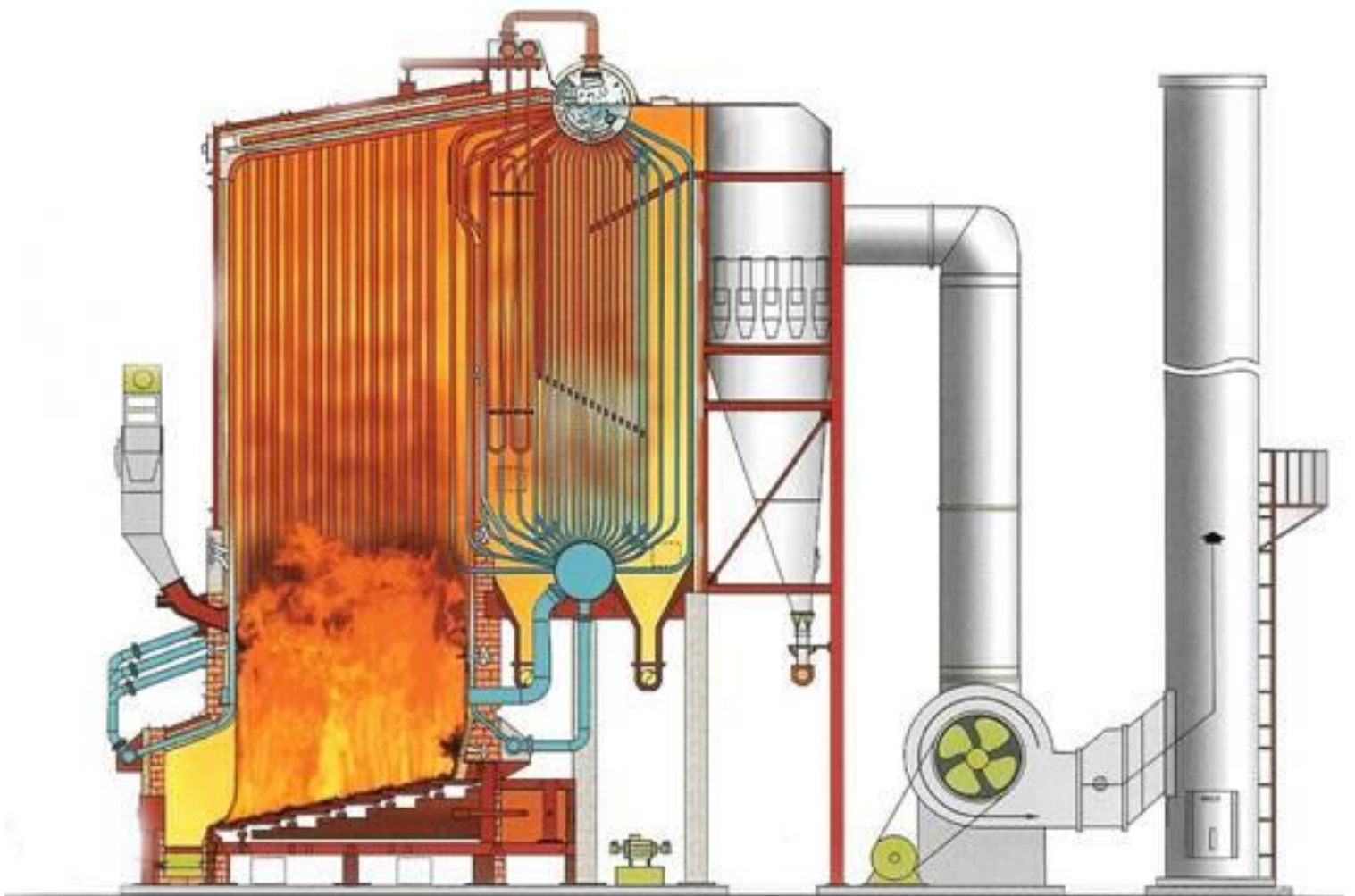


Guidance on Safe Operation of Water Tube Boilers

Ref: BG11



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Foreword

This document, Guidance on the Safe Operation of Water Tube Boilers (Ref: BG11) has been developed and written by the Combustion Engineering Association (CEA) in consultation with other stakeholders within the boiler industry to help designers, managers and operators of new and existing water tube boiler systems make health and safety and environmental improvements in the industry.

This publication should not be regarded as an authoritative interpretation of the law, nor a mandatory legal requirement. However, if the guidance provided is followed, it will normally be regarded as sufficient to comply with the relevant health and safety duties.

The CEA is an educational charity which promotes the science of combustion engineering in commercial and industrial sectors. The CEA is concerned with industry good practice and the safe and efficient operation of combustion related plant and equipment.

In memory of our friend and colleague Malcolm Semple

Acknowledgments

The CEA acknowledges the contribution of several individuals, Member companies and partner organisations in the compiling of the information herein, including a number of BOAS Cat 3 Trainers and Assessors, and:

- Allianz UK
- British Engineering Services
- Deep Water Blue Ltd
- Delta-Mobrey
- Emerson Process Management
- Energy & Environmental Solutions
- Thermo Technology Ltd
- TJB Risk Engineering & Consultancy Ltd.
- Uniper Technologies Limited

Front cover picture courtesy of Thermo Technology Ltd.

