BRITISH STANDARD

BS EN 15378:2007

Heating systems in buildings — Inspection of boilers and heating systems

ICS 91.140.10

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

BSI Documents Document Sharing Hub British Standards

Full document details: BS EN 15378:2007

National foreword

This British Standard is the UK implementation of EN 15378:2007.

The UK participation in its preparation was entrusted to Technical Committee RHE/24, Central heating installations.

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

BSI, as a member of CEN, is obliged to publish EN 15378 as a British Standard. However, attention is drawn to the fact that during the development of this European Standard, the UK committee expressed concern that it was overly complex to serve the purpose for which it was designed.

Inspection class tables for use in the UK are given in the National Annex.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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 30 April 2008

© BSI 2008

ISBN 978 0 580 55968 6

Amendments/corrigenda issued since publication

Date	Comments

Documents
Document Sharing Hub

Full document details: BS EN 15378:2007

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 15378

September 2007

ICS 91.140.10

English Version

Heating systems in buildings - Inspection of boilers and heating systems

Systèmes de chauffage dans les bâtiments - Inspection des chaudières et des systèmes de chauffage

Heizungssysteme in Gebäuden - Inspektion von Kesseln und Heizungssystemen

This European Standard was approved by CEN on 28 July 2007.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

© 2007 CEN All rights of exploitation in any form and by any means reserved worldwide for CEN national Members.

Ref. No. EN 15378:2007: E

Documents
Document Sharing Hub

Full document details: BS EN 15378:2007

Contents

Page

Foreword 5
Introduction 6
1 Scope 8
2 Normative references 8
3 Terms and definitions, symbols and units 8
3.1 Terms and definitions 8
3.2 Symbols and units 10
4 Principle of the method 12
4.1 Boiler regular inspection 12
4.2 Heating system one-off inspection 12
4.3 Inspection classes 13
4.4 Advice 14
4.5 Inspection report 14
5 Boiler inspection procedure 14
5.1 Boiler inspection class identification 14
5.2 Boiler identification 14
5.3 Document collection 15
5.4 Boiler visual inspection 15
5.5 Boiler maintenance status 15
5.6 Boiler functionality check 15
5.7 Boiler controls, sensors and indicators 15
5.8 Meter readings 15
5.9 Boiler performance evaluation 16
5.10 Boiler inspection report and advice 16
6 Heating system inspection procedure 17
6.1 Heating system inspection class identification 17
6.2 Heating system inspection preparation 18
6.3 Heating system identification 18
6.4 Heating system functionality check 18
6.5 Heating system maintenance status 18
6.6 Heating system controls, sensors and indicators 19
6.7 Energyware consumption 19
6.8 Space heating emission sub-system 19
6.9 Space heating emission control sub-system 20
6.10 Space heating distribution sub-system 20
6.11 Generation sub-system 21
6.12 Generation sub-system sizing 22
6.13 Efficiency of space heating sub-systems 22
6.14 Domestic hot water systems 23
6.15 Inspection report and advice for space heating system and domestic hot water system 23
Annex A (informative) Default inspection class tables 25
A.1 Legend for default inspection class tables 25
A.2 Boiler inspection 25
A.3 Heating system inspection 28
A.4 Obligatory references if applying this annex 28
Annex B (informative) Examples of national inspection class tables 36
B.1 Definition of classes 36
B.2 Boiler inspection 36

AVA Documents
Document Sharing Hub

Full document details: BS EN 15378:2007

Annex C (informative) Flue gas analysis and boiler basic settings check 38
C.1 Measuring procedure 38
C.2 Maintenance data 42
C.3 Reference values for flue gas analysis 42
C.4 Advice on boiler basic setting 42
C.5 Obligatory references if applying this annex 43

Annex D (informative) Sample boiler inspection report 44

Annex E (informative) List of possible improvement actions 46
E.1 Introduction 46
E.2 Boiler 46
E.3 Heating system generation 46
E.4 Space heating distribution system 47
E.5 Space heating emission system 47
E.6 Heating system control 47
E.7 Domestic hot water 48
E.8 Other 48

Annex F (informative) Evaluation of energyware consumption for space heating system and domestic hot water system 50
F.1 General 50
F.2 Energyware measurement methodologies 50
F.3 Measurement period 52
F.4 Usage separation 53
F.5 Climatic data and domestic hot water production 54
F.6 Reference values 54
F.7 Advice criteria on energyware consumption 55
F.8 Obligatory references if applying this annex 56

Annex G (informative) Stratification in high ceiling rooms 57

Annex H (informative) Space heating emission control sub-system 58
H.1 Identification of the heat emission control level 58
H.2 Indoor temperature check 58
H.3 Advice 59

Annex I (informative) Space heating distribution sub-system 60
I.1 Flow rate 60
I.2 Type and setting of circulation pumps 60
I.3 Distribution circuit typology 60
I.4 Compatibility of distribution circuits with boiler typology 60
I.5 Insulation 60

Annex J (informative) Domestic hot water system 61
J.1 Recirculation losses 61

Annex K (informative) Sample inspection report for heating system 62

Annex L (informative) Boiler settings verification 68

Annex M (informative) Boiler combustion power 69
M.1 Measurement methodologies 69
M.2 Maintenance data 71
M.3 Advice criteria on combustion power 71
M.4 Obligatory references if applying this annex 72

