



BSI Standards Publication

Building automation and control systems (BACS)

Part 4: Control applications

National foreword

This British Standard is the UK implementation of EN ISO 16484-4:2025. It is identical to ISO 16484-4:2025. It supersedes [BS EN 17609:2022](#), which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee RHE/2, Ventilation for buildings, heating and hot water services.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Systèmes d'automatisation et de contrôle des
bâtiments (BACS) - Partie 4: Applications de contrôle
(ISO 16484-4:2025)

Systeme der Gebäudeautomation - Teil 4:
Steuerungsanwendung (ISO 16484-4:2025)

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European foreword

This document (EN ISO 16484-4:2025) has been prepared by Technical Committee ISO/TC 205 "Building environment design" in collaboration with Technical Committee CEN/TC 247 "Building Automation, Controls and Building Management" the secretariat of which is held by SNV.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2026, and conflicting national standards shall be withdrawn at the latest by March 2026.

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The text of ISO 16484-4:2025 has been approved by CEN as EN ISO 16484-4:2025 without any modification.

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Foreword

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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).

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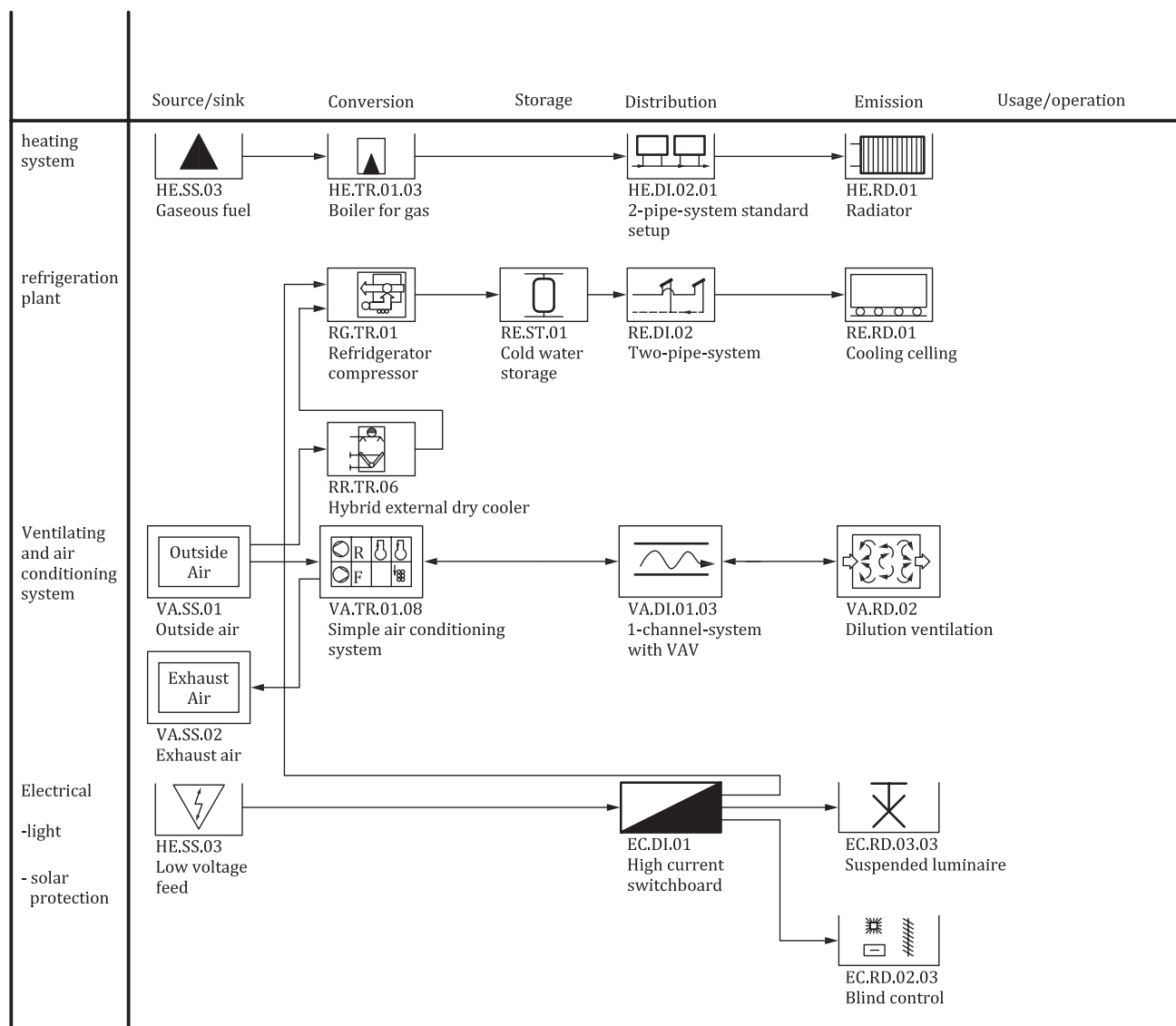
Introduction

Buildings are built and operated to serve a specific purpose, e.g. as an office workspace, a manufacturing floor, or a data centre. In each case, the usage of the space requires specific environmental conditions, e.g. temperature, light level or air quality.

Increasing the efficient usage of energy to provide these environmental conditions is a key aspect of building design as addressed in ISO 52120-1.

Energy efficiency requirements cannot be fulfilled by optimizing the primary systems of a building alone. A holistic view on the building and especially on the room control systems for lighting, solar protection and heating, ventilation and air conditioning (HVAC) is the basis for optimizing the energy efficiency of buildings. This requires integration of the room and building controls and management systems from the design phase through installation and commissioning to the building operation.

The planning process for the technical infrastructure of a building and its spaces includes several steps starting with a rough set of requirements. With each step in the planning process the design becomes more detailed. Firstly, basic design choices or decisions allow for a budget estimate. These first design choices can be documented as depicted in [Figure 1](#).

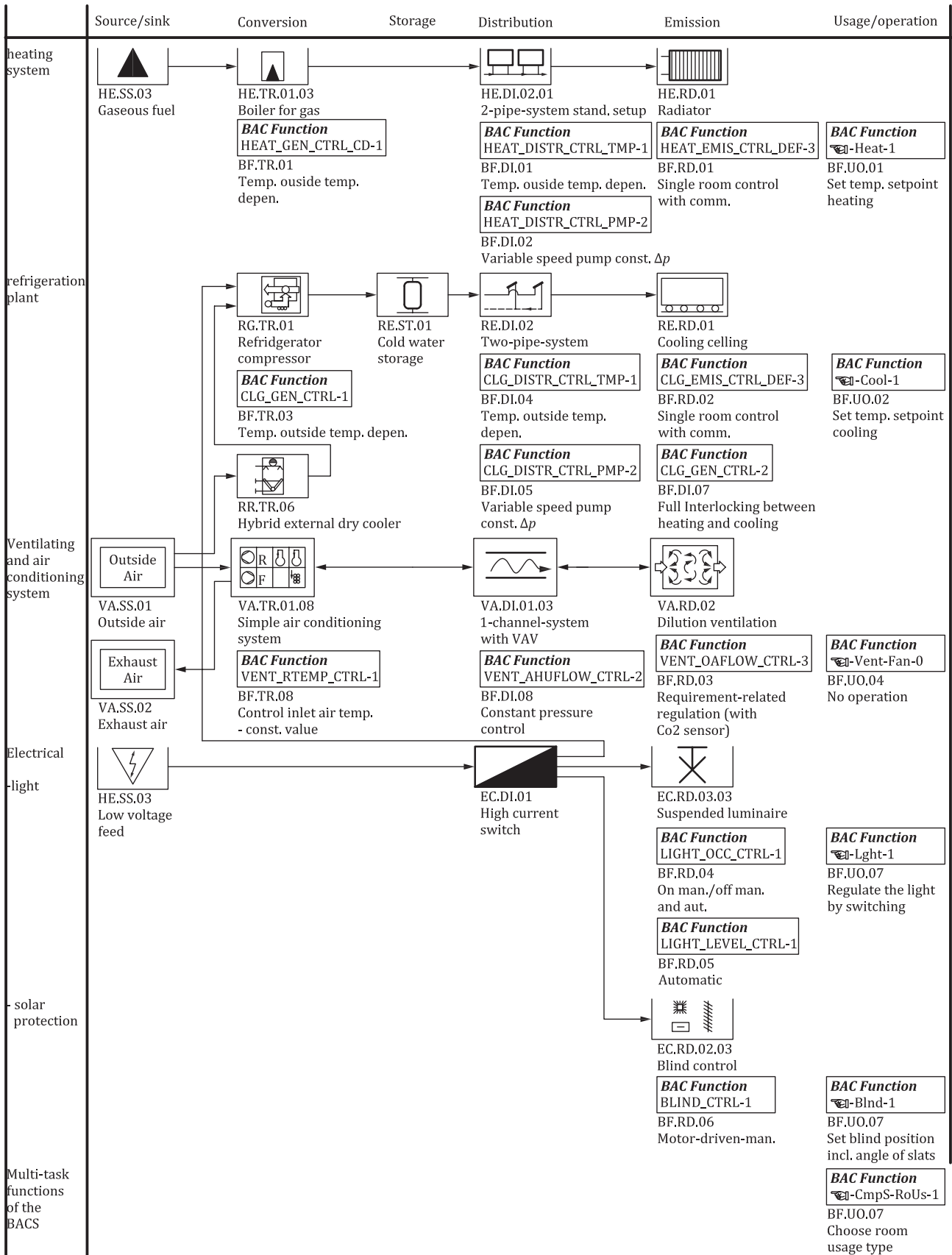


SOURCE SN 502411:2016 / SIA 411:2016

Figure 1 — Example for documentation of design choices for technical infrastructure of a building

[Figure 1](#) shows equipment used for the different technical building disciplines (e.g. heating, cooling, ventilation, lighting, solar protection) in the space including energy related interconnections between the equipment of the respective disciplines. The schema depicts source/sink, conversion, storage, distribution, and emission elements and their interconnections in a simple manner. This is a high-level view on the mechanical and electrical equipment. It does not yet include the automation requirements associated with the equipment.

