PD CEN/TR 12098-7:2016

BSI Standards Publication

Controls for heating systems

Part 7: Accompanying TR prEN 12098-3:2015 — Modules M3-5,6,7,8

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee RHE/16, Performance requirements for control systems.

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

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Published by BSI Standards Limited 2016

ISBN 978 0 580 92595 5

ICS 91.140.10; 97.120

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 August 2016.

Amendments/corrigenda issued since publication

Date	Text affected

TECHNICAL REPORT

RAPPORT TECHNIQUE

TECHNISCHER BERICHT

CEN/TR 12098-7

August 2016

ICS 91.140.10; 97.120

English Version

Controls for heating systems - Part 7: Accompanying TR prEN 12098-3:2015 - Modules M3-5,6,7,8

Begleitender TR zu EN 12098-3

This Technical Report was approved by CEN on 11 April 2016. It has been drawn up by the Technical Committee CEN/TC 247.

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CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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European foreword

This document (CEN/TR 12098-7:2016) has been prepared by Technical Committee CEN/TC 247 “Building Automation, Controls and Building Management”, the secretariat of which is held by SNV.

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This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This document is currently divided into the following parts:

— Controls for heating systems — Part 1: Control equipment for hot water heating systems;

— Controls for heating systems — Part 3: Control equipment for electrical heating systems;

— Controls for heating systems — Part 5: Start-stop schedulers for heating systems;

— Controls for heating systems — Part 6: Accompanying TR prEN 12098-1:2015 Modules M3-5,6,7,8 [Technical Report; currently at Voting stage];

— Controls for heating systems — Part 7: Accompanying TR prEN 12098-3:2015 Modules M3-5,6,7,8 [the present Technical Report; currently at Voting stage];

— Controls for heating systems — Part 8: Accompanying TR prEN 12098-5:2015 Modules M3-5,6,7,8 [Technical Report; currently at Voting stage].

Introduction

The CENSE project, the discussion between CEN and the Concerted action highlighted the high page count of the entire package due to a lot of “textbook” information. This resulted in flooding and confusing the normative text.

A huge amount of informative contents shall indeed be recorded and available for users to properly understand, apply and nationally adapt the EPB standards.

The detailed technical rules 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 shall be accompanied by an informative technical report, like this one, where all informative content is collected.

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

Table 1 — Relative position of this TR within the EN EPB package of standards

	Over-arching	**Building (as such)**	**Technical Building System**									
Submodule	**Descriptions**	**Descriptions**	**Descriptions**	**Heating**	**Cooling**	**Ventilation**	**Humidification**	**Dehumidification**	**Domestic Hot waters**	**Lighting**	**Building automation and control**	**PV, wind, ..**
sub 1	**M1**	**M2**		**M 3**	**M 4**	**M5**	**M6**	**M 7**	**M8**	**M 9**	**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	x								
6	Building Occupancy and Operating Conditions	Heat Transfer by Infiltration and Ventilation	Distribution and control	x								
7	Aggregation of Energy Services and Energy Carriers	Internal Heat Gains	Storage and control	x								
8	Building Partitioning	Solar Heat Gains	Generation and control	x								
9	Calculated Energy Performance	Building Dynamics (thermal	Load dispatching									

	Over-arching	**Building (as such)**	**Technical Building System**									
Submodule	**Descriptions**	**Descriptions**	**Descriptions**	**Heating**	**Cooling**	**Ventilation**	**Humidification**	**Dehumidification**	**Domestic Hot waters**	**Lighting**	**Building automation and control**	**PV, wind, ..**
sub 1	**M1**	**M2**		**M 3**	**M 4**	**M5**	**M6**	**M 7**	**M8**	**M 9**	**M10**	**M11**
		mass)	and operating conditions									
10	Measured Energy Performance	Measured Energy Performance	Measured Energy Performance									
11	Inspection	Inspection	Inspection									
12	Ways to Express Indoor Comfort		BMS									
13	External Environment Conditions											
14	Economic Calculation											

1 Scope

This Technical Report refers to prEN 12098-3, *Controls for heating systems — Part 3: Control equipment for electrical heating systems — Modules M3-5,6,7,8*.