Annex N (informative) Boiler seasonal efficiency 73
N.1 Measurement and estimation methodologies 73
N.2 Reference values 74
N.3 Advice 75
N.4 Boiler β_{cmb} (average load) determination 75
N.5 Estimation of loss factors 76
N.6 Obligatory references if applying this annex 79

Annex O (informative) Boiler or generation sub-system sizing 80

Documents
Document Sharing Hub

Full document details: BS EN 15378:2007

O.1 Methodologies....80
O.2 Reference value....81
O.3 Obligatory references if applying this annex....82
Annex P (informative) Examples of national data....83
Bibliography....86

Documents
Document Sharing Hub
Full document details: BS EN 15378:2007

Foreword

This document (EN 15378:2007) has been prepared by Technical Committee CEN/TC 228 “Heating systems in buildings”, the secretariat of which is held by DS.

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 2008, and conflicting national standards shall be withdrawn at the latest by March 2008.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association (Mandate M/343), and supports essential requirements of EU Directive 2002/91/EC on the energy performance of buildings (EPBD). It forms part of a series of standards aimed at European harmonisation of the methodology for calculation of the energy performance of buildings. An overview of the whole set of standards is given in prCEN/TR 15615.

The subjects covered by CEN/TC 228 are the following:

— design of heating systems (water based, electrical etc.);

— installation of heating systems;

— commissioning of heating systems;

— instructions for operation, maintenance and use of heating systems;

— methods for calculation of the design heat loss and heat loads;

— methods for calculation of the energy performance of heating systems.

Heating systems also include the effect of attached systems such as hot water production systems.

All these standards are systems standards, i.e. they are based on requirements addressed to the system as a whole and not dealing with requirements to the products within the system.

Where possible, reference is made to other European or International Standards a.o. product standards. However, use of products complying with relevant product standards is no guarantee of compliance with the system requirements.

The requirements are mainly expressed as functional requirements, i.e. requirements dealing with the function of the system and not specifying shape, material, dimensions or the like.

The guidelines describe ways to meet the requirements, but other ways to fulfil the functional requirements might be used if fulfilment can be proved.

Heating systems differ among the member countries due to climate, traditions and national regulations. In some cases requirements are given as classes so national or individual needs may be accommodated.

In cases where the standards contradict with national regulations, the latter should be followed.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

AVA Documents
Document Sharing Hub

Full document details: BS EN 15378:2007

Introduction

This European Standard specifies procedures and optional measurement methods to be used for the inspection and assessment of energy performance of boilers and heating systems, in order to provide advice to users on the replacement of boilers, other modifications to the heating system and on alternative solutions as required by article 8 of Council Directive 2002/91/EC.

This European Standard includes, either in the normative text or in the informative annexes:

— inspection procedures;

— measurement procedures;

— calculation equations;

— sample reports;

— advice criteria.

Procedures and methodologies defined in this European Standard are not intended to provide a full energy audit of the heating system. They are intended to:

— support identification of areas of possible improvements;

— define criteria to produce reliable advice on possible improvements of the energy performance of boilers and heating systems through replacement of components or other measures.

Any replacement of appliances or modification of the heating system following advice should be designed according to appropriate methodologies. This may require additional input and investigation for detailed design and final check of economical effectiveness.

Clauses 5 and 6 separately describe basic inspection procedures related to:

— regular inspection of boilers;

— one-off inspection of the entire heating system.

This European Standard introduces inspection classes by which different levels of inspection accuracy and detailed inspection requirements can be determined, because:

— the same inspection procedure and level of details cannot reasonably be required for any kind and/or any size of boilers/heating systems;

— there are currently significant differences among member states with respect to:

  — heating systems typologies;

  — legal and/or standard requirements;

  — maintenance and inspection practices.

Alternative and/or optional partial inspection procedures and measurement methods for boilers and for other sub-systems of the heating system are described in the relevant annexes.

Documents
Document Sharing Hub

Full document details: BS EN 15378:2007

Inclusion of/omission of/alternatives to individual inspection items, as well as border lines between classes. are specified through tables given in national annexes. If no specific national annex is available, default tables and inspection classes are given in Annex A. Tables in the national annexes may refer either to methodologies given in the annexes to this European Standard or to suitable existing national standards.

This European Standard has been drafted to support inspection required by Council Directive 02/91/CE, that is "*Regular inspection of boilers fired by non-renewable gaseous, liquid or solid fuel"* and "O*ne-off inspection of heating systems with boilers that are more than 15 years old*". This does not exclude the possibility to use this European Standard for other types of generation devices (e.g. warm air heaters, heat pumps, thermal solar, CHP) and for domestic hot water systems, if appropriate additional classes are defined in the national annexes.

AVA Documents
Document Sharing Hub

Full document details: BS EN 15378:2007

1 Scope

This European Standard specifies inspection procedures and optional measurement methods for the assessment of energy performance of existing boilers and heating systems.

Boiler types covered by this European Standard are:

— boilers for heating, domestic hot water or both;

— gas, liquid or solid fuel fired boilers.

Parts of heating systems covered by this European Standard are:

— boilers, including generation control;

— other generation devices;

— domestic hot water production facilities;

— heating distribution network, including associated components and controls;

— heat emitters, including components and controls;

— space heating control system;

— storage and associated components;

— domestic hot water control system.

This standard covers issues related to energy conservation and environmental performance.