In a further planning step, the control functions (BAC functions) associated with the technical infrastructure equipment of a building are added as depicted in [Figure 2](#).



SOURCE SN 502411:2016 / SIA 411:2016

Figure 2 — Example for documentation of design choices for technical infrastructure and associated control functions of a building

The column “usage/operation” contains control functions used either for user interaction with the technical building infrastructure in the space or for super-ordinated (e.g. building-wide) functions and requirements or both.

Whereas the control functions are determined by the technical building equipment and the user operation interface in general, the sophistication of these control functions is determined by the desired level of energy efficiency of a building or comfort and operational requirements. Hence, in both views, the desired level of energy efficiency of a building and the comfort and operational requirements, are considered and documented such that this documentation serves as a requirement specification for building control applications (e.g. heating, cooling, ventilation, lighting, solar protection) in a space.

In [Figure 2](#), BAC functions have been added to the equipment. The labels refer to BAC functions listed in ISO 52120-1:2021, Table 5. These BAC functions are not specified in detail in ISO 52120-1.

[Clause 5](#) of this document provides a method to transfer energy performance, comfort, and operational requirements as defined in ISO 52120-1:2021 into a more detailed specification of building automation functions.

ISO 52120-1:2021, Table 5, contains a list of functions contributing to achieve the desired level of energy performance. Whereas ISO 52120-1 only provides a very brief description of the functionality, [Clause 5](#) contains a more detailed description.

NOTE Application of automated control improves the energy performance of buildings. [Clause 5](#) of this document covers automated control applications only. Any manual or non-automated control listed in ISO 52120-1:2021, Table 5, is not covered in this document.

For the purpose of clarity, each subclause in [Clause 5](#) identifies the corresponding entry in ISO 52120-1:2021, Table 5 directly after the sub-clause heading.

The more detailed description includes information about mandatory and optional inputs as well as mandatory and optional outputs for the control function. The control function is not described in detail but rather is a “black box” as the actual implementation can be project or manufacturer specific.

[Figure 3](#) provides an informative schematic view with the function (box), mandatory (blue) and optional (grey) inputs and mandatory (blue) and optional (grey) outputs. The informative schematic drawing also shows if inputs can be controlled, e.g. by manual operation or by a schedule, and if output values are associated, e.g. with an alarm or a trend.

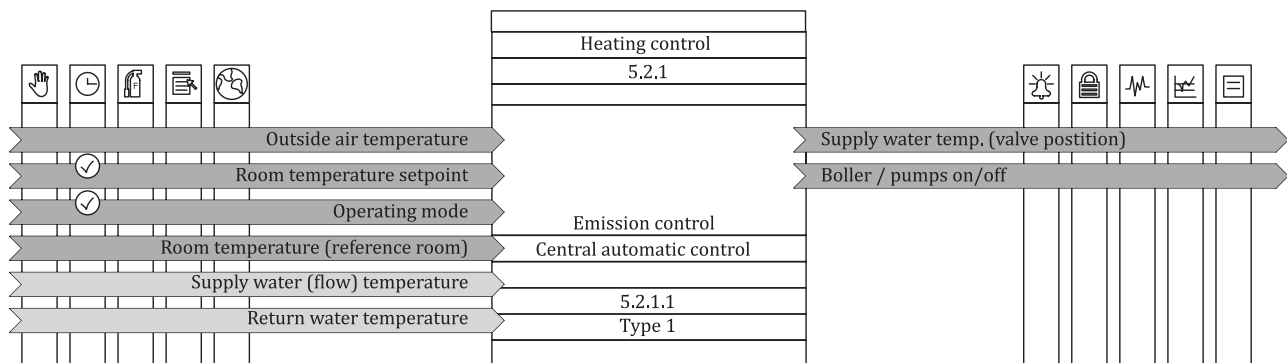


Figure 3 — Informative depiction of control application scheme for heating control — Emission control — Type 1: Central automatic control

[Clause 5](#) contains in each sub-clause a brief description of the control function itself, the target of the function, different operating modes, where applicable, and a description of the inputs and outputs of the function. Optionally, parameters and implementation equipment may be described.

For some of these functions, more than one version is described, covering different technological implementations.

Building control functions may be associated with a specific zone, a room, a building segment, or the whole building.

The result of applying [Clause 5](#) is a collection of building automation control function blocks. This does not yet depict how these blocks work in detail or how they are linked to each other. A more detailed control scheme description can be provided using the function blocks described in [Clause 6](#).

[Clause 6](#) of this document provides function blocks, which can be used to describe building control functions in more detail independent of a specific building control system or vendor.

Applications can be described by a combination of sensor input, actuator output, user interaction, and control and monitoring functions. Certain functions in a room (e.g. presence detection) can be shared by two or more applications. A common set of function blocks covering sensor input, actuator output, user interaction, and control functions for the different applications in a room serves as the basis for describing room automation, controls and management systems.

NOTE Room automation is coordinated control of lighting, solar protection, heating/ventilation/air conditioning devices and systems in a room providing the desired comfort level with maximum energy efficiency. Using a typical example, [Figure 4](#) shows the relationship between sensor, display/operation, control and actuator functions. Information exchanged between functions is provided from outputs to inputs. Physical inputs and outputs associated with sensor and actuator functions are not depicted in the [Figure 3](#). As some functions can require parameters, these are also depicted in each function block.

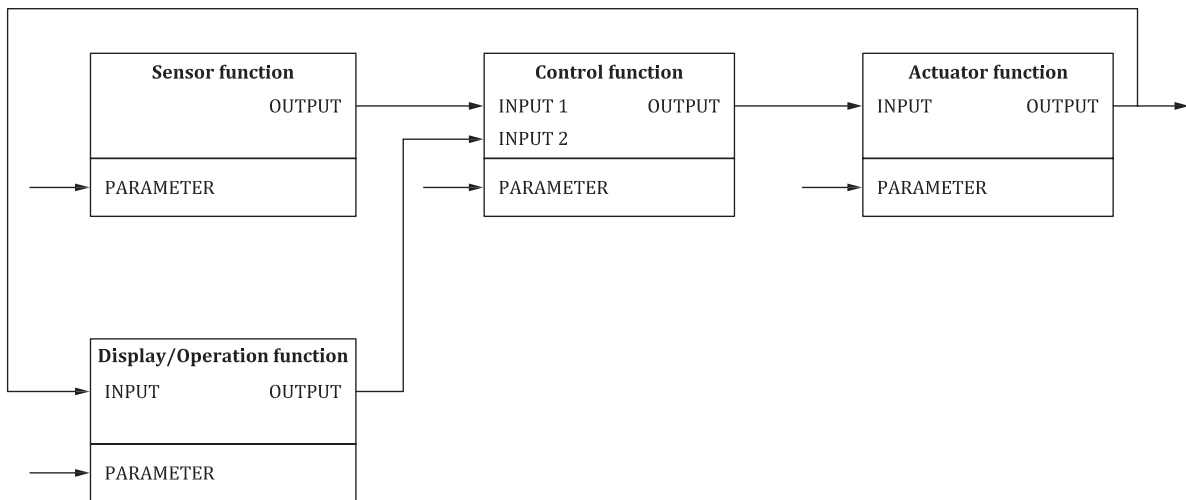


Figure 4 — Relationship between automation functions (typical example)

A sensor function typically includes a physical input (e.g. a temperature sensor, not depicted in [Figure 4](#)) and provides a logical output (OUTPUT of the Sensor function block in [Figure 4](#)) for use by other functions.

A display and operation function includes physical inputs or outputs depending on its functionality and provides logical inputs for display purposes and logical outputs for use by other functions (Display and Operation function block in [Figure 4](#)).

Control functionality as depicted in [Figure 4](#) is assigned to specific control functions with one or more logical inputs (INPUT 1 and INPUT 2 of the Control function block in [Figure 4](#)) and at least one logical output (OUTPUT of the Control function block in [Figure 4](#)). Control functions are not directly associated with physical inputs or outputs.

Actuator functionality is assigned to specific actuator functions. An actuator function typically includes a physical output (controlling a valve for example) and provides a logical input (INPUT of the Actuator function in [Figure 4](#)) and logical output. This logical output can be used as a feedback status information.

The generalized description format used in [Clause 6](#) for functions includes a brief description of the function, of the physical input(s), of the logical input(s) expected from other functions, of the logical output(s) provided

to other functions, and of the physical output(s). In addition, parameters are listed that are required to more precisely define the function for a specific project.

