 52016-1 replaces EN ISO 13790:2008. It contains an hourly calculation method and a monthly calculation method. The hourly calculation method is a specific application of the generic method provided in EN ISO 52017-1.

EN ISO 52016-1 further contains specific boundary conditions, specific simplifications and input data for the application: calculation of energy needs for heating and cooling. Amended simplifications and input data are provided for the application to calculate the design heating and design cooling load and (e.g. summer) internal temperatures.

In this way the generic calculation method (EN ISO 52017-1) is clearly separated from the specific application with all specific assumptions, simplifications and specific input data (EN ISO 52016-1).

The **hourly** method in EN ISO 52016-1 produces as additional output the key parameters needed to generate parameters for the **monthly** calculation method. This means that a number of (nationally) representative cases can be run with the hourly method and from the output, the key monthly parameters for the different cases, the monthly correlation factors can be derived. See flow chart in **Figure 1**.

Input-output relations between EN ISO 52016-1 and other standards of the set of EPB standards

In a previous REHVA Special on the EPB standards [4] the many links of EN ISO 52016-1 with other EPB standards were introduced. Special attention in this respect has been paid to testing the link with the procedures to calculate the thermal transmission through the **ground floor**, taking into account the inertia of the ground. These procedures are given in EN ISO 13370 (see parallel article by Mrs Kosmina) for monthly, but also for hourly calculation methods.

The hourly climatic data are given in EN ISO 52010-1 and the hourly and daily patterns of the conditions of use (operating schedules) are given in the relevant other EPB standards.

More details on the many inputs from and many interactions with many other EPB standards are given in CEN ISO/TR 52016-2.

Hourly versus monthly calculation method

The hourly and the monthly method in EN ISO 52016-1 are closely linked: they use as much as possible the same input data and assumptions. And the hourly method can be used to generate the parameters for the monthly calculation method, as shown above (**Figure 1**).

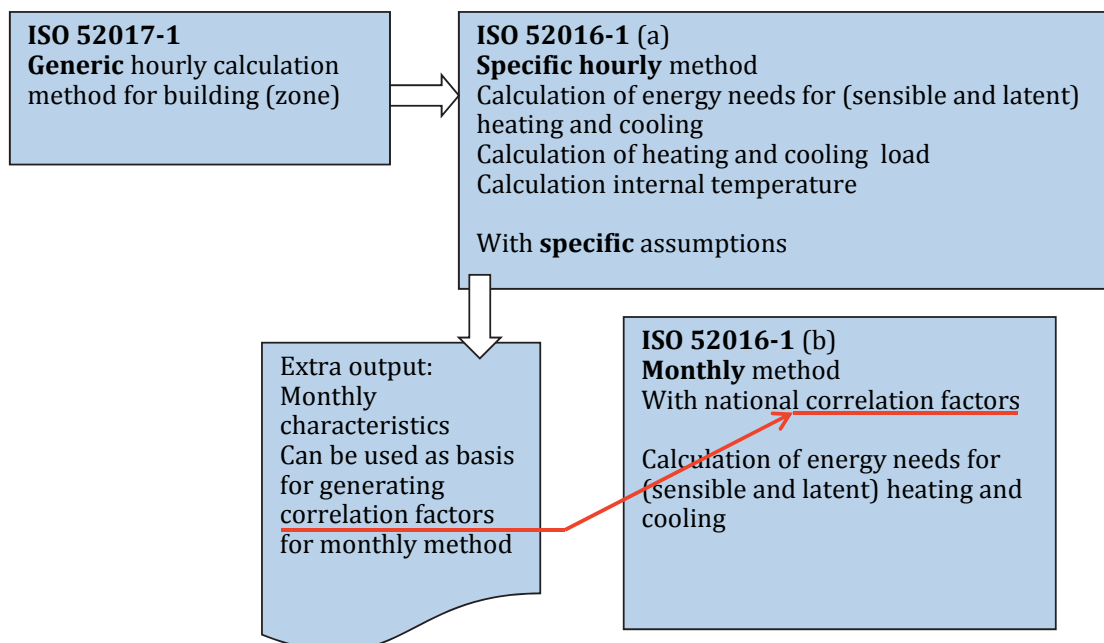


Figure 1. The relation between EN ISO 52016-1 and EN ISO 52017-1.

The hourly method in EN ISO 52016-1 is more advanced than the simplified hourly method given in EN ISO 13790:2008, to make the method more transparent and more widely usable, without asking more input data from the user. This was already explained in a previous article [5].

The main goal of the hourly calculation method compared to the monthly method is to be able to take into account the influence of hourly and daily variations in weather, operation (solar blinds, thermostats, heating and cooling needs, occupation, heat accumulation, etc.) and their dynamic interactions for heating and cooling.