2 Normative references

Not applicable.

3 Terms and definitions, symbols and units

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
space heating
process of heat supply for thermal comfort

3.1.2
domestic hot water heating
process of heat supply to raise the temperature of the cold water to the intended delivery temperature

3.1.3
gross calorific value
quantity of heat released by a unit quantity of fuel when it is burned completely with oxygen at a constant pressure equal to 101 320 Pa, and when the products of combustion are returned to ambient temperature

AVA Documents
Document Sharing Hub

Full document details: BS EN 15378:2007

NOTE 1 This quantity includes the latent heat of condensation of any water vapour contained in the fuel and of the water vapour formed by the combustion of any hydrogen contained in the fuel.

NOTE 2 According to ISO 13602-2, the gross calorific value is preferred to the net calorific value.

NOTE 3 The net calorific value does not take into account the latent heat of condensation.

3.1.4
net calorific value
gross calorific value minus latent heat of condensation of the water vapour in the products of combustion at ambient temperature

3.1.5
external temperature
temperature of external air

NOTE 1 For transmission heat transfer calculations, the radiant temperature of the external environment is supposed equal to the external air temperature; long-wave transmission to the sky is calculated separately.

NOTE 2 The measurement of external air temperature is defined in EN ISO 15927-1.

3.1.6
boiler
gas, liquid or solid fuelled appliance designed to provide hot water for space heating. It may (but need not) be designed to provide domestic hot water heating as well

3.1.7
combustion power
product of the fuel flow rate and the net calorific power of the fuel

3.1.8
condensing boiler
boiler designed to make use of the latent heat released by condensation of water vapour in the combustion flue products. The boiler needs to allow the condensate to leave the heat exchanger in liquid form by way of a condensate drain

NOTE Boilers not so designed, or boilers without the means to remove the condensate in liquid form, are termed ‘non-condensing’ boilers.

3.1.9
on/off boiler
boiler without the capability to vary the fuel burning rate while maintaining continuous burner firing. This includes boilers with alternative burning rates set once only at the time of installation, referred to as range rating

3.1.10
multistage boiler
boiler with the capability to vary the fuel burning rate stepwise while maintaining continuous burner firing

3.1.11
modulating boiler
boiler with the capability to vary continuously (from a set minimum to a set maximum) the fuel burning rate while maintaining continuous burner firing

3.1.12
energy carrier
substance or phenomenon that can be used to produce mechanical work or heat, or to operate chemical or physical processes

[ISO 13600:1997]

Documents
Document Sharing Hub
Full document details: BS EN 15378:2007

NOTE The energy content of fuels is given by their gross calorific value.

3.1.13
energyware
tradeable commodity used mainly to produce mechanical work or heat, or to operate chemical or physical processes, and listed in ISO 13600:1997, Annex A

NOTE Energywares form a proper subset of energy carriers. The set of energy carriers is open.

3.1.14
delivered energy
energy content, expressed per energy carrier, supplied to the building through the system boundary, to satisfy the uses taken into account (e.g. heating, cooling, ventilation, domestic hot water, lighting, appliances) or to produce electricity

NOTE 1 For active solar and wind energy systems, the incident solar radiation on solar panels or the kinetic energy of wind is not part of the energy balance of the building. Only the energy delivered by the generation devices and the auxiliary energy needed to supply the energy from the source (e.g. solar panel) to the building are taken into account in the energy balance and hence in the delivered energy.

NOTE 2 Delivered energy can be calculated for defined energy uses or it can be measured.

NOTE 3 It is decided on a national level whether or not renewable energy produced on site constitutes part of delivered energy.

3.1.15
operational rating
energy rating based on measured amounts of delivered and exported energy

NOTE The measured rating is the weighted sum of all energy carriers used by the building, as measured by meters or other means. It is a measure of the in-use performance of the building. This is particularly relevant to certification of actual energy performance.

3.2 Symbols and units

For the purposes of this document, the following symbols and units (Table 1) and indices (Table 2) apply.

Documents
Document Sharing Hub
Full document details: BS EN 15378:2007

Table 1 — Symbols and units

Symbol	Name of quantity	Unit
A	area	m²
c	coefficient	various
c	specific heat capacity	J/kg·K or Wh/kg·K [a]
DD	degree-days	°C·day
E	energy in general, except quantity of heat, mechanical work and auxiliary (electrical) energy	J or Wh [a]
f	factor	-
h	surface coefficient of heat transfer	W/(m²·K)
h	latent heat	J/kg or Wh/kg [a]
H	calorific value	J/mass unit or Wh/mass unit [a b]
k	factor	-
m	mass	kg
P	power in general, including electrical power	W
Q	quantity of heat	J or Wh [a]
t	time, period of time	s or h [a]
V	volume	m³
V'	volume flow	m³/s or m³/h [a]
W	auxiliary (electrical) energy, mechanical work	J or Wh [a]
x	relative humidity	%
X	volume fraction	%
α	loss factor	%
β	load factor	-
Δ	prefix for difference	-
η	efficiency factor	%
θ	Celsius temperature	°C
ξ	absolute humidity	kg/Nm³
ρ	density	kg/m³
Φ	heat flow rate, thermal power	W

[a] If the unit seconds (s) is used for time, the unit for energy shall be J; if the unit hours (h) is used for time, the unit for energy shall be Wh.

