TECHNICAL REPORT

ISO/TR 52127-2

First edition
2021-02

Energy performance of buildings — Building automation, controls and building management —

Part 2:
Explanation and justification of ISO 52127-1

Performance énergétique des bâtiments — Automatisation, régulation et gestion technique du bâtiment —

Partie 2: Explication et justification de l'ISO 52127-1

© ISO 2021

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 205, *Building environment design*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 247, *Building Automation, Controls and Building Management,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

A list of all parts in the ISO 52127 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document consolidates information that is considered important for users to properly understand, apply and nationally adopt the EPB standards.

The detailed technical rules in CEN/TS 16629 ask for a clear separation between normative and informative contents:

— to avoid flooding and confusing the actual normative part with informative content;

— to reduce the page count of the actual standard;

— to facilitate understanding of the package.

Therefore, each EPB standard should be accompanied by an informative Technical Report, like this document, where all informative contents are collected.

Table 1 shows the relative position of this document within the EPB set of standards.

Table 1 — Position of this document within the EPB set of standards

Sub module	Overarching	Building (as such)	Technical building system (Descriptions)	Heating	Cooling	Ventilation	Humidification	Dehumidification	Domestic hot waters	Lighting	Building automation and control	PV, wind...
	Descriptions	Descriptions	Descriptions									
sub1	M1	M2		M3	M4	M5	M6	M7	M8	M9	M10	M11
1	General	General	General									
2	Common terms and definitions; symbols, units and subscripts	Building energy needs	Needs									
3	Application	(Free) Indoor conditions without systems	Maximum load and power									
4	Ways to express energy performance	Ways to express energy performance	Ways to express energy performance									
5	Building functions and building boundaries	Heat transfer by transmission	Emission and control									
6	Building occupancy and operating conditions	Heat transfer by infiltration and ventilation	Distribution and control									
7	Aggregation of energy services and energy carriers	Internal heat gains	Storage and control									
8	Building partitioning	Solar heat gains	Generation and control									

NOTE   The shaded modules are not applicable.

Table 1 *(continued)*

Sub module	Overarching — Descriptions	Building (as such) — Descriptions	Technical building system — Descriptions	Heating	Cooling	Ventilation	Humidification	Dehumidification	Domestic hot waters	Lighting	Building automation and control	PV, wind...
sub1	M1	M2		M3	M4	M5	M6	M7	M8	M9	M10	M11
9	Calculated energy performance	Building dynamics (thermal mass)	Load dispatching and operating conditions									
10	Measured energy performance	Measured energy performance	Measured energy performance									
11	Inspection	Inspection	Inspection									
12	Ways to express indoor comfort		BMS									x	
13	External environment conditions												
14	Economic calculation												

NOTE   The shaded modules are not applicable.

Energy performance of buildings — Building automation, controls and building management —

Part 2:
Explanation and justification of ISO 52127-1

1 Scope

This document contains information to support the correct understanding, use and adoption of ISO 52127-1.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 52127-1, *Energy performance of buildings — Building management system — Part 1: Module M10-12*

ISO 7345, *Thermal insulation of buildings and building components — Physical quantities and definitions*

ISO 52000-1, *Energy performance of buildings — Overarching EPB assessment — Part 1: General framework and procedures*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7345, ISO 52000-1 and ISO 52127-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Symbols

For the purposes of this document, the symbols given in ISO 52000-1 and ISO 52127-1 apply.

5 Method description

5.1 Effect of building automation and control (BAC) and technical building management (TBM)

The key-role of building automation and control and TBM is to ensure the balance between the desired human comfort - which should be maximal, and energy used to obtain this goal - which should be minimal.

The scope of BAC and TBM covers in accordance with their role from one side all technical building systems (where the effect of the BAC is used in the calculation procedures) and from another side the global optimization of the energy performance of a building.

Several categories of controls could be identified.