It contains information to support the correct understanding, use and national adaption of prEN 12098-3:2015.

This Technical Report does not contain any normative provision.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

prEN 12098-1:2015, *Controls for heating systems - Part 1: Control equipment for hot water heating systems - Modules M3-5,6,7,8*

prEN 12098-3:2015, *Controls for heating systems - Part 3: Control equipment for electrical heating systems - Modules M3-5,6,7,8*

prEN 15232-1:2015, *Energy performance of buildings - Part 1: Impact of Building Automation, Controls and Building Management - Modules M10-4,5,6,7,8,9,10*

EN 15316–2-3:2007, *Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 2-3: Space heating distribution systems*

prEN ISO 52000-1:2015, *Energy performance of buildings - Overarching EPB assessment - Part 1: General framework and procedures (ISO/DIS 52000-1:2015)*

EN ISO 7345:1995, *Thermal insulation - Physical quantities and definitions (ISO 7345:1987)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 7345:1995, prEN ISO 52000-1:2015, prEN 12098-3:2015 (the accompanied EPB standard) apply.

4 Symbols and abbreviations

4.1 Symbols

For the purposes of this document, the symbols given in prEN ISO 52000-1:2015 and prEN 12098-3:2015 (the accompanied EPB standard) apply.

4.2 Abbreviations

Abbreviation	Term
OTC	outside temperature compensated
RTC	room temperature control
FSS	fixed start-stop scheduling
OSS	optimum start –stop scheduling

5 Control heating systems, general design rules

5.1 Control heating systems, main design rules, general design rules

Efficient Heating control system consists on integrated functions applied to all parts of heating system taking account predictable or detected occupancy and other events as smart metering information, ... etc.

5.2 Partitioning control heating zones in buildings

For efficiently control heating, the heating power shall satisfy heat demand. For this purpose, heating power is compensated by outside temperature and scheduled for intermittent heating in relation with conditions of use. For efficiency of control systems, the heating system distribution building shall be partitioned into zones or spaces with uniform conditions of use,

NOTE Partitioning of heating systems described on prEN ISO 52000-1:2015, 9, D.2, D.3, may usefully be applied for the design of heating systems.

BAC heating control system shall have multiple controls and intermittent scheduling adapted to zones or elementary spaces conditions of use. Special attention shall be done to keep watch for update set points and schedulers to real conditions of use and needs, during exploitation.

For satisfy these indications size of zones shall be limited.

NOTE An indication is given in EN 15316–2–3:2007, A2: limit zones area to 1 000 m2.

5.3 Generation, distribution, emission control

5.3.1 General

As a general rule, heating control systems consists to integrate many functions applied to central (generation, storage), zone (distribution) and room (emission) parts of heating systems.

OTC control and OSS and complementary integrated functions specified by prEN 12098-3:2015 fulfil items in prEN 15232-1:2015, Table 4, 1.3.

NOTE Better control and scheduling of heating systems imply a data communication network linking control devices for integration of these functions and other technical building management capabilities for energy performance.

5.3.2 Generation

Generation part consists to switch on-off or to modulate the available heating power.

For this part, objectives of control functions are:

— the lowest heating power satisfying the higher zone demand

— the longest reduced (or stop) heating power satisfying the shorter reduced (or stop) heating zone period.

For single zone distribution, generation control take account thermal characteristics and conditions of use (see prEN 52000-1:2015, Clause 9, D.2, D.3).

5.3.3 Distribution

Distribution parts are controlled in the same way as for generation, switching or modulating available electrical power, for same objectives.