[b] Mass unit for fuel may be Stm³, Nm³ or kg.

AVA Documents Document Sharing Hub

Full document details: BS EN 15378:2007

Table 2 — Indices

air	air	floor	near the floor	O2	oxygen
auxh	auxiliary heater	fr	flow to return	off	off
avg	average	gas	gas	on	on
ceil	near the ceiling	ge	generator envelope	P0	stand-by
ch	chimney	gen	generation	pmp	circulation pump
cmb	combustion	gnr	generator	r	return
CO	carbon monoxide	H2O	water vapour	rd	reading
CO2	carbon dioxide	i	net (calorific value)	ref	reference
cond	condensation	i	running index	s	gross (calorific value)
corr	corrected	ini	initial	sat	saturation
del	delivered	int	internal	sens	sensible
des	design	j	running index	st	stoichiometric
dry	dry gases	lf	liquid fuel	str	stratification
e	external	ls	loss	test	in test conditions
el	electrical	m	average	vol	volumetric
f	fuel	meas	measured	w	water
fg	flue gas	mid	at 1,5 m height	x	net or gross
fin	final	min	minimum	θ	temperature

4 Principle of the method

4.1 Boiler regular inspection

Regular boiler inspection procedures and methods are intended to:

— verify if the boiler is set, operated and maintained correctly with regard to energy efficiency;

— estimate actual boiler energy performance;

— when required, support advice on possible boiler energy performance improvements.

NOTE Council Directive 2002/91/CE does not require advice following boiler regular inspection.

4.2 Heating system one-off inspection

One-off heating system inspection procedures and methods are intended to:

— verify if the heating systems is set, equipped, operated and maintained correctly with regard to energy efficiency;

— estimate actual heating system energy performance;

— support advice on possible heating system energy performance improvements.

Inspection procedures and optional measurement methods (if any) are specified separately for each sub-system of the heating system.

Documents
Document Sharing Hub
Full document details: BS EN 15378:2007

4.3 Inspection classes

Boiler and heating system inspection classes shall be specified according to one or more of the following parameters:

— fuel type;

— nominal boiler power input or output;

— boiler type;

— heated space area or volume;

— type of heat distribution;

— type of heat emitters;

— other relevant properties.

Optional inspection items and/or measurement methods are applied according to the inspection class.

NOTE 1 If intermediate inspection results provide evidence of significant possible improvements, the inspector should recommend more accurate inspection as appropriate and effective to support specific advice.

For each inspection class, required and/or alternative inspection items and/or procedures shall be specified through tables where:

— each row corresponds to a specific inspection item and/or partial inspection procedure and/or methodology;

— each column corresponds to an inspection class;

— each cell specifies whether or not the specific inspection item and/or partial inspection procedure and/or methodology (row) is required for the inspection class (column), according to Table A.1.

Two basic types of tables may be used to specify details of inspection classes:

— list of information required about the inspected boiler / heating system / sub-system of the heating system (typically a choice between alternatives, e.g. YES/NO) are specified through tables like Table A.2;

— list of properties to be estimated or measured and required alternative procedures or methods to be applied (e.g. efficiencies may be obtained from measurements, maintenance records or estimation through tables) are specified through tables like Table A.3.

For each inspection item and/or optional procedure, the table shall state whether or not the inspection item is required to comply with the inspection class. If the inspection item is required to comply with the inspection class, the table shall further state:

— whether or not the specific procedure is suitable to comply with the inspection class (there might be more than one possibility with preference, if any, stated in notes to the table);

— whether or not the specific procedure is sufficient to comply with the inspection class;

— whether the specific procedure is more than required to comply with the inspection class;

NOTE 2 This option provides the information that the specific inspection item or optional procedure is more detailed than what is required to comply with the inspection class.

Documents
Document Sharing Hub
Full document details: BS EN 15378:2007

— the source of the specific procedure referred (reference to clause or annex of this European Standard or other relevant document).

If no such table is available in the relevant national annex, default inspection class tables are given in Annex A.

Inspection class tables in a national annex need not show items which are optional for all classes (i.e. items which are not required for any of the national inspection classes). Inspection class tables in a national annex should include only such items, which are required by at least one (national) inspection class.

NOTE 3 A national inspection class table may be shorter than the corresponding default table in informative Annex A.

An example of such national inspection class tables is given in informative Annex B.

4.4 Advice

General criteria for advice following boiler inspection, when required, are given in 5.10.2.

General criteria for advice following heating system inspection are given in 6.15.2.

4.5 Inspection report

Following inspection of the boiler or heating system, results shall be recorded in an inspection report for transfer to the responsible for operation and maintenance of the boiler or heating system. The report shall include:

— identification of the boiler or heating system;

— identification of the required inspection class;

— description of any activity (e.g. adjusting, setting) which was performed during the inspection;

— data recorded and/or measured as required by the inspection class;

— source of recorded data;

— reference and benchmark values, as required by the inspection class;

— advice, when required.

Benchmark and/or reference values shall be indicated near corresponding actual values.

Inspection report, results and documentation shall be archived and kept available as a reference for follow-up.

5 Boiler inspection procedure

5.1 Boiler inspection class identification

The inspection class of the boiler is determined according to the relevant national annex, or, if no national annex is available, default Annex A.

5.2 Boiler identification

The information on user, building (i.e. address, location) and boiler identification is recorded as specified in the appropriate table of the national annex, or, if no national annex is available, in default Table A.2.