The description of the functions blocks follows this uniform scheme:

- short description of the function;
- physical input(s);
- logical input(s);
- logical output(s);
- physical output(s);
- parameters (optional).

The list of functions can be extended where necessary.

Building automation and control systems (BACS) —

Part 4: Control applications

1 Scope

This document specifies control applications and function blocks focusing on, but not limited to, lighting, solar protection and heating, ventilation and air conditioning (HVAC) applications.

It describes how energy performance, comfort, and operational requirements of buildings are translated into functional specifications for integrated plant and room control.

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 52120-1:2021, *Energy performance of buildings — Contribution of building automation, controls and building management — Part 1: General framework and procedures*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 52120-1 and the following apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 display function

presentation of information coming from an actuator, control, monitoring or sensor function in a visible format understandable by a human user

Note 1 to entry: Information may be displayed in text form (e.g. 18 °C, 100 %) or in a graphical form (e.g. light blue for cool, bar graph).

3.2 energy efficiency

ratio or other quantitative relationship between an output of performance, service, goods or energy, and an input of energy

EXAMPLE Efficiency conversion energy; energy required/energy used; output/input; theoretical energy used to operate/energy used to operate.

Note 1 to entry: Both input and output need to be clearly specified in quantity and quality. Additionally, they need to be measurable.

[SOURCE: ISO 52120-1:2021, 3.9]

3.3

building automation

coordinated control of lighting, solar protection, heating, ventilation, and air conditioning (HVAC) devices and systems in a building providing the desired comfort level with maximum energy efficiency

Note 1 to entry: Coordinated control may also encompass access control via information links from those devices and systems to other building control devices and systems.

3.4

logical input

interface of a function receiving data from an output of another function

3.5

logical output

interface of a function sending data to an input of another function

3.6

operation function

means for input of information by a human user intended for use by an actuator, control, monitoring or display function

Note 1 to entry: Operation of, for example, a wall switch or touch panel area, may be used as input.

3.7

plant

equipment for generation of either hot or cold water, or conditioned air, or both

3.8

room

one or more zones with a joint perimeter typically determined by walls or other types of partitions

Note 1 to entry: Typically, a room is a part of a building segment.

3.9

solar protection

means for reducing heat losses at night and for controlling the impact of solar radiation on the temperature in a space or on the visual comfort of an occupant of a space, or both

Note 1 to entry: The impact of solar radiation on the temperature can lead to an undesired (in warm climates) or a desired (in cold climates) temperature rise.

3.10

space

complete building, building part, room, or zone

3.11

zone

smallest space determined by the minimum technical infrastructure required to operate that space

Note 1 to entry: The minimum technical infrastructure may be a heating radiator, ventilation outlet, or other mechanical or electrical equipment element.

4 Abbreviated terms

Abbreviated term	Description
BAC	building automation and control
BACS	building automation and control system
COP	coefficient of performance
DHW	domestic hot water
TABS	thermally activated building structure

5 Functional specifications having an impact on energy performance, comfort, and operational requirements of buildings

5.1 Heating control

5.1.1 Emission control

5.1.1.1 Type 1 — Central automatic control

See ISO 52120-1:2021, Table 5: 1.1, HEATING CONTROL, Emission control, Type 1, for information on energy performance level.

NOTE This Type 1 is no longer considered to be energy efficiency class C but defined as energy efficiency class D.

Description: Central automatic control of temperature in rooms by means of heating, is acting either on the distribution or on the generation. Heating control is performed without consideration of local demand of different rooms, possibly by using one room as reference. This can be achieved for example by an outside air temperature controller conforming to EN 12098-1 or EN 12098-3.

Target: To improve energy performance by minimizing emitted heat by emitters (e.g. radiators) or by air in the building using central control of temperature and/or flow. This control may be based on outside air temperature and/or a reference sensor inside the building and assumes similar demands in different parts/rooms of the building.

Different operating modes: comfort, economy (pre-comfort), night, building protection.

Inputs (mandatory):

- Outside air temperature (varies inside space temperature setpoint; in summer: increases cooling setpoint, in winter: reduces heating setpoint)
- Room temperature setpoint
- Operating mode
- Room temperature (reference room)

Inputs (optional):

- Supply (flow) water temperature
- Return water temperature

Outputs (mandatory):

- Supply water (valve position)
- Boiler/Pumps On/Off

Outputs (optional):

--

5.1.1.2 Type 2 — Individual room control

See ISO 52120-1:2021, Table 5: 1.1, HEATING CONTROL, Emission control, Type 2, for information on energy performance level.

Description: Individual room control by thermostatic valves or electronic controllers.

The individual room control of heating temperature in rooms is performed either by thermostatic valves or local (non-communicating) electronic control units. The individual control should and may be combined with scheduler programs providing different operating modes.

Target: To improve energy performance by minimizing emitted heat by emitters (e.g. radiators) or by air in the building using local control of temperature and/or flow in the rooms, thereby adapting to local demand, i.e. different loads in different rooms.

Different operating modes: comfort, pre-comfort (economy), night, building protection.

Inputs: indoor temperature as reference.

Inputs (mandatory):

- Room temperature
- Room temperature setpoint
- Operating mode

Inputs (optional):

- Presence detection
- Optimized start/stop control (adaptive)
- Window contact

Outputs (mandatory):

- Supply water (valve position)

Outputs (optional):

--

5.1.1.3 Type 3 — Individual modulating room control with communication

See ISO 52120-1:2021, Table 5: 1.1, HEATING CONTROL, Emission control, Type 3, for information on energy performance level.

Description: Individual modulating room control with communication between controllers and to BACS.

Individual modulating control of temperature in rooms by means of heating, with communication between controllers and to BACS, allows exchange of setpoints, demand and other status information.

Target: To improve energy performance by minimizing emitted heat by emitters (e.g. radiators) or by air in the building using local control of temperature and/or flow in the rooms, thereby adapting to local demand, i.e. different loads in different rooms. Furthermore, to obtain energy demand for further use to control distribution and generators, keeping run time at minimum and setpoints optimal.

Different operating modes: comfort, pre-comfort (economy), night, building protection.

Inputs (mandatory):

- Room temperature
- Room temperature setpoint
- Operation mode (Operation request on demand – local push button control overriding automatic sequence)
- Window contact (override automatic control if a window is opened)

Inputs (optional):

- Presence detection (to change operating mode)
- Outside air temperature (varies inside space temperature setpoint; in summer increases cooling setpoint, in winter reduces heating setpoint)
- Frost protection [based on central plant and outside air temperature 1st (pump circulation) and 2nd stage (Pumps plus heating demand) strategy]
- Optimized start/stop control (adaptive; provides a pre occupancy comfort mode and optimised start/stop based around a time/calendar schedule and internal building fabric protection)

Outputs (mandatory):

- Heating demand
- Supply water (valve position)

Outputs (optional):

- Manual override – local manual control overriding automatic sequence

5.1.1.4 Type 4 — Individual modulating room control with communication and occupancy detection

See ISO 52120-1:2021, Table 5: 1.1, HEATING CONTROL, Emission control, Type 4, for information on energy performance level.

Description: Individual modulating room control with communication between controllers and to BACS. Demand/presence control performed by occupancy.

Individual modulating control of temperature in rooms by means of heating, with communication between controllers and to BACS, allows exchange of setpoints, demand and other status information.

Presence detection shall be installed to reach the highest level of energy performance.

Outside air temperature – varies inside space temperature setpoint; in summer increases cooling setpoint, in winter reduces heating setpoint.

Optimum start stop provides a pre-occupancy comfort mode and optimised start/stop based around a time/calendar schedule and internal building fabric protection.

Target: To improve energy performance by minimizing emitted heat by emitters (e.g. radiators) or by air in the building using local control of temperature and/or flow in the rooms, thereby adapting to local demand, i.e. different loads in different rooms. Furthermore, to obtain energy demand for further use to control distribution and generators, keeping run time at minimum and setpoints optimal.

Different operating modes: comfort, pre-comfort (economy), night, building protection.

Inputs (mandatory):

- Room temperature

- Room temperature setpoint
- Operation mode (Operation request on demand – local push button control overriding automatic sequence)
- Presence detection
- Window contact (override automatic control if a window is opened)

Inputs (optional):

- Optimized start/stop control (adaptive)

Outputs (mandatory):

- Heating demand

Outputs (optional):

--

5.1.2 Emission control for TABS (heating mode)

5.1.2.1 Type 1 — Central automatic control

See ISO 52120-1:2021, Table 5: 1.2, HEATING CONTROL, Emission control for TABS (heating mode), Type 1, for information on energy performance level.

Description: The central automatic control for a TABS zone (which comprises all rooms which get the same supply water temperature) typically is a supply water temperature control loop whose setpoint is dependent on the median outside air temperature, e.g. the average of the previous 24 h.

Target: The supply water temperature shall be set according to the median outside air temperature (median-weather compensated supply water temperature).

Inputs (mandatory):

- Outside air temperature
- Supply (flow) water temperature

Inputs (optional):

- Room temperature
- Room temperature (reference room)
- Room temperature setpoint
- Presence detection

Outputs (mandatory):

- Supply water temperature (valve position)
- Heating demand

Outputs (optional):

--

Parameters: Ramp to determine setpoint.

Additional equipment: None.

Possible variants: The controls might cover both heating and cooling.