— Technical building systems specific controls: these controllers are dedicated to the physical chain of transformation of the energy, from generation, to storage, distribution and emission. We find them in the matrix starting with the modules M3-5 to M9-5 and finishing with M3-8 till M9-8. We could consider that one controller exists by module, but sometimes one controller does the control among several modules. More often, these controllers are communicating between them via a standardized open bus, such as BACnet, KNX or LON.

— BAC used for all or several technical building systems that do multidiscipline (heating, cooling, ventilation, DHW, lighting) optimization and complex control functions. For example, one of them is INTERLOCK, a control function that avoids heating and cooling at the same time.

— If all technical building system are used in the building, we have (depending of the size of the building) a technical building management system. Specific global functions are implemented here and are necessary to reach the key-role mentioned above. Usually, in this case, an interrelation with the building as such (module M2) will occur, mainly to take in consideration the building needs; for example, due to outside temperature, taking into account the inertia of the building when the control will reach the set point in a room.

In a control system dedicated to a building, in this case BAC and TBM, we can distinguish three main characteristics:

— control accuracy,

— control function,

— control strategy.

Technical building management systems are implemented to realize an overall building operation strategy by interdisciplinary orchestration of building energy systems (heating, cooling, ventilation, lighting) whereas systems are controlled by BAC functions. Further information about control accuracy and control functions can be found in ISO/TR 52120-2. ISO 52120-1 describes two approaches, how to evaluate the contribution of building automation and how to control the energy performance of buildings. This document is dedicated to control strategy and technical building management issues covered by ISO 52127-1.

5.2 Control strategy

The control strategy is applied to achieve a given level of control to reach a goal. Optimal control strategies deliver a desired level of control at a minimum cost. A control strategy could consist of a control function or a group of control functions. An example of a control strategy implemented by a control function is optimum start, optimum stop or night set back described in EN 12098-1 and EN 12098-3. The timer function is described in EN 12098-5.

An example of a control strategy that is carried out by a group of control functions is the control strategy used by intermittence. This function uses several control functions, operation modes, optimum start-stop and timer at the same time. All elements together are called either building profile or user pattern. Usually, to implement such building profile, a TBM is a prerequisite.

The most important control strategy described and implemented in ISO 52120-1 is demand-oriented control. Usually these strategies implement the sense of the energy flow (from generation to emission) with flow of calculation (from building needs to delivered energy). Usually for this complex control strategy, a TBM is necessary with a distributed specific control for each technical building system that communicates in system architecture via a communication standardized bus such as BACnet, KNX or LON.

Explained in more detail, this demand oriented control works as follows: when the comfort is reached in the emission area, the controller from the emission sends the message to the controller in charge of distribution to stop to distribute energy, then the controller in charge of distribution sends the message to the controller in charge of storage to either store the energy or if the storage cannot store more

energy, then to send the message to the controller in charge of the generation to stop to generating more energy.

Another important control strategy is the control strategy for multi generators either from the same type (e.g. several boilers) or different types (e.g. a boiler and heat pomp) including also the renewable energy sources. This strategy is described in more detail in the sequencing of multiple generators (BMS function 3) in 5.5.3.

The standards enabling to calculate the effect of BACS and TBM functions on energy consumption use different approaches to calculate this impact.

5.3 Rationale

This method is meant for a detailed energy performance analysis of a building in case detailed information about the building, the HVAC system and especially the type of automation, control and management functions is available and that this information can be applied in a holistic EPB calculation method. The method is used only when a sufficient knowledge about automation, control and management functions used for the building and the energy systems is available. The application of the calculation procedures implies that all automation, control and management functions that are accounted for the operation of a building and its energy systems are known.

5.4 Time steps

5.4.1 General

The method is compatible to any time step:

— yearly,

— monthly,

— hourly,

or the statistical BIN method can be applied.

Apart from the Bin method, this is according to the time-step of the input. Normally it is designed for a monthly or hourly method.