State in the report the source of information recorded.

Documents
Document Sharing Hub

Full document details: BS EN 15378:2007

5.3 Document collection

Collect and identify available relevant documents to support inspection according to the inspection class.

EXAMPLES Heating system or boiler instructions, previous inspection reports, maintenance reports, fuel bills, commissioning data, system design documentation, schematic diagrams, log-books.

5.4 Boiler visual inspection

Check for visual evidence of:

— fuel, flue gas or heating medium leaks in the boiler installation room;

— boiler insulation damage;

— soot or other dirt in the burner, combustion chamber and heat exchanger.

State in the report any such evidence.

5.5 Boiler maintenance status

Determine whether the boiler is regularly and correctly maintained by qualified and/or authorised personnel.

Reference shall be made to:

— system designer's instructions;

— boiler manufacturer's instructions;

— any legal or statutory requirements.

NOTE Consideration may be given to heat medium quality.

5.6 Boiler functionality check

Check whether the boiler is capable of providing the desired and designed services.

State in the report any malfunctioning.

Record in the report any relevant feed-back from users and operation and maintenance personnel, as available and appropriate.

5.7 Boiler controls, sensors and indicators

Identify and provide advice, as appropriate, on:

— location (either external, internal and other),

— function,

— settings

of boiler controls, sensors and indicators, which are relevant for energy performance.

5.8 Meter readings

Read available meters and counters, such as:

Documents
Document Sharing Hub
Full document details: BS EN 15378:2007

— fuel meter, noting if the same meter takes into account other usages,

— fuel level in the storage (if any),

— operation hour counters,

— any auxiliary energy meters,

— feed water meter,

— domestic hot water meter,

— cycle counters,

— heat meter and

— record values in the report.

If there is no fuel meter, advice should be given on the installation of simple devices (i.e. hour counters) to support reliable tracking of fuel consumption.

5.9 Boiler performance evaluation

Inspection of correct settings and actual performance of the boiler may include:

— boiler combustion power check;

— energyware consumption check;

— boiler basic settings and combustion efficiency check;

— other boiler losses check (e.g. radiation losses, total stand-by losses);

— boiler seasonal efficiency check;

— controls settings check;

— boiler sizing check.

The items which are to be inspected and the required methodologies according to the inspection class are specified in the appropriate table of the national annex, or, if no national annex is available, in default Table A.3.

Examples of methodologies related to flue gas analysis and boiler basic settings inspection are given in informative Annex C.

5.10 Boiler inspection report and advice

5.10.1 Inspection report

Following inspection of the boiler, an inspection report with optional related advice shall be provided.

An example of a boiler inspection report is given in informative Annex D.

5.10.2 Boiler performance advice

Any advice on boiler performance shall be drafted according to the following general requirements and any specific advice criteria related to inspection items required by the inspection class.

Documents
Document Sharing Hub
Full document details: BS EN 15378:2007

Advice shall be based on:

— inspection results;

— availability of better components and appliances, including controls;

— comparison between recorded actual properties, status and values and corresponding references (benchmarks).

Consideration shall be given to the following reference values, as appropriate and available:

— applicable legal requirements;

— manufacturer's instructions and data;

— average values for similar boilers, given as national tables based on boiler typology;

NOTE 1 This reference value is meant to support identification of possible problems of the specific boiler under inspection.

— design specifications;

— best achievable (target) values using cost effective available technologies, given as national tables based on boiler typology.

NOTE 2 This reference value is meant to support estimation of possible achievable energy and/or economic returns through improvements.

Advice shall take care of cost effectiveness and feasibility of recommended actions.

Advice shall include/suggest both possible immediate actions (replacements) and other actions to be taken in the event of major renovation or replacement due to aging or breakdown of components.

Advice shall take into account interactions between suggested actions.

Advice shall indicate available options and suggestions for cost effective use of renewable energies.

Advice shall include a recommendation that regular maintenance by competent personnel is essential to keep a stable good energy performance of the boiler.

Informative Annex E provides a list of possible improvement actions to be recommended. The list is neither exhaustive nor compulsory.

NOTE 3 Additional advice criteria on specific topics are included in relevant clauses and related annexes.

6 Heating system inspection procedure

6.1 Heating system inspection class identification

Before the inspection, the responsible for operation and maintenance of the heating system shall be identified. Suitable information has to be available to determine the heating system inspection class according to relevant national annex or default Annex A.

NOTE Heating system inspection class may depend on e.g. heated surface, generation system power, date of erection, building type (residential/non residential), and other criteria.

Documents
Document Sharing Hub
Full document details: BS EN 15378:2007

6.2 Heating system inspection preparation

Identify and ask for preparation, collection and availability for inspection of relevant documents and basic information, as appropriate according to the inspection class.

EXAMPLE Building plans, heated volume, actual use of the building, system design, schematic diagrams, components or heating system instructions, operation or maintenance log-books, previous inspection reports, maintenance reports, fuel bills, commissioning data, energy calculation, energy declaration.

6.3 Heating system identification

The information and documentation on owner and heating system identification is collected and recoded as specified in the appropriate table of the national annex, or, if no national annex is available, in default Table A.4.