5.3.4 Emission

The aim of individual control consist to adapt conditions of operation (individual room temperature set point and scheduling), to consumer's needs (see prEN 15232-1:2015, Figure 1) and to compensate room heat gains, reducing heating for comfort and energy saving.

Individual room temperature control performance doesn't depend only of individual controllers; it depends also of the available heating power limited by central (generation, distribution) control, mainly for these cases:

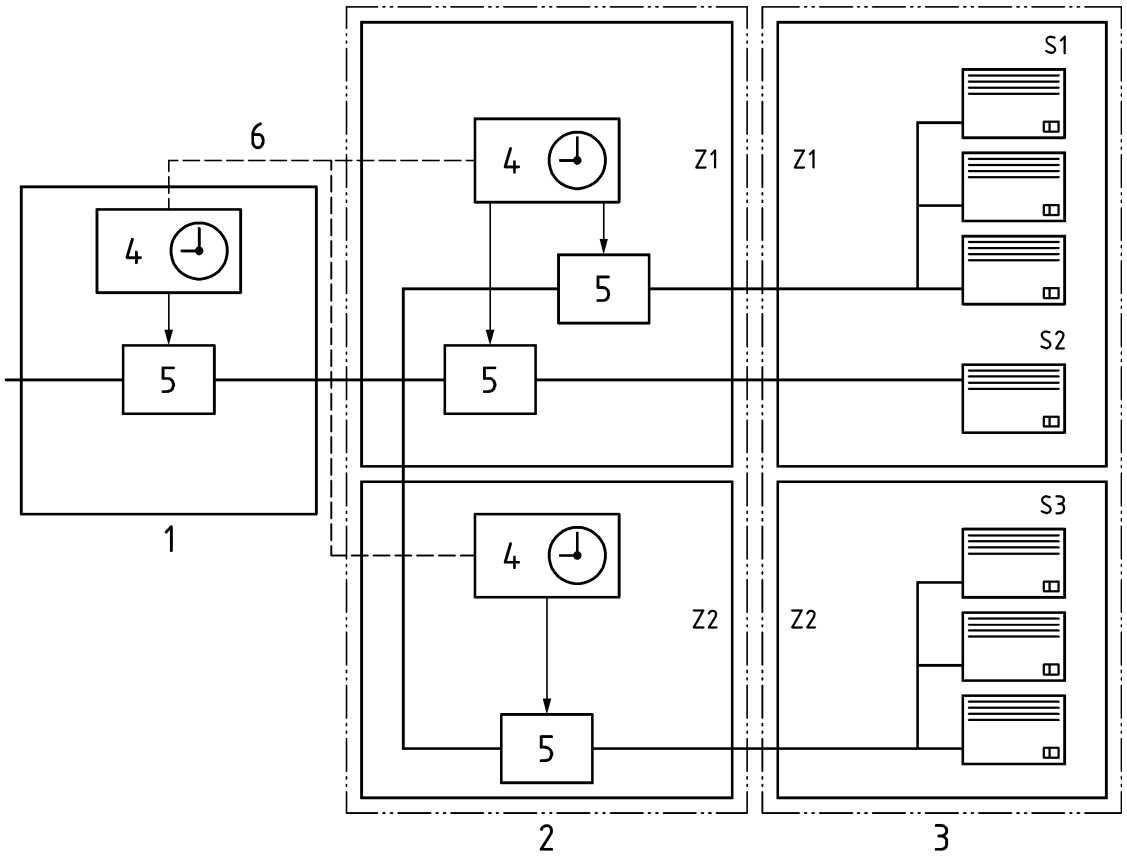
— Emitters are not equipped with efficient electronic individual controllers (conform to prEN 15500-1:2015).

— Users are not encouraged to adapt the set point of their room temperature controller considering their comfort needs related to energy consumption.

— Heated room or space doesn't permit to measure a representative temperature for individual (closed loop) control, e.g.: entrance, corridor, reception hall, exhibition hall, atrium, Emission control is operated only by the central power control (generation, distribution parts).