5.1.2.2 Type 2 — Advanced central automatic control

See ISO 52120-1:2021, Table 5: 1.2, HEATING CONTROL, Emission control for TABS (heating mode), Type 2, for information on energy performance level.

Description: This is an automatic control of the TABS zone that fulfils the following conditions

- If the TABS is used only for heating: The central automatic control is designed and tuned to achieve an optimal self-regulating of the room temperature within the required comfort range (specified by the room temperature heating setpoint). “Optimal” means that the room temperatures of all rooms of the TABS zone remain during operation periods in the comfort range, to meet comfort requirements, but also is as low as possible to reduce the energy demand for heating.
- If the TABS is used for heating and cooling: The central automatic control is designed and tuned to achieve an optimal self-regulating of the room temperature within the required comfort range (specified by room temperature heating and cooling setpoints). “Optimal” means that the room temperatures of all rooms of the TABS zone remain during operation periods in the comfort range, to meet comfort requirements, but also uses as far as possible the full range to reduce the energy demand for heating and cooling.
- If the TABS is used for heating and cooling: the automatic switching between heating and cooling is not done only dependent on the outside air temperature, but also taking at least indirectly the heat gains (internal and solar) into account.

Target: Achieve temperatures within the desired bandwidth for all rooms in the heating/cooling group.

Inputs (mandatory):

- Outside air temperature
- Supply (flow) water temperature
- Room temperature
- Room temperature setpoint

Inputs (optional):

- Room temperature (reference room)
- Presence detection

Outputs (mandatory):

- Supply water temperature (valve position)
- Heating demand

Outputs (optional):

--

Parameters: Room heating setpoint, comfort range.

Additional equipment: Room setpoint device.

Possible variants: Heating/cooling changeover, room cooling setpoint.

5.1.2.3 Type 3 — Advanced central automatic control with intermittent operation and/or room temperature feedback control

See ISO 52120-1:2021, Table 5: 1.2, HEATING CONTROL, Emission control for TABS (heating mode), Type 3, for information on energy performance level.

Description: Advanced central automatic control with room temperature feedback control:

- Advanced central automatic control with intermittent operation. This is an advanced central automatic control according to 2) with the following supplement: The pump is switched off regularly to save electrical energy, either with a fast frequency – typically 6 hours on/off cycle time – or with a slow frequency, corresponding to 24 hours on/off cycle time. If the TABS is used for cooling, intermittent operation with 24 hours on/off cycle time can also be used to reject the heat to the outside air if the outside air is cold.
- Advanced central automatic control with room temperature feedback control. This is an advanced central automatic control according to 2) with the following supplement: The supply water temperature setpoint is corrected by the output of a room temperature feedback controller, to adapt the setpoint to non-predictable day-to-day variation of the heat gain. Since TABS react slowly, only day-to-day room temperature correction is applied, an instant correction cannot be achieved with TABS. The room temperature that is fed back is the temperature of a reference room or another temperature representative for the zone.
- Advanced central automatic control with intermittent operation and room temperature feedback control.

Target: The goal is to compensate room/zone behaviour into the supply water temperature control in order to optimize emissions considering heat gain and radiation.

Inputs (mandatory):

- Outside Air Temperature
- Supply(flow) water temperature
- Return water temperature
- Room temperature
- Room Temperature setpoint

Inputs (optional):

- Room temperature
- Room Temperature (reference room)
- Return water temperature
- Presence detection

Outputs (mandatory):

- Supply water temperature (valve position)
- Pumps On/Off
- Heating demand

Outputs (optional):

- Heating/cooling status

NOTE Locking of heating and cooling operation is described in [5.3.6.1](#).

Parameters: Setpoint heating, setpoint cooling (if)

Additional equipment: None.

Possible variants: Mean zone temperature instead of reference temperature.

5.1.3 Control of distribution network hot water temperature (supply or return)

5.1.3.1 Type 1 — Outside air temperature compensated control

See ISO 52120-1:2021, Table 5: 1.3, HEATING CONTROL, Control of distribution network hot water temperature (supply or return), Type 1, for information on energy performance level.

Description: Control of the temperature of the hot water distribution based on outside air temperature compensation.

Target: To achieve energy performance by lowering the mean temperature of the flow, thereby minimizing heat losses.

Inputs (mandatory):

- Outside air temperature
- Supply water temperature

Inputs (optional):

- Room temperature (reference room)
- Room temperature setpoint (ref. room)
- Supply (flow) water temperature
- Return water temperature

Outputs (mandatory):

- Supply water temperature (valve position)
- Heating demand (to the boiler)

Outputs (optional):

- Boiler/Pumps On/Off

Additional equipment: Outside air temperature sensor.

Possible variants: None.

5.1.3.2 Type 2 — Demand based control

See ISO 52120-1:2021, Table 5: 1.3, HEATING CONTROL, Control of distribution network hot water temperature (supply or return), Type 2, for information on energy performance level.

Description: Control of the temperature of the hot water distribution is based on indoor temperature measurements.

Prerequisite: Communicating system to room control units.

Target: To achieve energy performance by lowering the mean temperature of the flow as well as decreasing the flow rate, thereby minimizing heat losses. In addition, use energy demand information to keep run time at minimum and setpoints optimal.

Heating demand from space (emissions) Utilisation of loop parameters or valve positions to affect a reduction in flow rate or temperature set-points based on overall distribution demand

Frost protection based on central plant and outside air temperature 1st(pump circulation) and 2nd stage (Pumps plus heating demand) strategy

Outside air temperature – varies inside space temperature setpoint; in summer increases cooling setpoint, in winter reduces heating setpoint

Time/Calendar Schedule – utilised to switch between different operating modes

Optimum start stop in addition to the time/Calendar schedule provides a pre-occupancy comfort mode and optimised start/stop based around a time/calendar schedule and internal building fabric protection.

Manual override – local manual control overriding automatic sequence

Operational request on demand – local push button or setpoint override

Energy usage metering – provide information on energy used in local area to enable analysis and benchmarking

Boiler on/off – switch generator demand

Pumps on/off – switch distributor demand

Inputs (mandatory):

- Supply water temperature
- Room temperature (reference room)
- Room temperature setpoint (reference room)

Inputs (optional):

- Outside air temperature
- Heating demand from space (emission)

Outputs (mandatory):

- Supply water temperature (valve position)
- Heating demand

Outputs (optional):

- Boiler/pumps, on/off

Parameters: Time programs for different operating modes.

Possible variants: Outdoor temperature measurement included.

5.1.4 Control of distribution pumps in networks

5.1.4.1 Type 1 — On/off control

See ISO 52120-1:2021, Table 5: 1.4, HEATING CONTROL, Control of distribution pumps in networks, Type 1, for information on energy performance level.

Description: Automatic control is realised to reach intermittent operation of the emission and/or distribution components.

Target: To get energy performance by lowering the temperature setpoints during certain conditions (e.g. night). This leads to energy performance due to shortened operation time of the generation/distribution, lower losses of the room(s) due to lower temperature differences to the outside.

Inputs (mandatory):

- Supply water temperature
- Return water temperature

Inputs (optional):

- Operating mode
- Time schedule
- Outside air temperature
- Differential pressure

Outputs (mandatory):

- Pump on/off

Outputs (optional):

--

Parameters: Setpoints for “economy”, “pre-comfort”, “comfort”.

Possible variants: One-time program for a “group” of rooms (zone); one-time program for a whole building.

5.1.4.2 Type 2 — Multi stage control

See ISO 52120-1:2021, Table 5: 1.4, HEATING CONTROL, Control of distribution pumps in networks, Type 2, for information on energy performance level.

Description: Automatic control is realised to reach optimized start/stop of intermittent operation of the emission and/or distribution components.

Target: To achieve energy performance through optimized start/stop to maximize time for economy mode by considering energy capacity of the building in control.

Inputs (mandatory):

- Supply (flow) water temperature
- Return water temperature

Inputs (optional):

- Heating demand (valve position)
- Time schedule
- Differential pressure
- Outside air temperature

Outputs (mandatory):

- Pump on/off – Stage 1
- Pump on/off – Stage 2

Outputs (optional):

- Pump on/off – variable speed drive

Parameters: Setpoints for “economy”, “pre-comfort”, “comfort”.

Possible variants: One-time program for a “group” of rooms (zone); one-time program for a whole building.

5.1.4.3 Type 3 — Variable speed pump control (pump unit (internal) estimations)

See ISO 52120-1:2021, Table 5: 1.4, HEATING CONTROL, Control of distribution pumps in networks, Type 3, for information on energy performance level.

Description: Automatic control is realised to reach intermittent operation of emission and/or distribution based on demand (occupancy).

Target: To achieve energy performance through maximizing “pre-comfort” and/or “economy” time periods by detecting or using information about real demand (e.g. occupancy).

Optional

- Pump status contact – for flow proving
- Differential pressure sensor – monitoring system pressure and evaluating demand
- Time/Calendar Schedule – utilised to switch between different operating modes
- Frost protection based on central plant and outside air temperature 1st(pump circulation) and 2nd stage (pumps plus heating demand) strategy
- Outside air temperature
- Pump start/stop to switch off VSD when not required

Inputs (mandatory):

- Supply (flow) water temperature
- Return water temperature
- Heating demand (valve position and/or emission control)
- Differential pressure

Inputs (optional):

- Outside air temperature
- Demand sensing information (e.g. occupancy)

Outputs (mandatory):

- Pump on/off – variable speed drive

Outputs (optional):

--

Parameters: Setpoints for “economy”, “pre-comfort”, “comfort”.