In this document the following words convey specific meaning:

Should: Compliance with this clause is not essential where supported by risk assessment and/or design calculation.

Shall: Compliance with this clause is required in order to claim compliance with this document.

Must: Compliance with this clause is a legal requirement within the United Kingdom.

Legislation may not be the same for other jurisdictions, but the 'best practice' principles remain valid throughout the industry.

Unless otherwise stated, all pressures refer to gauge pressure.

TABLE OF CONTENTS:	PAGE
1 INTRODUCTION	6
2 SCOPE	7
3 DESIGN AND INSTALLATION	9
3.1 Design Considerations – General Principles	11
3.2 Water Tube Boiler Construction	12
3.3 Boiler Ancillary Items	14
3.4 Control Systems and Instruments	21
3.5 Water-Side Protection of Idle Boilers	42
3.6 Chimneys and Flues	43
3.7 Communications and Alarms	44
3.8 Gas Detection, Fire Detection and Automatic Fuel Shut-Off Systems	44
3.9 Back-Up Power Supplies for Critical Items	45
4 BOILER OPERATION	47
4.1 Boiler Instructions	47
4.2 Recording of Controls, Limiters and Water Quality Tests	50
4.3 Water Level Controls and Limiters	51
4.4 Burners and Combustion Tests	56
4.5 Solid Fuel and Alternative Sources of Heat	59
4.6 Feed Water and Boiler Water Checks	60
4.7 Emissions Control Equipment	61
4.8 Calibration and Testing of Instrumentation	62
5 MAINTENANCE, REPAIR AND MODIFICATION	65
5.1 Maintenance	66
5.2 WSE and Modifications or Repairs	67
5.3 Responsibility	68
6 PERSONNEL AND RESPONSIBILITIES	69
6.1 User/Owner	69
6.2 Competent Person (CP)	69
6.3 Employers	69
6.4 Employees Managing The Operation Of Boiler Plant	70
6.5 Competent Boiler Operator	70
6.6 Personnel Monitoring Boiler Alarms	71

6.7	Maintenance Personnel	71
6.8	Sub-Contractors	72
6.9	Manning and Supervision of Boiler Houses	72
7	TRAINING	74
7.1	Training Courses	74
7.2	Training Records	75
8	PERIODIC EXAMINATION OF BOILERS	76
8.1	Failure Mechanisms	77
9	LEGISLATION	79
9.1	The Management of Health and Safety at Work Regulations (MHSWR)	79
9.2	The Pressure Equipment (Safety) Regulations (PER)	80
9.3	Pressure Systems Safety Regulations (PSSR)	80
9.4	Provision and Use of Work Equipment Regulations (PUWER)	82
9.5	The Construction (Design and Management) Regulations (CDM)	82
9.6	The Dangerous Substances & Explosive Atmospheres Regulations (DSEAR)	82
9.7	The Control of Substances Hazardous to Health Regulations (COSHH)	82
9.8	The Industrial Emissions Directive and the Environmental Permitting Regulations	83
9.9	The Waste Incineration Directive	84
10	LEGAL RESPONSIBILITIES	85
10.1	Risk Assessments – For Existing and New Sites	85
10.2	Written Scheme Of Examination (WSE)	86
10.3	Examinations in Accordance with The WSE (Thorough Examinations)	87
10.4	Summary of Responsibilities	88
11	ENERGY AND ENVIRONMENT	89
11.1	Energy Management	89
11.2	Environmental Issues	89
	APPENDIX 1 - REFERENCES	91
	APPENDIX 2 - WATER TUBE BOILER - FAILURE MECHANISMS	94
	APPENDIX 3 - DIAGRAMS OF TYPICAL BOILER ARRANGEMENTS	99
	APPENDIX 4 - TYPICAL LOG SHEET EXAMPLES	101
	APPENDIX 5 - DEFINITIONS	111
	APPENDIX 6 - ACRONYMS	113

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1 INTRODUCTION

Guidance on the Safe Operation of Water Tube Boilers (Ref: BG11) is a guidance document intended to assist the designers, managers, operators, maintenance personnel and Competent Persons (CP) of new and existing steam boiler systems in addressing the following issues:

- The safe and efficient use and operation of the boiler installation;
- Determining adequate supervision and maintenance requirements (levels and competence) that are consistent with the installed plant and its location;
- Reducing the likelihood of explosion or other dangers from events such as:
 - Loss of feed water or low water level;
 - Over-pressure;
 - Overheating e.g. due to excessive scale;
 - High wastage rates on metal surfaces;
 - Incomplete combustion of fuel;
- Using efficient boiler operation to avoid excessive pressure or thermal cycles and load swings which can accelerate component fatigue damage through to premature failure;
- Having the proper treatment and monitoring of the feed water and condensate to:
 - Minimise corrosion and scale; and
 - Avoid carry-over of water with the steam which in turn can cause steam hammer and other issues;
- Compliance with various legal requirements, in particular that for periodic examination by a CP in accordance with a Written Scheme of Examination (WSE) and all relevant environmental legislation.