Whatever, for avoid energy wasting by unusual use, inattentive settings or defaults of room controllers, the central OTC control limit the available heating power.

EXAMPLE Room temperature able to be reached by OTC controlled available power may be limited to 22 °C, room controller reduce this level, reducing power emitter.



Key

1	generation
2	distribution
3	emission
4	OTC control and OSS
5	power control
6	digital networks
S1, S2, S3	elementary spaces
Z1, Z2	zones

Figure 1 — Example of control parts of a heating system

6 Control heating functions and they impact

6.1 OTC - Outside Temperature Compensated control

Heating power modulation by OTC control (function in standalone devices or BAC system) shall be applied to generation and distribution parts (see Figure 1).

prEN 12098-3:2015 specifies functionalities and tests of OTC devices and functions, including OSS function.

prEN 15232-1:2015 gives many indication for calculate effects of OTC control for distribution.

Table 2 — Impact of OTC flow temperature on distribution heating part

1.3	Control of distribution network hot water temperature (supply or return)	HEAT_DISTR_CTRL
		Similar function can be applied to the control of direct electric heating networks
	0	No automatic control
	1	Outside temperature compensated control: Actions generally lower the mean flow temperature
	2	Demand based control: e.g. based on indoor temperature control variable; Actions generally lower the mean flow temperature

Control of emission is normally done by Individual electronic controllers (see prEN 15500-1:2015).

However:

— OTC control is partly in charge of the room temperature control accuracy, completing individual room controller effect, e.g. in case of emitters not equipped with efficient electronic individual room temperature control (conform to prEN 15500-1:2015) or if users are not encouraged to adapt the set point of their room temperature controller considering comfort needs and related energy consumption (see 5.3.4).

— OTC may be the unique controller of room temperature, in case of impossibility to measure a representative temperature of comfort (see 5.3.4).

6.2 Added functions to OTC control

6.2.1 Auto tuning heating curve parameters

Auto tuning the OTC heating curve with feedback room temperature sensor(s) for continuous or temporary adjustments lead for adaptation to emitters heating curve and improve room temperature accuracy.

6.2.2 Compensation by emitters energy demand transmission

Centralizing temperature settings of emitters allow identifying lack of attention of users to emitters control settings.

This function implies a data communication network.

6.2.3 Other meteorological variables and forecast

OTC control and OSS functions may receive other meteorological compensation variables, e.g. sun shining, wind speed, so that outside temperature and other variables forecast.

6.2.4 OSS - Optimum Start-Stop scheduling

With respect to FSS scheduler, OSS intermittent switch heating for the longest reduced heating (stop heating or frost protection periods, see prEN 12098-1:2015, Figure 2). This function bringing additional energy saving without lack of comfort shall be applied to all heating parts.

OSS function is integrated to OTC control for better use and energy efficient of these two main control functions for heating systems.

The standard prEN 12098-3:2015 specifies functionalities and tests of OSS function.

6.2.5 OSS generation impact

Daily, weekly or yearly switch heat generation control to normal - frost protection or reduced mode, (see Figure 3) according to a program which includes memorized switch times, reproducing periods or periodic cycles, daily, weekly or yearly (prEN 12098-3:2015, Table 4).

Daily or weekly programming may be override by manual or presence detection derogation.