Outputs: Communication to distribution.

Possible variants: In combination with fixed time programs or optimized start/stop to switch between “pre-comfort” and “comfort”, or exclusively demand driven.

5.1.4.4 Type 4 — Variable speed pump control (external demand signal)

See ISO 52120-1:2021, Table 5: 1.4, HEATING CONTROL, Control of distribution pumps in networks, Type 4, for information on energy performance level.

Description: Automatic control is realised to reach intermittent operation of emission and/or distribution based on demand (occupancy).

Target: To achieve energy performance through maximizing “pre-comfort” and/or “economy” time periods by detecting or using information about real demand (e.g. occupancy).

Inputs (mandatory):

- Supply (flow) water temperature
- Return water temperature
- Heating demand (valve position)
- Differential pressure

Inputs (optional):

- Outside air temperature
- Demand sensing information (e.g. occupancy)
- Pump status contact (for flow proving)

Outputs (mandatory):

- Pump on/off – variable speed drive

Outputs (optional):

- Pump start/stop to switch off VSD when not required

Parameters: Setpoints for “economy”, “pre-comfort”, “comfort”. Time/calendar schedule to switch between different operating modes.

Possible variants: In combination with fixed time programs or optimized start/stop to switch between “pre-comfort” and “comfort”, or exclusively demand driven.

Achieve frost protection based on central plant and outside air temperature 1st (pump circulation) and 2nd stage (Pumps plus heating demand) strategy.

Apply differential pressure sensor for monitoring system pressure and evaluating demand.

5.1.5 Intermittent control of emission and/or distribution

5.1.5.1 Type 1 — Automatic Control with fixed Time Program

See ISO 52120-1:2021, Table 5: 1.5, HEATING CONTROL, Intermittent control of emission and/or distribution, Type 1, for information on energy performance level.

Description: Automatic control is realised to reach intermittent operation of the emission and/or distribution components.

Target: To get energy performance by lowering the temperature setpoints during certain conditions (e.g. night), this leads to energy performance due to shortened operation time of the generation/distribution, lower losses of the room(s) due to lower temperature differences to the outside.

Intermittent control of EMISSION and/or distribution — Type 1-a

Inputs (mandatory):

- Temperature setpoints
- Operating mode

Inputs (optional):

- Window contact
- Time schedule

Outputs (mandatory):

- Actual room temperature setpoint
- Valve position room

Outputs (optional):

- Heating demand

Intermittent control of emission and/or DISTRIBUTION — Type 1-b

Inputs (mandatory):

- Temperature setpoint supply water

Inputs (optional):

- Outside air temperature
- Time schedule

Outputs (mandatory):

- Actual supply water temperature

Outputs (optional):

- Mixing valve position
- Heating demand
- Pump on/off

Outputs: Communication to distribution.

Possible variants: One-time program for a “group” of rooms (zone); one-time program for a whole building.

5.1.5.2 Type 2 — Automatic control with optimum start/stop

See ISO 52120-1:2021, Table 5: 1.5, HEATING CONTROL, Intermittent control of emission and/or distribution, Type 2, for information on energy performance level.

Description: Automatic control is realised to reach optimized start/stop of intermittent operation of the emission and/or distribution components.

Target: To achieve energy performance through optimized start/stop to maximize time for economy mode by considering energy capacity of the building in control.

Intermittent control of EMISSION and/or distribution — Type 2-a

Inputs (mandatory):

- Temperature setpoints
- Operating mode
- Outside air temperature
- Room temperature

Inputs (optional):

- Window contact
- Time schedule

Outputs (mandatory):

- Actual room temperature setpoint
- Valve position room

Outputs (optional):

- Heating demand

Intermittent control of emission and/or DISTRIBUTION — Type 2-b

Inputs (mandatory):

- Temperature setpoint supply water
- Outside air temperature
- Room temperature (reference room)

Inputs (optional):

- Time schedule

Outputs (mandatory):

- Actual supply water temperature setpoint

Outputs (optional):

- Mixing valve position
- Heating demand
- Pump on/off

Parameters: Setpoints for “economy”, “pre-comfort”, “comfort”.

Outputs: Communication to distribution.

Possible variants: One-time program for a “group” of rooms (zone); one-time program for a whole building.

5.1.5.3 Type 3 — Automatic control with demand evaluation

See ISO 52120-1:2021, Table 5: 1.5, HEATING CONTROL, Intermittent control of emission and/or distribution, Type 3, for information on energy performance level.

Description: Automatic control is realised to reach intermittent operation of emission and/or distribution based on demand (e.g. derived from occupancy) with minimal operation time.

Target: To achieve EP through maximizing “pre-comfort” and/or “economy” time by detecting or using information about real demand (e.g. occupancy).

Optional

- Outside air temperature — influence the zone demand
- Room temperature influence the zone demand
- Frost protection based on central plant and outside air temperature 1st (pump circulation) and 2nd stage (pumps plus heating demand) strategy
- Mixing valve position – vary flow rate temperature
- Pump on/off – to control distribution based on demand
- Heating demand – to heat generator

Inputs (mandatory):

- Heating demand

Inputs (optional):

- Outside air temperature
- Room temperature
- Demand sensing information (e.g. occupancy)

Outputs (mandatory):

- Actual supply water temperature setpoint

Outputs (optional):

- Mixing valve position
- Heating demand
- Pump on/off

Parameters: Setpoints for “economy”, “pre-comfort”, “comfort”.

Outputs: Communication to distribution.

Possible variants: In combination with fixed time programs or optimized start/stop to switch between “pre-comfort” and “comfort”, or exclusively demand driven.

5.1.6 Heat generator control (combustion and district heating)

5.1.6.1 Type 1 — Variable temperature control depending on outside temperature

See ISO 52120-1:2021, Table 5: 1.6, HEATING CONTROL, Heat generator control (combustion and district heating), Type 1, for information on energy performance level.

Description: Generator temperature setpoint is variable depending on outdoor temperature.

Target: To achieve energy performance by minimizing the generator operation temperatures using outdoor temperature information.

Inputs (mandatory):

- Outside air Temperature

- Supply water temperature

Inputs (optional):

- Operating mode

Outputs (mandatory):

- Generator supply water temperature (e.g. valve position of district heating transfer station, burner modulation, heating power)
- Heating demand

Outputs (optional):

- Boiler/pumps, on/off

Additional equipment: Outdoor temperature sensor, flow temperature setpoint.

Possible variants: Temperature sensor is included in generator control. Temperature is received via communication from other parts of the system.

5.1.6.2 Type 2 — Variable temperature control depending on the load

See ISO 52120-1:2021, Table 5: 1.6, HEATING CONTROL, Heat generator control (combustion and district heating), Type 2, for information on energy performance level.

Description: Generator temperature setpoint is variable depending on the load of the system.

Target: To achieve energy performance by minimizing the generator operation temperatures using information about current demand of the system.

Inputs (mandatory):

- Supply (flow) water temperature
- Return water temperature
- Flow volume

Inputs (optional):

- Outside air temperature
- Optimized start/stop control
- Operating request

Outputs (mandatory):

- Generator supply water temperature (e.g. valve position of district heating transfer station, burner modulation, heating power)
- Heating demand

Outputs (optional):

- Boiler/pumps, on/off

Inputs: Load of systems (requires communication to other parts of the system).

Additional equipment: Load is measured within the generator (volumes and differences of flow and return temperature).

Possible variants: Load is measured within generator. Load information is transmitted by other parts of the system.

Manual override for local manual control overriding automatic sequence.

Operation request on demand using local push button control overriding automatic sequence.

NOTE According to ISO 52120-1:2021, 7.3, annunciation of manual control has to be foreseen for non-residential buildings. These can have a high energy related impact.

Outside air temperature varies inside space temperature setpoint; in summer increases cooling setpoint, in winter reduces heating setpoint

Pump on/off to control distribution based on demand.

Boiler on/off to switch generator demand.

5.1.7 Heat generator control (heat pump)

5.1.7.1 Type 1 — Variable temperature depending on outdoor temperature

See ISO 52120-1:2021, Table 5: 1.7, HEATING CONTROL, Heat generator control (heat pump), Type 1, for information on energy performance level.

Description: The control temperature is calculated with the goal to operate the heat pump with minimized operating temperature setpoints depending on outdoor temperature.

Target: To achieve energy performance by avoiding unnecessary electrical pumping energy by minimizing the generator operation temperatures using outdoor temperature information.

Inputs (mandatory):

- Outside air temperature
- Supply (flow) water temperature

Inputs (optional):

- Room temperature (reference room)
- Return water temperature
- Flow volume

Outputs (mandatory):

- Heat pump on/off
- Heat pump operating temperature setpoint
- Current COP of the heat pump

Outputs (optional):

--

Additional equipment: Outdoor temperature sensor.

Possible variants: Outdoor information is transmitted via communication.

5.1.7.2 Type 2 — Variable temperature depending on the load

See ISO 52120-1:2021, Table 5: 1.7, HEATING CONTROL, Heat generator control (heat pump), Type 2, for information on energy performance level.