Information and documentation shall at least allow identification of:

— functional diagram of the heating system;

— location of main components of the heating system;

— intended and actual use of the building;

— intended and actual operation of the heating system (e.g. heated volume, time schedules);

— type of control sub-system and settings;

— any attached systems and related requirements.

If a satisfactory documentation is not available, a minimum set of information on the heating system shall be assembled by direct inspection.

Correspondence between documentation and actual installed equipment shall be checked. Any differences shall be stated in the report and the documentation shall be corrected.

6.4 Heating system functionality check

Check whether the heating system is capable of providing the desired and designed services (i.e. space heating, domestic hot water production and attached systems requirements).

State in the report any malfunctioning.

Record in the report any relevant feed-back from users and operation and maintenance personnel, as available and appropriate.

6.5 Heating system maintenance status

Determine whether the heating system is regularly maintained by qualified and/or authorised personnel.

Reference shall be made to:

— system designer’s instructions;

— appliances and component manufacturers’ instructions;

— any legal or statutory requirements.

NOTE Consideration may be given to heat medium quality.

Documents
Document Sharing Hub
Full document details: BS EN 15378:2007

6.6 Heating system controls, sensors and indicators

Identify and provide advice, as appropriate, on:

— location (either external, internal and other),

— function,

— settings

of heating system controls, sensors and indicators, which are relevant for energy performance.

Check location of such sensors for possible negative interactions with environment, furniture, possible direct insulation, heat emitters and heat distribution sub-system.

6.7 Energyware consumption

6.7.1 Measurement

Energyware consumption (operational rating) is assessed according to relevant national standards or default Annex F. Fuel and auxiliary energy shall be determined separately.

6.7.2 Reference values

Energyware consumption shall be compared to the following reference (benchmark) values:

— expected energyware consumption of the heating system, which is:

  — if available, energy declaration values;

  — if available, design delivered energy;

  — otherwise, calculated consumption based on gross volume (or floor area) and specific values specified in national tables. An example of the structure of such tables is given in Table F.2;

— target values, calculated consumption based on gross volume (or floor area) and specific values specified in national tables. An example of the structure of such tables is given in Table F.3.

6.7.3 Advice criteria on energyware consumption

Advice shall contain a comparison between actual energyware consumption and reference values.

If actual energyware consumption significantly deviates from expected reference values, possible causes shall be investigated and further energy auditing be recommended. Possible causes for significant deviations are suggested in F.7.

6.8 Space heating emission sub-system

The information on the space heating emission sub-system is collected and recorded as specified in the relevant national annex, or, if no national annex is available, in default Table A.5.

Identify and provide advice, as appropriate, on:

— type of heat emitters and suitability for the type of room and their intended use;

EXAMPLE 1 For high ceiling rooms and stratification, see Annex G.

Documents
Document Sharing Hub
Full document details: BS EN 15378:2007

— sizing of heat emitters;

— positioning of heat emitters;

— insulation and obstructions around heat emitters;

— auxiliary energy requirements;

— maintenance requirements, if applicable, for specific types of heat emitters;

— type of hydraulic connection of heat emitters to distribution;

— type of valves / controls for room-specific supply limitation (hydraulic balancing).

EXAMPLE 2 Fan coils require periodic filter cleaning.

6.9 Space heating emission control sub-system

The information on the space heating emission control sub-system is collected and recorded as specified in the relevant national annex, or, if no national annex is available, in default Table A.6.

Identify and provide advice, as appropriate, on:

— type of space heating emission control sub-system in relation to its ability to sense indoor temperature and control heat emission according to heat losses and gains;

— method of zone temperature settings and method of control according to occupancy;

— type, location (either external, internal and other), accuracy and maintenance of controls, sensors and indicators;

— settings of controls, including outdoor reset function for supply water temperature.

EXAMPLE Base settings of floor heating, hydraulic balancing.

Information on inspection methodologies and advice criteria are given in informative Annex H.

6.10 Space heating distribution sub-system

The information on the space heating distribution sub-system is collected and recorded as specified in the relevant national annex, or, if no national annex is available, default Table A.7.

Identify and provide advice, as appropriate, on:

— structure and zoning of the heat distribution network compared to building use;

— type of heat distribution with respect to heating medium, single or multiple circuits, direct or indirect connection to heat generator;

— type of limitation of differential pressure in the heat distribution network during normal operation;

— type of hydraulic balancing of the heat distribution circuits;

— temperatures of the heat distribution circuits;

— sizing and settings of circulation pumps;

— type and settings of any flow rate control;

Documents
Document Sharing Hub
Full document details: BS EN 15378:2007

— operation and control of individual circuits, including flow temperature control, timing and settings;

— compatibility of heat distribution circuits with boiler typology and requirements;

— thermal insulation of piping and components;

— open vented / closed vented, including wrong circulation in open vented systems;

— losses of heat medium;

— heat medium quality.

Information on inspection methodologies and advice criteria are given in informative Annex I.

6.11 Generation sub-system

6.11.1 Generation sub-system identification

The information on generation sub-system identification is collected and recorded as specified in the appropriate table of the national annex, or, if no national annex is available, in default Table A.8.

6.11.2 Boiler(s) inspection

For each boiler, the information on inspection is collected and recorded as specified in the appropriate table of the national annex, or, if no national annex is available, in default Table A.9.