5.4.2 Assumption

It is assumed that a calculation method is available that can be used to quantify the impact of technical building management and building automation and control on the energy performance of a building. The EPBD holistic approach is an appropriate calculation method.

5.4.3 Data input — Item 1

Beside all technical input data providing information about the design and construction of both the building fabric as well as the HVAC systems, further important information is required to evaluate the energy performance of a building, e.g. by applying a holistic calculation approach.

— How to use the building: for example, occupancy pattern defining comfort requirements and internal gains. This information is provided by module 2 and is used to calculate energy demands respective needs of the building.

— How to operate the building energy systems to meet the comfort requirements. Setpoints and runtimes of all the technical systems are managed – either manually or automatically – to ensure maximum energy performance. Automated operation requires communication between the BAC and the TBM system.

Finally, the way the building is operated will have a significant impact on building energy performance. The application of TBM in the calculation method is strongly based on selecting certain TBM functions to be taken into account when calculating building energy performance.

Data input = selection of BAC/TBM function level

BMS/TBM functions and their levels are described in ISO 52120-1:—, Table 4[1]. Functions and levels are categorized into classes A, B, C and D. Default values for BMS functions are referring to the minimum requirements defined in ISO 52120-1:—, Annex A. As an alternative, BAC efficiency class C related to BMS functions could be used as a default.

According to the BMS/TBM function level that has been initially selected numerical values as temperature setpoint-off-sets or runtime are defined that will be integrated in the calculation method.

5.4.4 Simplified input

EN 15232 gives the opportunity to classify a building or different HVAC disciplines following a standardized classification scheme instead of defining specific BAC and TBM functions.

5.4.5 Calculation information

In a large number of buildings, the BAC/TBM system supervises a certain part of the building only. Accordingly, the contribution of TBM is restricted to the energy consumption related to this area only. The floor area infected by TBM can be estimated as follows: Use the supervised area to make an estimate of how much of the building is actually supervised/fault detected/reported on. In a building, e.g. with limited communication to the BACS from the control devices in rooms, or sub-systems that are not connected to the BACS, the supervised area should be considerably lower than the total room area.

5.5 List of functions covered by the method

Calculation methods to cover TBM functions described in ISO 52127-1 are related to building operational data and information that could be influenced and optimized by a building management or technical building system. Those data are exemplarily used to characterise:

— set points including set back,

— run times of heating, ventilation, cooling and lighting systems including start-stop-optimization,

— sequencing of multiple generators,

— energy management with regard to the utilization of local renewable energy and local energy production,

— heat recovery and heat shifting,

— smart grid interactions and peak shaving.

Calculation is in general independent from the time step chosen but is according to the time-step of the input.

From the above list the following BMS functions have been derived and described in ISO 52127-1.

5.5.1 Setpoint management (BMS function 1)

This BMS function can be used to calculate the impact of the room temperature setpoint management for heating and/or cooling on the building energy performance. The setpoint management by BMS function

---

1) Under preparation. Stage at the time of publication ISO/DIS 52120-1:2021.

1 is taken into account by introducing a temperature shift to any temperature setpoint reflecting the building use. Temperature setpoints for space heating and cooling are modified as follows:

$$\vartheta_{set} = \vartheta_{set,0} + \Delta\vartheta_{BMS} \tag{1}$$

where

$\vartheta_{set,0}$ is the original temperature setpoint predefined based on building user profile. This temperature is a user requirement. Normally buildings will either never be operated at this temperature from the beginning or there is a shift of room temperature setpoints over time. This shift is caused by user interaction that is not set back but will lead to long term deviation of observed energy performance from the design value;

$\Delta\vartheta_{BMS}$ is a temperature shift of room temperature setpoints over time accounting for user interaction that is not set back but will lead to long term deviation of observed energy performance from the design value. Building management systems are able to compensate setpoint shifting by setting back setpoints manually or automatically;

ϑ_{set} is the effective room temperature setpoint used to calculate heating/cooling demands.