Description: Heat pump temperature setpoint is variable depending on demand based on the load of the system (e.g. supply water temperature setpoint).

Target: To achieve energy performance by optimizing efficiency of the heat pump at given environmental conditions based on current demand of the system.

Inputs (mandatory):

- Outside air temperature
- Supply (flow) water temperature
- Room temperature (reference room)
- Return water temperature
- Current COP of heat pump

Inputs (optional):

- Flow volume
- Demand from heating or cooling
- Availability status of heat pump

Outputs (mandatory):

- Heat pump on/off
- Heat pump operating temperature setpoint
- Auxiliary electric heater on/off
- Heat pump speed
- Operation in heating/cooling mode
- current COP of the heat pump

Outputs (optional):

--

Output: Efficiency of heat pump

Possible variants: Mixed mode heat generator application (e.g. boilers and heat pump). Heating demand may be equal to or less than the heat pump capacity.

5.1.8 Heat generator control (outdoor unit)

5.1.8.1 Type 1 -Multi-stage control of heat generator depending on the load or demand

See ISO 52120-1:2021, Table 5: 1.8, HEATING CONTROL, Heat generator control (outdoor unit), Type 1, for information on energy performance level.

Description: Output of heat generator (split-air conditioning system (outdoor unit) as heat and cold generator) is controlled depending on the load or demand (e.g. on/off of several compressors)

Target: Improve energy performance by adapting run-time of generator to load or demand.

Inputs (mandatory):

- Demand from heating or cooling

- Outside air temperature
- Current COP of heat pump

Inputs (optional):

- Supply (flow) water temperature
- Room temperature (reference room)
- Return water temperature

Outputs (mandatory):

- Heat pump operation stage
- Heat pump speed
- Operation in heating/cooling mode

Outputs (optional):

- Heat pump operating temperature setpoint

5.1.8.2 Type 2 -Variable control of heat generator capacity depending on the load or demand

See ISO 52120-1:2021, Table 5: 1.8, HEATING CONTROL, Heat generator control (outdoor unit), Type 2, for information on energy performance level.

Description: Output of heat generator depends on the load or demand (e.g. hot gas bypass, inverter frequency control)

Target: Improve energy performance by reducing auxiliary power of generator to load or demand.

Inputs (mandatory):

- Demand from heating or cooling
- Outside air temperature
- Current COP of heat pump

Inputs (optional):

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Outputs (mandatory):

- Current heat generator capacity
- Heat pump speed
- Operation in heating/cooling mode

Outputs (optional):

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5.1.9 Sequencing of different heat generators

5.1.9.1 Type 1 — Control according to fixed priority list

See ISO 52120-1:2021, Table 5: 1.9, HEATING CONTROL, Sequencing of different heat generators, Type 1, for information on energy performance level.

Description: Priority based sequencing of multiple heating generators. The generators of higher priority are running first. A given generator in the priority list is running only if the generators of higher priority are running at full load. The sequence is fixed – the priority list is arbitrarily created.

Target: To achieve energy performance by only using as many generators as needed at any point in time and drive each generator in its most efficient mode (full load).

Inputs (mandatory):

- Each generator max. capacity
- Each generator current loading
- Total heating demand
- Outside air temperature

Inputs (optional):

- Priority list

Outputs (mandatory):

- Capacity requested from each generator

Outputs (optional):

--

Inputs: Current total demand, manual input of fixed sequence, (optional demand signal from heat consumer).

Outputs: Operating conditions to each boiler.

Additional equipment: (Variant) Load is measured within the generator (volumes and differences of flow and return temperature).

Possible variants: Load is calculated from demand signal (communicating system). Load is measured from flow temperatures (sensors).

5.1.9.2 Type 2 — Control according to dynamic priority list based on generator efficiency and capacity

See ISO 52120-1:2021, Table 5: 1.9, HEATING CONTROL, Sequencing of different heat generators, Type 2, for information on energy performance level.

Description: The generators of higher priority are running first. A given generator in the priority list is running only if the generators of higher priority are running at full load. The priority list is dynamically created reflecting the generators current efficiency and capacity.

Target: To achieve energy performance by only using as many as needed and drive each generator in its most efficient mode (full load), and only using the most efficient generators at any point in time.

Inputs (mandatory):

- Each generator max. capacity
- Each generator current loading
- Each generator current performance
- Each generator performance characteristics
- Total heating demand

- Outside air temperature

Inputs (optional):

- Priority list (dynamically created based on current performance)

Outputs (mandatory):

- Capacity requested from each generator

Outputs (optional):

--

Inputs: Current total demand, current load and efficiency of each generator.

Outputs: Operating conditions to each boiler.

Additional equipment: None.

Prerequisite: Demand must be transferred via communication

5.1.9.3 Type 3 — Control according to dynamic priority list based on predicted and current load, efficiency and capacity of generators

See ISO 52120-1:2021, Table 5: 1.9, HEATING CONTROL, Sequencing of different heat generators, Type 3, for information on energy performance level.

Description: Priority based sequencing of multiple heating generators considering their capacities. The generators of higher priority are running first. A given generator in the priority list is running only if the generators of higher priority are running at full load. The priority list is dynamically created based on load, considering the current efficiencies and capacities of the generators (max power).

Target: To achieve energy performance by only using as many generators as needed at any point in time – to avoid generators to run at very low load (e.g. < 30 %), but there is also a target to avoid too short “cycle times” (e.g. as each burner start consumes additionally energy).

Inputs (mandatory):

- Each generator max. capacity
- Each generator current loading
- Total heating demand
- Outside air temperature

Inputs (optional):

- Priority list (dynamically created)

Outputs (mandatory):

- Capacity requested from each generator

Outputs (optional):

--

Inputs: Current total demand, current load of each generator.

Outputs: Operating conditions to each boiler.

Additional equipment: None.

Prerequisite: Demand must be transferred via communication.

5.1.10 Control of Thermal Energy Storage (TES) charging

5.1.10.1 Type 1 — 2-sensor charging of storage

See ISO 52120-1:2021, Table 5: 1.10, HEATING CONTROL, Control of Thermal Energy Storage (TES) charging, Type 1, for information on energy performance level.

Description: Once the TES is enabled for operation it is charged if the lower temperature sensor indicates a minimum state of charge. Charging will be stopped based on the second sensor information at the top of the Storage

Target: To improve energy performance by reducing charging intervals. Based on that energy losses of the TES can be reduced.

Inputs (mandatory):

- Temperature sensor at bottom of thermal energy storage
- Temperature sensor at top of thermal energy storage

Inputs (optional):

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Outputs (mandatory):

- State of charging (on/off)
- Current temperature of thermal energy storage

Outputs (optional):

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5.1.10.2 Type 2 — Load prediction based storage operation

See ISO 52120-1:2021, Table 5: 1.10, HEATING CONTROL, Control of Thermal Energy Storage (TES) charging, Type 2, for information on energy performance level.

Description: Thermal energy storage is operated considering load predictions.

Target: To improve energy performance by reducing state of charge when storage is not needed. Based on that energy losses of the TES can be reduced.

Inputs (mandatory):

- Expected minimum thermal energy temperature level
- Predicted thermal energy load profile

Inputs (optional):

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Outputs (mandatory):

- Maximum thermal capacity of thermal energy storage
- Current thermal capacity of thermal energy storage
- State of charging (on/off)

- Current temperature of thermal energy storage

Outputs (optional):

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5.1.11 Hydronic balancing heating distribution (including contribution to balancing to the emission side)

5.1.11.1 Type 1 — Balanced statically per emitter, without group balance

See ISO 52120-1:2021, Table 5: 1.4a, HEATING CONTROL, Hydronic balancing heating distribution (including contribution to the balancing to the emission side), Type 1, for information on energy performance level.

Description: Static hydronic balancing is achieved with a manual adjustable flow restriction per emitter.

Target: To get statical balancing of the flow per emitter in the hydronic system ensures energy performance on the physical distribution level.

Inputs (mandatory):

- Setting of the hydronic balancing resistance (e.g. radiator valve presetting)

Inputs (optional):

- Operating mode
- Time schedule

Outputs (mandatory):

- Supply water (balancing valve position)

Outputs (optional):

--

5.1.11.2 Type 2 — Balanced statically per emitter, and a static group balance

See ISO 52120-1:2021, Table 5: 1.4a, HEATING CONTROL, Hydronic balancing heating distribution (including contribution to the balancing to the emission side), Type 2, for information on energy performance level.

Description: Statical balancing per emitter is achieved with a manual adjustable flow restriction per emitter. Static group balancing is achieved with a manual adjustable flow restriction per group of max 10 emitters.

Target: To change the hydronic resistance per emitter to achieve the specified flow at design conditions, and to change the hydronic resistance for a group of emitters to avoid high differential pressures and flow noise from valves and emitters. Statical balancing of the flow per emitter and across a group of emitters in the hydronic system ensures energy performance on the physical distribution level.

Inputs (mandatory):

- Setting of the hydronic balancing resistance (e.g. presetting of valves on radiators and risers)

Inputs (optional):

- Heating demand (valve position)
- Differential pressure

Outputs (mandatory):

- Supply water (position of presetting and balancing valves on emitter's and risers)

Outputs (optional):

- Pump on/off – variable speed drive

5.1.11.3 Type 3 — Balanced statically per emitter and dynamic group balance

See ISO 52120-1:2021, Table 5: 1.4a, HEATING CONTROL, Hydronic balancing heating distribution (including contribution to the balancing to the emission side), Type 3, for information on energy performance level.