For each boiler, inspection of correct settings and actual performance of the boiler may include:

— boiler combustion power check;

— boiler basic settings and combustion efficiency check;

— other boiler losses check (e.g. radiation losses, total stand-by losses);

— boiler seasonal efficiency check;

— controls settings check, including running time and effect on cycling (hysteresis).

The items which are to be inspected and the required methodologies according to the inspection class are specified in the appropriate table of the national annex, or, if no national annex is available, in default Table A.10.

6.11.3 Storage sub-system for heating system

Identify and provide advice, as appropriate, on sizing, thermal insulation and temperature control of any hot water storage vessel.

6.11.4 Heat exchangers for heating system

Identify and provide advice, as appropriate, on sizing, performance (including fouling), thermal insulation and temperature control of any heat exchanger.

6.11.5 Other generation sub-systems

Identify and provide advice, as appropriate, on sizing, performance, thermal insulation, temperature control, and settings of any other generation sub-systems connected to the heating system.

Documents
Document Sharing Hub
Full document details: BS EN 15378:2007

6.11.6 Generation sub-system control inspection

Identify and provide advice on the flow temperature control strategy.

If there are more than one heat generator (including non-combustion generators), identify and provide advice on:

— method of total heating system load dispatching among available boilers and other heat generators, including e.g. priorities, load splitting and optimisation strategy, running time, proper hydraulic connection;

— method of hydraulic balance of generators;

— method of hydraulic isolation of stand-by generators from the heating system;

— settings of the generation control devices (if any).

6.12 Generation sub-system sizing

6.12.1 General

Installed power of the generation sub-system shall be compared to the actual heat power requirement of the heating system and any attached systems, such as domestic hot water production system.

Boiler (or generation sub-system) sizing is determined using the method specified in the appropriate table of the national annex, or, if no national annex is available, in default Table A.11.

6.12.2 Advice

Any statement on the extent to which over-sizing of the boiler affects system efficiency should be qualified by reference to:

— boiler type, taking into account thermal capacity, stand-by losses, effect of actual power on efficiency;

— type of burner control (fixed, stepped or modulating), taking into account the modulating range (mainly minimum on power);

— controls settings and mode (e.g. interlock with boiler firing, night shut-down of burner, operation timing according to external temperature);

— generation sub-system controls and hydraulic circuits;

EXAMPLE 1 Are stand-by units hydraulically shut-off when off?

— any specific reason for over-sizing and/or stand-by operation.

EXAMPLE 2 Instantaneous domestic hot water production or high reliability requirements (spare stand-by units).

6.13 Efficiency of space heating sub-systems

The inspection may include an assessment of the efficiency (or any equivalent parameter, e.g. expenditure factors, relative losses) of the sub-systems of the space heating system.

NOTE Performance of the generation sub-system is already covered in 6.11.2.

The items which are to be inspected and the required methodologies according to the inspection class are specified in the appropriate table of the national annex, or, if no national annex is available, in default Table A.12.

Documents
Document Sharing Hub
Full document details: BS EN 15378:2007

6.14 Domestic hot water systems

The information on the domestic hot water system is collected and recorded as specified in the relevant national annex, or, if no national annex is available, in default Table A.13.

Identify and provide advice, as appropriate, on:

— structure of the domestic hot water system;

— actual domestic hot water consumption pattern compared to design;

— thermal insulation of domestic hot water piping;

— operation timing, settings and control of circulation system;

— type and size of heat generator used for domestic hot water production;

— sizing, thermal insulation and temperature control of any storage vessel;

— sizing, performance (including fouling and scaling), thermal insulation and temperature control of heat exchanger;

— auxiliary energy requirements (e.g. circulation pump).

Information on inspection methodologies and advice criteria are given in informative Annex J.

6.15 Inspection report and advice for space heating system and domestic hot water system

6.15.1 Heating system inspection report

Following inspection of the heating system and domestic hot water system, an inspection report with related advice shall be provided as specified in 4.5 for transfer to the responsible for the heating system.

An example of an inspection report for a heating system is given in informative Annex K.

6.15.2 Heating system advice

Heating system advice shall be drafted according to the following general requirements and any specific criteria related to inspection items required by the inspection class.

Advice shall be based on:

— results of the inspection, including:

  — original design;

  — changes in the use, structure and/or properties of the building and heating system;

— availability of better components and appliances, including controls;

— comparison between recorded actual properties, status and values and corresponding references (benchmarks).

Consideration shall be given to the following reference values, as appropriate and available:

— applicable legal requirements;

Documents
Document Sharing Hub
Full document details: BS EN 15378:2007

— average values for similar boilers or heating systems, given as national tables based on boiler or heating system typology;

NOTE 1 This reference value is meant to support identification of possible problems of the specific boiler or heating system under inspection.

— declared values from design specification or energy declaration, as available;

— best achievable (target) values using cost effective available technologies, given as national tables based on boiler, heating system or building typology.

NOTE 2 This reference value is meant to support estimation of possible achievable energy and/or economic returns through improvements.

Advice shall take care of cost effectiveness and feasibility of recommended actions.

Advice shall include/suggest both possible immediate actions (replacements) and other actions to be taken in the event of major renovation or replacement due to aging or breakdown of components.

Advice shall take into account interactions between suggested actions.

Advice shall indicate available options and suggestions for cost effective use of renewable energies.

Advice shall include recommendation that regular maintenance by competent personnel is essential to keep a stable good energy performance of the boiler and heating system.

