EN342

Boilers

2 Credits

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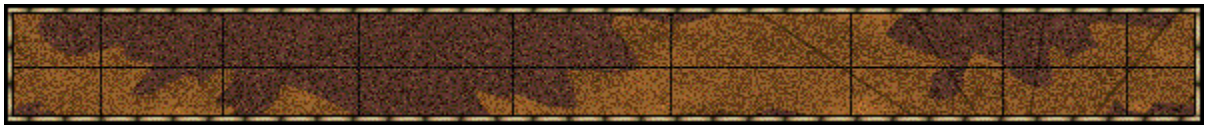

Boilers

Calendar Description

This course examines the design aspects of heat transfer and circulation in steam generators as well as the fittings and components associated with boilers. Construction methods, installations and insulation are also examined. Students are exposed to the detailed procedures of boiler inspections, operations and maintenance.

Rationale

This course has been developed to support students seeking to further their careers, as Second Class Power Engineers, with an ever increasing industry demand to replace retiring Power Engineers and operate new facilities.

Industry has shifted their focus from employing the 4th and 3rd class levels of Power Engineering certification to higher levels of certification.

Upon successful completion of this program the student is eligible for a 9 month reduction in qualifying time experience granted by ABSA.

The six parts of the program are divided into 15 courses where the student has the option of registering for individual courses, Part A, Part B, or both Part A and Part B.

Prerequisites

EN310, EN320, EN410, EN420 or Third Class Power Engineer's Certificate of Competency.

Co-Requisites

None

Course Learning Outcomes

Upon successful completion of this course, students will be able to

1. explain how the ratings of boilers and steam generators are calculated.
2. explain the factors to be considered in designing a steam generator.

3. contrast the influence of solid fuel, liquid fuel, and gas fuel on steam generator design.
4. explain the principles of natural water circulation in a steam generator. Explain why forced circulation is used in a steam generator and how it is attained.
5. explain the design, placement and installation considerations for water walls, superheaters, desuperheaters, reheaters, economizers, and air heaters.
6. explain the purpose and placement of screen tubes, divisional walls, water-cooled stringer tubes in superheaters, and wall mounted radiant superheaters.
7. describe top and bottom support systems for a steam generator.
8. describe furnace casing design considerations.
9. describe the purpose and use of specialized steam generator duct arrangements, including air heater by-pass, economizer by-pass, and air heater recirculation.
10. describe the methods used to insulate different parts of a steam generator.
11. explain the general steps used to construct a steam generator.
12. describe typical designs, components, and operating strategies for once-through steam-flood boilers.
13. describe typical designs, components, and operating strategies for fluidized bed boilers (bubbling bed and circulating bed types).
14. describe typical designs, components, and operating strategies for heat recovery steam generators.
15. compare different designs of heat recovery steam generators (HRSG); natural circulation, controlled circulation and once-through (OTGS).
16. describe typical designs, components, and operating strategies for supercritical steam generators.
17. describe typical designs, components, and operating strategies for black liquor recovery boilers.
18. describe typical designs, components, and operating strategies for refuse boilers used in waste disposal.
19. describe typical designs, components, and operating strategies for biomass boilers.
20. describe typical designs, components, and operating strategies for waste-heat boilers (firetube and watertube types).
21. discuss the detailed hot and cold startup procedures for a steam generator including safety precautions.
22. discuss the detailed shutdown procedure for a steam generator including safety precautions.
23. describe the detailed lay-up procedures for a steam generator including safety precautions.
24. describe the detailed refractory dry out procedure for a new steam generator including safety precautions.
25. describe the detailed boil out procedure for a new steam generator including safety precautions.
26. explain the mechanical cleaning procedures for a boiler including safety precautions.
27. describe the detailed chemical cleaning procedures for a watertube boiler including safety precautions.
28. explain the detailed hydrostatic testing procedure for a boiler including safety precautions
29. describe standard shutdown activities and preventative maintenance procedures required for a boiler.