Description: Statical balancing per emitter is achieved with a manual adjustable flow restriction per emitter. Dynamic group balancing is achieved with an automatic differential pressure controller in combination with an electronic or manual adjustable flow restriction per group of max 10 emitters.

Target: To change the hydronic resistance per emitter to achieve the specified flow at design conditions, and to automatically change the hydronic resistance for a group of emitters to ensure constant differential pressure across the group of emitters at partial and design flow conditions.

Inputs (mandatory):

- Setting of the hydronic balancing resistance (e.g. presetting of valves on radiators and risers)
- Water pressure before the emitter group
- Water pressure after the emitter group
- Adjustable differential pressure setpoint for emitter group

Inputs (optional):

- Outside air temperature
- Demand sensing information (e.g. occupancy)

Outputs (mandatory):

- Supply water (position of presetting valves on emitters)
- Supply water (position of balancing valves on risers)

Outputs (optional):

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5.1.11.4 Type 4 — Balanced dynamically per emitter

See ISO 52120-1:2021, Table 5: 1.4a, HEATING CONTROL, Hydronic balancing heating distribution (including contribution to the balancing to the emission side), Type 4, for information on energy performance level.

Description: Dynamic balancing per emitter is achieved with an automatic differential pressure controller in combination with a manual adjustable flow restriction. An automatic pressure controller measures and controls the differential pressure across the room temperature control valve.

Target: To change the hydronic resistance per emitter to achieve the specified flow at design conditions, and to automatically maintain constant differential pressure across the room temperature control valve at partial and design flow conditions. Dynamic balancing of the flow per emitter ensures energy performance on the physical distribution level under changing emission conditions at each emitter.

Inputs (mandatory):

- Setting of the hydronic balancing resistance (e.g. presetting of radiator valve)

- Water pressure before the room temperature control valve
- Water pressure after the room temperature control valve
- Differential pressure setpoint across room temperature control valve (e.g. fixed at 0,1 bar)

Inputs (optional):

- Demand sensing information (e.g. occupancy)
- Pump status contact (for flow proving)

Outputs (mandatory):

- Supply water (position of presetting valves)
- Supply water (position of automatic differential pressure control valve)

Outputs (optional):

- Pump start/stop to switch off VSD when not required

5.2 Domestic hot water (DHW) supply control

5.2.1 Control of DHW storage charging with direct electric heating or integrated electric heat pump

5.2.1.1 Type 1 — Automatic control on/off and scheduled charging enable

See ISO 52120-1:2021, Table 5: 2.1, DOMESTIC HOT WATER SUPPLY CONTROL, Control of DHW storage charging with direct electric heating or integrated electric heat pump, Type 1, for information on energy performance level.

Description: Control of the DHW (standalone DHW) storage temperature avoiding early recharging using time-based charging blocking.

Target: To achieve energy performance by lowering mean DHW buffer temperature to reach less isolation losses from the buffer. This can be achieved by using up the full capacity of buffer heat before recharging. Less number of recharge cycles has also positive benefits for energy generators.

Inputs (mandatory):

- Hot water setpoint temperature
- DHW storage temperature

Inputs (optional):

- Hot water flow

Outputs (mandatory):

- Heating demand

Outputs (optional):

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Possible variants:

- DHW with built in electrical heating coil
- DHW with exclusively coupled heat pump
- DHW with exclusively coupled burner (e.g. direct fired DHW)

5.2.1.2 Type 2 — Automatic on/off control and scheduled charging enable and multi-sensor storage management

See ISO 52120-1:2021, Table 5: 2.1, DOMESTIC HOT WATER SUPPLY CONTROL, Control of DHW storage charging with direct electric heating or integrated electric heat pump, Type 2, for information on energy performance level.

Description: Automatic control on/off and charging time release and multi-sensor storage management (Standalone DHW)

Control of the DHW storage temperature thus avoids early recharging using multi sensing detection of remaining heat capacity of the buffer.

Target: To achieve energy performance by lowering mean DHW buffer temperature to reach less isolation losses from the buffer. This can be achieved by using up the full capacity of buffer heat before recharging. Less number of recharge cycles has also positive benefits for energy generators.

Inputs (mandatory):

- Hot water setpoint temperature
- DHW storage temperature
- Hot water flow

Inputs (optional):

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Outputs (mandatory):

- Heating demand

Outputs (optional):

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Parameters: Recharge limit

Possible variants:

- DHW with built in electrical heating coil
- DHW with exclusively coupled heat pump
- DHW with exclusively coupled burner (e.g. direct fired DHW)

5.2.2 Control of DHW storage charging using hot water generation

5.2.2.1 Type 1 — Automatic on/off control and scheduled charging enable

See ISO 52120-1:2021, Table 5: 2.2, DOMESTIC HOT WATER SUPPLY CONTROL, Control of DHW storage using hot water generation, Type 1, for information on energy performance level.

Description: Control of the DHW storage temperature avoiding early recharging using time-based charging blocking.

Target: To improve energy performance by lowering mean DHW buffer temperature to reach less isolation losses from the buffer. This can be achieved by using the full capacity of buffer heat before recharging. Less number of recharge cycles has also positive benefits for energy generators.

Inputs (mandatory):

- Hot water setpoint temperature

- DHW storage temperature
- Hot water flow

Inputs (optional):

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Outputs (mandatory):

- Heating demand

Outputs (optional):

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Parameters: Recharge limit

Possible variants:

- DHW is fed by one heat generator (which also feeds other heat consumers)
- DHW is fed by a multivalent heat generating system which also feeds others

5.2.2.2 Type 2 — Automatic on/off control and scheduled charging enable and demand-based supply temperature control or multi-sensor storage management

See ISO 52120-1:2021, Table 5: 2.2, DOMESTIC HOT WATER SUPPLY CONTROL, Control of DHW storage using hot water generation, Type 2, for information on energy performance level.

Description: Control of the DHW storage temperature avoiding early recharging using time-based charging blocking and submitting demand information to Heat generators or multi sensing detection of remaining heat capacity of the buffer.

Target: To achieve energy performance by lowering mean DHW buffer temperature to reach less isolation losses from the buffer. This can be achieved by using up the full capacity of buffer heat before recharging. Transmission of demand information enables optimized energy performance in heat generator systems. Less number of recharge cycles has also positive benefits for energy generators.

Inputs (mandatory):

- Hot water setpoint temperature
- DHW storage temperature
- Remaining heat capacity

Inputs (optional):

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Outputs (mandatory):

- Heating demand

Outputs (optional):

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Outputs: Heat demand to heat generation system

Parameters: Charging release time, recharge limit

Possible variants:

- DHW is fed by one heat generator (which also feeds other heat consumers)
- DHW is fed by a multivalent heat generating system which also feeds others

5.2.3 Control of DHW storage charging with solar collector and supplementary heat generation

5.2.3.1 Type 1 — Automatic control of solar storage charge (Prio. 1) and supplementary storage charge (Prio. 2)

See ISO 52120-1:2021, Table 5: 2.3, DOMESTIC HOT WATER SUPPLY CONTROL, Control of DHW storage charging with solar collector and supplementary heat generation, Type 1, for information on energy performance level.

Description: Control of the DHW storage temperature preferring energy out of solar energy in combination with automatically supplementary recharging in case solar energy is not sufficient.

Target: To achieve energy performance by maximizing charging of solar energy and in case that no solar energy is available. Automatic switch to supplementary loading of buffer with other Heat generations

Inputs (mandatory):

- Hot water setpoint temperature
- DHW storage temperature
- Supply water temperature (from heat generator)
- Supply water temperature (from solar generator)
- Temperature at top of storage for supplementary loading by heat generator
- Temperature at bottom of storage for control of solar pump

Inputs (optional):

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Outputs (mandatory):

- DHW temperature
- Solar collector pump, on/off
- Solar collector pump, control value
- Valve position

Outputs (optional):

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Parameters: Available power of solar energy.

Possible variants:

- DHW is fed by solar primary and heat generator is delivering supplementary.
- DHW is fed by solar primary and electrical reheat in DHW is delivering supplementary energy
- DHW is fed by solar primary and heat pump delivering supplementary energy

- DHW is fed by solar primary and combination of heat pump and heat generators are delivering supplementary energy

5.2.3.2 Type 2 — Automatic control of solar storage charge (Prio. 1) and supplementary storage charge (Prio. 2) plus demand based supply temperature control or multi-sensor storage management

See ISO 52120-1:2021, Table 5: 2.3, DOMESTIC HOT WATER SUPPLY CONTROL, Control of DHW storage charging with solar collector and supplementary heat generation, Type 2, for information on energy performance level.

Description: Control of the DHW storage temperature preferring energy out of solar energy in combination with automatically supplementary recharging in case solar energy is not sufficient.

Target: To achieve energy performance by maximizing charging of solar energy and in case that no solar energy is available control supplementary loading of buffer with other Heat generations with minimum losses and max efficiency of the generators. In “Supplementary operation mode” energy performance efficiency is reached by minimizing mean DHW buffer temperature to reach less isolation losses from the buffer. This can be achieved by using up the full capacity of buffer heat before recharging. Less number of recharge cycles has also positive benefits for energy generators. To achieve energy performance through optimized selection of energy source which feeds the buffer at a given condition. Further improvement of energy efficiency can be achieved with demand based DHW supply temperature.