Informative Annex E provides a list of possible improvement actions to be recommended. The list is neither exhaustive nor compulsory.

NOTE 3 Additional advice criteria on specific topics are included in relevant clauses and related annexes.

Documents
Document Sharing Hub
Full document details: BS EN 15378:2007

Annex A
(informative)

Default inspection class tables

A.1 Legend for default inspection class tables

The terms used in the cells of the inspection class tables of Annex A are explained in Table A.1.

Table A.1 — Legend for default inspection class tables

Optional	inspection item is not required to comply with the inspection class
Required	inspection item is required to comply with the inspection class
Suitable	inspection item is required and the specific procedure is suitable to comply with the inspection class (there might be more than one possibility with preference, if any, stated in notes to the table)
NO	inspection item is required but the specific procedure is not sufficient to comply with the inspection class
Excellent	inspection item is required and the specific procedure is more than required to comply with the inspection class
NOTE The last option ("Excellent") provides the information that the specific inspection item or optional procedure is more detailed than what is required to comply with the inspection class.	

A.2 Boiler inspection

Default boiler inspection classes are based on:

— fuel type;

— maximum boiler rated power input.

Documents
Document Sharing Hub
Full document details: BS EN 15378:2007

Table A.2 — User, building and boiler, identification information (for use in 5.2)

Fuel type	Gaseous and liquid		Solid	
Power	< 100 kW	> 100 kW	< 100 kW	> 100 kW
Owner, user or administrator name	Required	Required	Required	Required
Address	Required	Required	Required	Required
Fuel	Required	Required	Required	Required
Fuel feed typology [a]	Optional	Optional	Required	Required
Boiler duty (heating / domestic hot water / both)	Required	Required	Required	Required
Boiler manufacturer	Required	Required	Required	Required
Boiler model	Required	Required	Required	Required
Boiler serial number	Optional	Required	Optional	Required
Boiler manufacture date or year	Required	Required	Required	Required
Maximum power rated input [b]	Required	Required	Required	Required
Maximum power rated output [c]	Optional	Optional	Optional	Optional
Minimum power rated input	Required	Required	Required	Required
Minimum power rated output	Optional	Optional	Optional	Optional
Boiler classification [d]	Optional	Optional	Optional	Optional
Condensing/non condensing	Required	Required	Required	Required
CE labelling efficiency stars (if available)	Required	Required	Required	Required
Burner manufacturer [e]	Required	Required	Required	Required
Burner model [e]	Required	Required	Required	Required
Power modulation type [f]	Required	Required	Required	Required
Heating medium quality reports	Optional	Required	Optional	Required

[a] Automatic or manual.

[b] Combustion power. Specify if referred to net or gross calorific value.

[c] Net power to heating system.

[d] Bxx or Cyyy : typology of air flue gas circuit, fan position etc.

[e] If a separate burner is fit to the boiler.

[f] Fixed, stepped (multistage), continuous modulation.

Documents
Document Sharing Hub
Full document details: BS EN 15378:2007

Table A.3 — Procedures and methodologies required for boiler inspection (for use in 5.9)

Fuel type			**Gaseous and liquid**		**Solid**	
Power		**(ref. annex)**	**< 100 kW**	**> 100 kW**	**< 100 kW**	**> 100 kW**
Combustion power	Measurement	M.1	Excellent	Suitable	Excellent	Suitable
	Maintenance data	M.2	Suitable	NO	Suitable	NO
Evaluation of energyware consumption		F	Optional	Suitable	Optional	Suitable
Boiler basic settings and combustion efficiency	Measurement	C.1	Suitable	Suitable	Suitable	Suitable
	Maintenance data	C.2	Suitable	NO	Suitable	NO
Losses through the envelope (radiation losses)	Surface temperature	N.5.1.1	Optional	Optional	Optional	Optional
	Tabulated values	N.5.1.2	Optional	Optional	Optional	Optional
Losses through the chimney with burner off	Tabulated values	N.5.2	Optional	Optional	Optional	Optional
Total stand-by losses test	Tabulated values	N.5.3.1	Optional	Optional	Optional	Optional
	Stand-by operation	N.5.3.2	Optional	Optional	Optional	Optional
	Auxiliary heater	N.5.3.3	Optional	Optional	Optional	Optional
Boiler seasonal efficiency [a]	Database reference	N.1.1	Optional	Optional	Optional	Optional
	Default tables	N.1.2	Optional	Optional	Optional	Optional
	Boiler directive data	N.1.3	Optional	Optional	Optional	Optional
	Boiler cycling method	N.1.4	Optional	Optional	Optional	Optional
	Total stand-by losses	N.1.5	Optional	Optional	Optional	Optional
Controls settings verification		L	Suitable	Suitable	Suitable	Suitable
Boiler sizing check		O.1.3	Optional	Optional	Optional	Optional

[a] Specify required methodologies for necessary individual losses factors in the rows before.

AVA Documents
Document Sharing Hub
Full document details: BS EN 15378:2007

A.3 Heating system inspection

Default heating system inspection classes are based on:

— heated surface;

— type of building;

— heat generation power.

A.4 Obligatory references if applying this annex

EN 15316-2-1, *Heating systems in buildings — Method for calculation of system energy requirements and system efficiencies — Part 2-1: Space heating emission systems*

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

Documents
Document Sharing Hub

Full document details: BS EN 15378:2007