Water tube boilers are large and expensive items of capital plant that frequently have a service life of 25 years or more. It is not possible in this document to cover every type of boiler or every installation scenario for water tube boilers, but the safe operation and maintenance of boilers that have been in service for many years is of equal importance to the design and operation of new boilers; references in the text may include plant items and techniques that are no longer available but still in daily use.

One important aspect of water tube boiler design and operation is the availability, maintenance and monitoring of appropriate high quality water supplies. Many volumes of excellent material exist that cover this subject in more detail, so the references to water treatment plant and water quality in this document are here as a reminder of the general principles and the reasons for maintaining good quality water and not a detailed explanation of the individual plant items or techniques required which will be bespoke to each and every installation.

Another significant consideration is the selection and treatment of the correct metals and alloys in various boiler parts commensurate with the type of fuel to be combusted. The vast majority of the damage that occurs in a water tube boiler results from corrosion and erosion effects which commonly act in combination to contribute to excessive local wastage rates on metal parts.

Water tube boilers come in many shapes and sizes, use a wider variety of fuels than any other boiler type, and serve a range of industries in many different sectors. It would be impossible to cover every aspect of design, operation and maintenance of all such installations in one document. The contributors to this guidance have used their combined years of experience to bring together as many elements as possible, but if errors are found or adjustments to the text are required, please contact the CEA for clarification and for amendments to be made.

This document will be kept under review and amended as necessary in the light of emerging technologies, improved working practices, new legislation or any other relevant aspect.

2 SCOPE

This document applies to all industrial and commercial water tube steam and hot water boiler plant operating at a working pressure up to 100 bar and utilising a wide variety of fuels or heat sources including fired and unfired heat recovery steam generators (HRSG) where appropriate. Whilst the cut off pressure for this guidance is set at 100 bar there are many aspects of boiler operation and maintenance herein which are equally applicable to higher pressure boilers.

For the purpose of this guidance, the boiler assembly includes:

- The water tube boiler including all the pressure parts from the feed water inlet (including the inlet valve) up to and including the steam or hot water outlet (including the outlet valve or, if there is no valve, the first circumferential weld or flange downstream of the outlet header);
- All superheaters, re-heaters, air heaters, economisers, their associated safety accessories and the interconnecting tubing that are heated by the gases and process of combustion and are not capable of isolation from the main system by interposing shut-off valves;
- The pipework that is connected to the boiler involved in services such as draining, venting, de-superheating, etc., up to and including the first isolating valve in the pipework downstream of the boiler;
- Re-heaters which are heated by the flue gas or independently fired, and are separately provided with their own safety accessories including all control and safety systems;
- Isolatable superheaters, re-heaters, economisers, air heaters and related interconnecting pipework;
- The heat supply or firing system;
- The means of feeding the fuel to the boiler including their control systems;
- The means of providing the boiler with feed water including the control system;
- The pressure expansion vessels and tanks of hot water generating plant.

Auxiliary components associated with the operation of the boiler and the User's system are included as indicated in the text. The delivery and storage of different fuels are specifically **not included**, nor is the handling of any related waste arising, such as ash.

A detailed description of water treatment plant and water treatment techniques is not provided in this document. For more information please refer to CEA's BG04, Guidance on Boiler Water Treatment, for boilers up to 32 bar, and other standards such as BS 2486 referenced in Appendix 1.

The following boilers are **specifically excluded** from the scope of this guidance document:

- Shell and tube steam boilers (see BG01);
- Domestic and commercial hot water boilers (see BG02);
- Boilers heated by electricity;
- Coil type steam generators;
- Boilers other than stationary boilers;
- Nuclear primary circuits, the failure of which can cause an emission of radioactivity.

The purpose of this document is to provide water tube boiler system designers, operators and maintainers with a better understanding of how water tube boiler systems are designed and operated, and to assist those who operate, service and maintain the boiler system to do so safely, efficiently, and in a way that provides for protection of the environment.

It is not, however, a design manual nor is it a catalogue of manufacturer's individual items of equipment, and to ensure safe operation, sufficient procedures for all normal and abnormal activities (start-up, shut down action in emergency etc) need to be developed and documented for each boiler at each site. These procedures shall reflect the requirements of manufacturers' operating instructions and the site operational needs. The overall responsibility for the safe operation and maintenance of the plant rests solely with the Employer and owner of the plant.

This document has been compiled by CEA members and boiler industry specialists with reference to legislation and practices specifically relevant to installations in the UK. Regulations and guidance in other jurisdictions will differ, although many of the general principles and best practice guidelines herein may be relevant and equally applicable outside the UK.

Typical Water Tube Boilerhouse Schematic

Hand drawn diagram provided by Cat 3 BOAS candidate