Inputs (mandatory):

- Hot water setpoint temperature
- DHW storage temperature
- Supply water temperature (from heat generator)
- Supply water temperature (from solar generator)
- Demand-based DHW supply temperature
- Temperature at half-height of storage
- Temperature at top of storage for supplementary loading by heat generator
- Temperature at bottom of storage for control of solar pump

Inputs (optional):

Outputs (mandatory):

- DHW temperature
- Primary pump, on/off
- Solar collector pump, control value
- Valve position

Outputs (optional):

Parameters: Available power of solar energy.

Possible variants:

- DHW is fed by solar primary and heat generator is delivering supplementary

- DHW is fed by solar primary and electrical reheat in DHW is delivering supplementary energy
- DHW is fed by solar primary and heat pump delivering supplementary energy
- DHW is fed by solar primary and combination of heat pump and heat generators are delivering supplementary energy

5.2.4 Control of DHW circulation pump

5.2.4.1 Type 1 — Control of DHW circulation pump, with time switch program

See ISO 52120-1:2021, Table 5: 2.4, DOMESTIC HOT WATER SUPPLY CONTROL, Control of DHW circulation pump, Type 1, for information on energy performance level.

Description: Control of DHW circulation pump using time switch program

Target: To achieve energy performance by avoiding energy losses in pipes as well as unnecessary energy consumption of circulation pump during time while no DHW comfort with circulation pump is needed.

Inputs (mandatory):

- Hot water setpoint temperature
- DHW storage temperature
- Supply water temperature (from heat generator)
- Supply water temperature (from solar generator)
- Temperature at bottom of storage
- Temperature in the middle of storage
- Temperature at top of storage
- Solar radiation
- DHW circulation request

Inputs (optional):

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Outputs (mandatory):

- DHW temperature
- Primary pump, on/off
- Valve position

Outputs (optional):

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Possible variants:

DHW is fed by heat generator and electrical heating where during summer season electrical heat generation is more energy performance than standard heat generators

Parameters: Time program of DHW circulation pump

5.3 Cooling control

5.3.1 Emission Control

5.3.1.1 Type 1 — Central automatic control

See ISO 52120-1:2021, Table 5: 3.1, COOLING CONTROL, Emission Control, Type 1, for information on energy performance level.

NOTE This Type 1 is no longer considered to be energy efficiency class C but defined as energy efficiency class D.

Description: Central control of temperature in rooms by means of cooling, it is acting either on the distribution or on the generation. Cooling control is performed without consideration of local demand of different rooms, possibly by using one room as reference.

Target: To improve energy performance by minimizing emitted cooling (e.g. chilled beams) or by air in the building using central control of temperature and/or flow. This control may be based on outside air temperature and/or a reference sensor inside the building and assumes similar demands in different parts/rooms of the building.

Different operating modes: comfort, pre-comfort (economy), night, building protection

Inputs (mandatory):

- Outside air temperature (varies inside space temperature setpoint; in summer increases cooling setpoint, in winter reduces heating setpoint)
- Room temperature setpoint
- Operating mode
- Room temperature (reference room)

Inputs (optional):

- Supply (flow) water temperature
- Return water temperature

Outputs (mandatory):

- Supply water (valve position)
- Boiler/pumps on/off

Outputs (optional):

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5.3.1.2 Type 2 — Individual room control

See ISO 52120-1:2021, Table 5: 3.1, COOLING CONTROL, Emission Control, Type 2, for information on energy performance level.

Description: Individual room control by (non-communicating) thermostatic valves or electronic controller.

The individual control of cooling temperature in rooms is performed either by thermostatic valves or local (non-communicating) electronic control units. The individual control may be combined with central scheduler/calendar providing different operating modes.

Target: To improve energy performance by minimizing emitted cooling (e.g. chilled beams) or by air in the building using local control of temperature and/or flow in the rooms, thereby adapting to local demand, i.e. different loads in different rooms.

Different operating modes: comfort, pre-comfort (economy), night, building protection.

Inputs (mandatory):

- Room temperature
- Room temperature setpoint
- Operating mode

Inputs (optional):

- Presence detection
- Optimized start/stop control (adaptive)
- Window contact

Outputs (mandatory):

- Supply water (valve position)

Outputs (optional):

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5.3.1.3 Type 3 — Individual modulating room control with communication

See ISO 52120-1:2021, Table 5: 3.1, COOLING CONTROL, Emission Control, Type 3, for information on energy performance level.

Description: Individual modulating room automatic control with communication between controllers and the supervisory BACS.

Individual modulating control of temperature in rooms by means of cooling with communication between controllers and to supervisory BACS, allows exchange of setpoints, demand and other status information.

Target: To improve energy performance by minimizing cooling by emitters (e.g. chilled beams) or by air in the building using local control of temperature and/or flow in the rooms, thereby adapting to local demand, i.e. different loads in different rooms. Furthermore, to obtain energy demand for further use to control distribution and generators, keeping run time at minimum and setpoints optimal.

Different operating modes: comfort, pre-comfort (economy), night, building protection.

Inputs (mandatory):

- Room temperature
- Room temperature setpoint
- Operation mode (operation request on demand – local push button control overriding automatic sequence)

Inputs (optional):

- Presence detection (to change operating mode)
- Outside air temperature (varies inside space temperature setpoint; in summer increases cooling setpoint, in winter reduces heating setpoint)
- Building protection (based on central plant and outside air temperature 1st (pump circulation) and 2nd stage (Pumps plus heating demand) strategy)

- Optimized start/stop control (adaptive; provides a pre-occupancy comfort mode and optimised start/stop based around a time/calendar schedule and internal building fabric protection)
- Window contact (override automatic control if a window is opened)

Outputs (mandatory):

- Supply water (valve position)

Outputs (optional):

- Cooling demand
- Manual override – local manual control overriding automatic sequence

5.3.1.4 Type 4 — Individual modulating room control with communication and occupancy detection

See ISO 52120-1:2021, Table 5: 3.1, COOLING CONTROL, Emission Control, Type 4, for information on energy performance level.

Description: Individual modulating room control with communication between controllers and to BACS. Demand/presence control performed by occupancy.

Individual modulating control of temperature in rooms by means of cooling, with communication between controllers and to BACS, allows exchange of setpoints, demand and other status information.

Presence detection shall be installed to reach the highest level of energy performance

Outside air temperature – varies inside space temperature setpoint; in summer increases cooling setpoint, in winter reduces heating setpoint

Optimum start stop provides a pre-occupancy comfort mode and optimised start/stop based around a time/calendar schedule and internal building fabric protection.

Target: To improve energy performance by minimizing cooling by emitters (e.g. chilled beams) or by air in the building using local control of temperature and/or flow in the rooms, thereby adapting to local demand, i.e. different loads in different rooms. Furthermore, to obtain energy demand for further use to control distribution and generators, keeping run time at minimum and setpoints optimal.

Different operating modes: comfort, pre-comfort (economy), night, building protection.

Inputs (mandatory):

- Room temperature
- Room temperature setpoint
- Operation mode (operation request on demand – local push button control overriding automatic sequence)
- Presence detection

Inputs (optional):

- Optimized start/stop control (adaptive)
- Window contact (override automatic control if a window is opened)

Outputs (mandatory):

- Cooling demand

Outputs (optional):

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5.3.2 Emission control for TABS (cooling mode)

5.3.2.1 Type 1 — Central automatic control

See ISO 52120-1:2021, Table 5: 3.2, COOLING CONTROL, Emission control for TABS (cooling mode), Type 1, for information on energy performance level.

Description: The central automatic control for a TABS zone (which comprises all rooms which get the same supply water temperature) typically is a supply water temperature control loop whose setpoint is dependent on the median outside air temperature, e.g. the average of the previous 24 hours.

Target: The supply water temperature shall be set according to the median outside air temperature (median – weather compensated supply water temperature).

Inputs (mandatory):

- Outside air temperature (mean outside air temperature of the previous day)
- Supply (flow) water temperature

Inputs (optional):

- Room temperature
- Room temperature (reference room)
- Room temperature setpoint
- Presence detection

Outputs (mandatory):

- Supply water temperature (valve position)

Outputs (optional):

- Cooling demand

Parameters: Ramp to determine setpoint.

Additional equipment: None.

Possible variants: The controls might cover both heating and cooling.

5.3.2.2 Type 2 Advanced central automatic control

See ISO 52120-1:2021, Table 5: 3.2, COOLING CONTROL, Emission control for TABS (cooling mode), Type 2, for information on energy performance level.

Description: This is an automatic control of the TABS zone that fulfils the following conditions:

- If the TABS is used for heating and cooling: The central automatic control is designed and tuned to achieve an optimal self-regulating of the room temperature within the required comfort range (specified by room temperature heating and cooling setpoints). “Optimal” means that the room temperatures of all rooms of the TABS zone remain during operation periods in the comfort range, to meet comfort requirements, but also uses as far as possible the full range to reduce the energy demand for heating and cooling.
- If the TABS is used for heating and cooling: The automatic switching between heating and cooling is not done only dependent on the outside air temperature, but also taking at least indirectly the heat gains (internal and solar) into account