This approach of adjusting the setpoint differs from the setpoint approach as described in ISO 52120-1 in a way that the setpoint approach calculates a virtual setpoint accounting for control accuracy and deviation effects where the BMS function 1 (setpoint management) is focussing on real setpoint adaptation. This adaptation can be done based on the information provided by TBM functions:

— detecting faults of technical building systems and providing support to the diagnosis of these faults;

— reporting information regarding energy consumption, indoor conditions;

as listed in ISO 52120-1:—, Table 4.

5.5.2 Runtime management (BMS function 2)

This function provides a signal to shut on/shut off the HVAC system in a building or to adapt the building system run time to the building needs. The run time of the HVAC system could be arranged according to the EN 12098 series by:

— a scheduler using a fixed or any pre-defined time program;

— an optimum start-stop function;

— an adaptive start-stop function also accounting for presence of occupants.

The adjustment of runtimes can be done based on the information provided by TBM functions:

— detecting faults of technical building systems and providing support to the diagnosis of these faults;

— reporting information regarding energy consumption, indoor conditions;

as listed in ISO 52120-1:—, Table 4.

Any decision on runtime of building energy systems requires information about occupancy patterns or other relevant user request regarding the conditioning of the building. These patterns are defined in a scheduler. Beside this information about occupancy, information (input or parameter) is needed on how to adjust operation of building energy systems to these patterns.

Run time (or operational time) of the HVAC systems is according to the modified setpoint profiles as calculated by BMS function 1. Normally runtime covers the occupied period of the building taking into account some additional preconditioning and start-stop periods.

BMS will allow optimizing the matching between building energy demand and system operation time by minimizing the time duration of preconditioning phase during unoccupied periods. Therefore, runtime of the HVAC systems is adjusted.

5.5.3   Sequencing of multiple generators (BMS function 3)

This function provides information on how to split the total energy demand for heating and cooling to different heat generators or chillers. Each generator supplies the energy that is addressed to it. The management strategy could be realized by defining priorities. These priorities may be:

— priorities only based on running time,

— fixed sequencing based on loads only: for example, depending on the generator's characteristics, e.g. hot water boiler vs. heat pump,

— priorities based on generator efficiency and characteristics: the generator operational control is set individually to available generators so that they operate with an overall high degree of efficiency (e.g. solar, geothermic heat, cogeneration plant, fossil fuels),

— load prediction-based sequencing: the sequence is based on efficiency and available power of a device and the predicted required power.

It is part of the building management function 3 to decide on the priority list. This can be done either manually or in an automated way accounting for variable input data and operating conditions.

Heating systems

If there are several generation sub-systems, the total heat demand of the distribution sub-system(s) is distributed among the available generation sub-systems. In general, sub-systems with multiple generators can be calculated as separated generation sub-systems in parallel. The calculation described in the EN 15316-4 series are performed independently for each heat generation device. ISO 52120-1 describes a correlated BAC function:

1.9		Sequencing of different heat generators	HEAT_GEN_CTRL_SEQ	M3–8
		This control function only applies to a system with a set of different heat generator sizes or types including renewable energy sources.		
	0	Priorities are only based on running time.		
	1	Control according to fixed priority list: e.g. heat pump prior to hot water boiler.		
	2	Control according to dynamic priority list (based on current efficiency and capacity of generators e.g. solar, geothermal heat, cogeneration plant, fossil fuels).		
	3	Control according to dynamic priority list (based on predicted and current load, efficiency and capacity of generators.		

Cooling systems

If there are several generation sub-systems, the total cooling demand of the distribution sub-system(s) is distributed among the available chiller sub-systems. In general, sub-systems with multiple chillers can be calculated as separated generation sub-systems in parallel. ISO 52120-1 describes a correlated BAC function:

3.8		Sequencing of different chillers (chilled water generators)	CLG_GEN_CTRL_SEQ	M4–8
		This control function only applies to a system with a set of different chiller sizes or chilled water generator types including free cooling and/or renewable energy sources.		