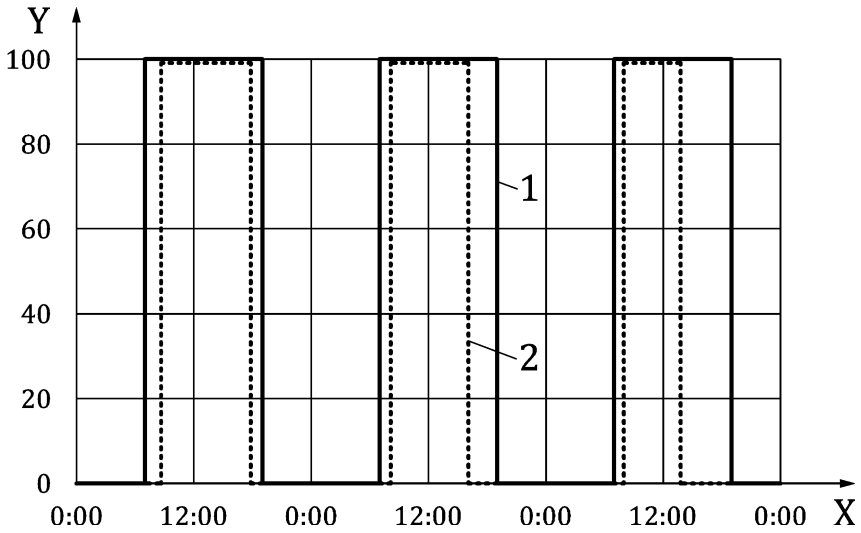
Yearly may be override in relation with actual and forecast climatic conditions (see 6.4.2).

prEN 12098–5:2015 describes tariff compensation function (6.3.5, Figure 12): in case of variable tariff energy price, like electricity, the switch time to a high room temperature mode should be anticipated with respect to the tariff rising time, providing cost energy saving.

6.2.6 OSS distribution impact

Scheduling of each heating zone completes generation scheduling for better adaptation to the zones condition of use. Reduced or frost protection periods are enlarged.

Partitioning distribution may also consist to switch on-off heating distribution parts (see Figure 2).



Key

Y heating power

X time of day

1 generation power

2 distribution power

Figure 2 — Scheduling the distribution power is on the frame of the generation

prEN 15232-1:2015 gives many indication for calculate effects of central intermittent control on emission.

Table 3 — Impact of intermittent control on distribution and emission heating part

1.5	Intermittent control of emission and/or distribution	HEAT_DISTR_CTRL
		One controller can control different rooms / zones having same occupancy patterns
	0	No automatic control
	1	Automatic control with fixed time program: To lower the operation time
	2	Automatic control with optimum start/stop: To lower the operation time
	3	Automatic control with demand evaluation: To lower the operation time

6.2.7 OSS emission impact

Individual electronic RTC of heated spaces or emitters may be equipped with programmable clock (see prEN 15500-1:2015).

The standard prEN 12098-3:2015 specifies functionalities and tests of OTC control and OSS function.

6.3 Added functions to OSS

6.3.1 Auto tuning OSS parameters

Auto tuning the OSS heating curve with feedback room temperature sensor(s) for continuous or temporary adjustments of parameters lead for better adaptation of the switching times. This feature avoids calculation of parameters and improves accuracy of time switching.

6.3.2 Summer-winter switch

In addition to periodic scheduling depending to occupancy during heating period, generation control OTC may start and stop heating power in relation with actual and forecast outside temperature.

7 Integrated functions in control systems and their impact

7.1 Integrated functions

Efficient electrical heating control implies many control functions (see Figure 1).

These functions applied to different parts of heating systems are separately treated as independent in calculation procedures. However, integration of these functions (networked devices or BAC) for concomitant actions improves their energy efficiency. Some functions integrated in BAC bring better performance than individual application of these functions. Additionally, such integration improves satisfaction of comfort needs for occupants and ease of use for technicians.

NOTE 1 “The contribution of building automation and control (BAC) including technical building management (TBM) to the building energy performance is considered in the calculation procedure as the impact of all installed building automation and control functions (BAC functions) on the building energy performance” (extract from prEN 52000–1:2015, 8.1.4).

NOTE 2 Outside temperature compensation (OTC) control and optimum start-stop (OSS) schedulers are essential, basic, functions of BAC dedicated to heating systems, there are improved with auto-adapt capabilities and by some other added functions.