30. describe the detailed procedure for complete inspection of a boiler including waterside, fireside, and auxiliary equipment.
31. discuss boiler inspection techniques and equipment.
32. discuss the required inspection records and reporting procedures.
33. explain the roles and responsibilities for an inspection including engineering staff, operators, and boiler inspectors.
34. discuss the safety requirements during a boiler inspection.

Resource Materials

Required Text:

Power Engineering Second Class (2015) A-3 Boilers and Water Treatment (2nd ed.).

Calgary, AB: PanGlobal Training Systems Ltd

Reference Material:

Woodruff, B., Everett, Lammers, B., Herbret, & Lammers, F., Thomas. (2005). *Steam*

Plant Operation (8th Edition) USA: McGraw-Hill.

Steam/Its Generation and Use. New York: Babcox and Wilcox

NOTE: Additional resource material is provided or accessed through D2L.

Conduct of Course

This course follows the syllabus as set out by the Standardization of Power Engineer's Examination Committee (SOPEEC) and the curriculum recommended by the Interprovincial Power Engineer Curriculum Committee (IPECC).

This course builds on the student knowledge gained through the Fourth Class and Third Class Power Engineering courses.

This course is delivered face to face with a component of online directed study, and includes class lectures, group discussions, demonstrations, assignments, and projects.

Cutaway models, videos, and actual equipment may be used to support instruction and demonstrations.

Desire2learn (D2L) is an online course management suite and is used as an educational resource for tracking attendance, administering quizzes, and reporting grades. Students will access D2L directly, from any computer, and may view their progress, grades and attendance at any time.

This course consists of four chapters. There is an exam at the end of each chapter as well as a midterm and final exam.

The exams consist of seven written questions of which the student chooses five questions to answer. Each question is worth 20 marks and partial marks are awarded for correct methods and partial answers.

Evaluation Procedures

Lakeland College is committed to the highest academic standards. Students are expected to be familiar with Lakeland College policies related to academic conduct and academic honesty and to abide by these policies.

The marking scheme for this course is:

Assignments or Projects	20%
Chapter Exams	20%
Midterm Exam	30%
Final Exam	30%

The contents and date of the chapter exams is determined in class.

All questions are long answer written types of questions.

A minimum grade of 65% is required to pass this course.

A GRADE OF AT LEAST 50% IS REQUIRED ON THE FINAL EXAM TO PASS THIS COURSE

Those students seeking a qualifying time reduction must achieve a grade of 65% for sections A-1, A-2, a-3, B-1, B-2, B-3.

Students receive a certificate from Lakeland College indicating successful completion of the program.

NOTE: This program consists of six components; each component corresponds to one examination paper of the Alberta Boiler Association (ABSA) examination process.

The requirements for a Second Class Power Engineer consist of six SOPEEC examinations and 30 months of qualifying time in industry.

Grade Equivalents and Course Pass Requirements

A minimum grade of C+ (65%) is required to pass this course.

Letter	F	C+	B-	B	B+	A-	A	A+
Percent Range	0-64	65-69	70-74	75-79	80-84	85-89	90-94	95-100
Points	0.00	2.30	2.70	3.00	3.30	3.70	4.00	4.00

Attendance

For those students seeking the nine (9) month experience qualifying time reduction granted by ABSA, a minimum attendance of 80% in all courses is required, as per the Student Handbook. If the experience credit is not desired, there is no mandatory attendance requirement.

Course Units/Topics

Boiler and Steam Generator Components and Design

(discuss the components and design of a steam generator)

Specialized Boiler Designs

(Identify and discuss specialized boiler designs)

Boiler and Steam Generator Operation

(Describe in detail the typical procedures for operation of a steam generator)

Boiler and Steam Generator Maintenance and Inspection

(Describe in detail the typical procedures for boiler maintenance and inspection)