Design heating and cooling load in EN ISO 52016-1

Upon request of CEN/TC 156, the method to calculate the design heating and cooling and latent heat load from prEN 16798-11:2015, prepared by CEN/TC 156, has been integrated in EN ISO 52016-1.

EN ISO 52016-1 includes specification of the method and the boundary conditions for the calculation of the design heating and cooling load, including latent load, as a basis for the dimensioning of equipment on zone level and on central level for cooling and dehumidification. It specifies also the methods and conditions for the calculation of the humidification load.

The method given for the design **heat** load is intended especially for the cases where the **cooling** load calculation needs to be done (for instance when cooling is

necessary) and/or an **hourly** calculation is used for the energy needs calculation. The principle idea is that there is only one method needed for load and energy calculations for heating and cooling in case of an hourly calculation interval.

If the design heating load is calculated with another (e.g. simplified) calculation method, such as EN 12831-1, the many input data are for 90% the same as for the energy needs calculation according to EN ISO 52016-1. It is advisable to check if duplication of gathering these input data could be avoided.

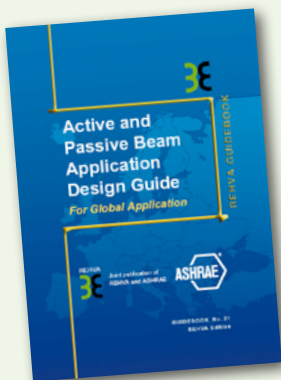
Flexibility

Options for national choices provided in “Annex A/ Annex B” of EN ISO 52016-1 comprise:

- References to other EPB or national standards.
- Selection of hourly or monthly method.
- Rules for thermal zoning.
- Simplifications (at various levels).
- Specific details of the hourly calculation method (solution technique, internal modelling of constructions, IR radiation exchange).
- Classification of constructions (e.g. thermal capacity of opaque constructions, solar energy transmittance of solar shading devices).
- (Fixed) values for specific assumed properties.
- Specific solar shading assumptions and simplifications.
- Values for various correlation factors of the monthly calculation method.



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Annex C of EN ISO 52016-1 gives a choice in references to other CEN (for CEN area) or ISO (elsewhere) standards that provide thermal, solar or daylight properties of (single or multiple) glazings and/or windows.

Accompanying spreadsheet

An extensive spreadsheet was produced on EN ISO 52016-1, covering both the hourly and the monthly calculation method. Examples of the calculation sheet can be found in CEN ISO/TR 52016-2. The (publicly available) spreadsheet is available since May 2015, based on the draft (prEN ISO/DIS 52016-1). It is intended to update the spreadsheet (symbols, numbering of formulae, minor changes in the calculation method, minor errata) before publication of the standard.

No spreadsheet was produced on EN ISO 52017-1, because this EPB standard (with reference hourly thermal balance calculation procedures) is not directly used for calculations.

Validation and verification

The hourly calculation procedures have been validated by using relevant cases from the so called BESTEST series. The BESTEST cases are well established since decades, widely used worldwide and well described. In the previous article on EN ISO 52016-1 we introduced the validation cases and presented the main results [5].

The technical report CEN ISO/TR ISO 52016-2 provides a detailed description of the verification and validation cases. Relevant BESTEST cases are also chosen for the validation of EN ISO 52010, the overarching EPB standard on external environment conditions, as presented in the parallel article by Mr Plokker on EN ISO 52010.

A full description of the most relevant validation cases and results are given in the standard itself, as a tool to **verify** if an hourly calculation method based on EN ISO 52016-1 is in line with the calculation procedures given in the standard. In case at national level it is decided (following the template of “Annex A” to make use of the specifically allowed deviations from the given calculation procedures, then these verification cases are to be used to **validate** the deviating calculation procedures.

Conclusion

EN ISO 52016-1 presents a coherent set of calculation methods at different levels of detail, for the (sensible) energy needs for the space heating and cooling and (latent) energy needs for (de-)humidification of a

building and/or internal temperatures and heating and/or cooling loads. The influence from technical buildings systems, control aspects and boundary conditions can be included where relevant for a “system specific” calculation, in addition to a “basic energy load or need” calculation. Choices are possible at national or regional level to accommodate the specific national or regional situation. The method has been successfully validated using relevant BESTEST cases.

EN ISO 52017-1 is not needed for the actual calculation of the energy performance of buildings. It contains a generic hourly calculation method, intended as reference method, for instance for EN ISO 52016-1.

More information is available in the accompanying technical report, CEN ISO/TR 52016-2 [2]. ■

Acknowledgments

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