7.2 Central control effect on room temperature control

7.2.1 General

Power control by OTC may be the main control of room temperature (see 5.3.4). Whatever, OTC contributes to efficiency and accuracy of room temperature controllers.

Programming periods are controlled by central scheduling applied to each zone or elementary space, zone or to generators (Figure 1), it take priority to eventual scheduling by room temperature controllers. Stop heating during non-heating periods is controlled by central control system (summer/winter switch function, see 6.4.2).

The energy demand and supply model (prEN 15232–1:2015, Figure 1) show dependence of distribution and generation controls by consumer's needs. This model shall be completed by introduction of constraints (limit scheduling periods, limit temperatures, and take account energy costs...) in distribution and generation parts. Additionally, realities of technical building services need to be aware of defaults at room control parts (lack of attention to emitters control settings, valve leakage, room sensors perturbations).

7.2.2 Heating power control accuracy

Conformal to test procedure of prEN 12098-3:2015, the recorded power shall not deviate by more than 4 % of the maximum or 8 % of power (the higher of these values, see prEN 12098-3:2015, 7.3, Figure 9) from the set point calculated by the controller based on the characteristic heating curve. The test result includes the accuracy of the sensors and test equipment.

7.2.3 Heating curve adaptation

The deviation should be lowered on heating plants by ability to adapt the heating curve curves with a commissioning process during some days of heating period. This adaptation consist to measure the OTC controlled room temperature and to adapt heating curve parameters for reduce deviation. This commissioning process may be manual, but preferably performed by an auto-setting (or self-adapting) OTC function. It consists to measure temporarily or continuously temperature(s) in a single room or many rooms in the controlled building zone and to automatically adapt heating curve parameters.

This adapting procedure is mainly required if the OTC control is destined to control effectively room temperature, i.e. in these cases:

— Emitters are not equipped with efficient electronic individual room temperature control, like controllers covered by prEN 15500-1:2015.

— Heated room or space don’t need or don’t permit to control the ambient temperature by individual room temperature (closed loop) controllers,

— Users are not encouraged to adapt the set point of their room temperature controller considering their comfort needs and related energy consumption.

In any case (except mono-family small house and residential dwelling), OTC is a mandatory controller on heating systems, even with efficient individual room controllers. Whatever, efficiency of room controllers is damaged without power control related with heating load of the building.

7.2.4 Calculating contribution of central control to emission control

prEN 15232-1:2015 gives many indication for calculate effects of central control (i.e. generation and/or distribution power control) on emission. Clauses 1.1 and 1.2 may overlap for some cases.

Table 4 — Impact of central control on emission control for the case 1

1.1	Emission control		HEAT_EMIS_CTRL
		The control system is installed at the heat emitter at room level (radiators, fan-coil unit, indoor unit), for case 1 one system can control several rooms	
	0	No automatic control of the room temperature	
	1	Central automatic control: There is only central automatic control acting either on the distribution or on the generation. This can be achieved for example by an outside temperature controller conforming to prEN 12098–1:2015 or prEN 12098–3:2015	
	2	Individual room control: By thermostatic valves or electronic controller	
	3	Individual room control with communication: Between controllers and BACS (e.g. scheduler, room temperature set point)	
	4	Individual room control with communication and presence control: Between controllers and BACS; Demand / Presence control performed by occupancy	

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[2] prEN 15500-1:2015, *Energy Performance of Buildings - Control for heating, ventilating and air conditioning applications - Part 1: Electronic individual zone control equipment - Modules M3-5, M4-5, M5-5*

[3] prEN 15316-1:2015, *Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 1: General and Energy performance expression, Module M3-1, M3-4, M3-9, M8-1, M8-4*

[4] prEN 15316-3:2015, *Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 3: Space distribution systems (DHW, heating and cooling), Module M3-6, M4-6, M8-6*

[5] CEN/TS 16629, *Energy Performance of Buildings - Detailed Technical Rules for the set of EPB-standards*

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