



**TECHNICAL
SAFETY BC**

REFERENCE SYLLABUS

For

**Antique Show Boiler
(Locomotive)**

**Operator's Certificate of
Qualification**

1.0 GENERAL INFORMATION:

This Body of Knowledge (Examination Syllabus) is intended to assist candidates in their preparation for writing the Antique Show Boiler-Locomotive Operator's Certificate of Qualification examination that has been approved by the Safety Manager. Before undertaking the examination, the candidate should be familiar with the operation and maintenance of steam locomotive engines in general.

2.0 CERTIFICATION REQUIREMENT:

An antique show boiler operation requires a person who holds an Antique Show Boiler Operator's certificate of qualification.

3.0 ELIGIBLE TO WRITE:

To qualify to take an Antique Show Boiler Operator's Certificate of Qualification, an applicant must

- (a) be the owner of, or be designated in writing by the owner to be responsible for the operation and maintenance of, an antique show boiler,
- (b) provide evidence, satisfactory to a provincial safety manager, that the applicant has experience with the construction, repair, operation and maintenance of antique show boilers, and
- (c) satisfy a safety officer that the applicant has a thorough knowledge of the
 - (i) operation of the plant for which the applicant is responsible, and
 - (ii) duties and responsibilities of a plant operator.

4.0 ELIGIBLE FOR CERTIFICATION:

For a candidate to qualify for an Antique Show Boiler Operator's Certificate of Qualification they must:

- (a) *pass the Antique Show Boiler Operator's Certificate of Qualification examination,*
- (b) *complete 100 hours of supervised operation experience, and*
- (c) *pass a practical examination that is satisfactory to the Safety Officer regarding the safe operation of Antique Show boiler*

5.0 PRACTICAL TIME REQUIREMENTS:

The practical training time requirements is 100 hours on Antique Show boiler, of which at least 50% of the time shall be while the plant is under steam and in operation, the remainder of the required time may include maintenance, start-up or lay up of the Antique Show boiler.

6.0 PROOF OF PRACTICAL EXPERIENCE MUST BE PROVIDED BY:

Completing and forwarding the Evaluation Form (FRM1206) and Plant Operating Experience form (FRM1026) signed by the certified steam locomotive power plant operator of the Antique Show boiler upon which the experience was gained.

Forwarding training records showing dates, type of experience gained, signatures of the steam plant owners and certified steam locomotive operator, (if not one and the same) that documents the candidate's experience. *Attach these to the application form.*

7.0 ANTIQUE SHOW BOILER PRACTICAL TEST:

Tasks to be performed by the operator before the Technical Safety BC Boiler Safety Officer.

- (a) *Bring the locomotive engine up to operating pressure, this may be required from a cold start.*
- (b) *Maintain the boiler level using both types of feeding devices.*
- (c)
 - (i) *Demonstrate the procedure in testing the safety valve, or*
 - (ii) *Explain the procedure in testing the safety valve.*
- (d) *Boiler blowoff, monitor boiler water in sight glass. Use tri-cocks if installed*
- (e) *Operate engine on level, uphill and downhill terrain.*
- (f)
 - (i) *Demonstrate the emergency shutdown of the locomotive engine, or*
 - (ii) *Explain the emergency shutdown of the locomotive engine.*

8.0 EXAMINATION INFORMATION :

Exam Type: 100 multiple choice questions

Writing Time: 3.5 hour

Exam Materials: Safety Standards Act

Power Engineers Boiler Pressure Vessel Refrigeration Safety
Regulation

CSA B51 Boiler, pressure vessel and pressure piping code

Passing Grade: 65%

To book the exam, submit completed application along with clear copies of prerequisites. Examination application (FRM-1004) and fees must be received and approved before the registration cut-off date in order to reserve an examination date, subject to seating availability. Read the examination scheduling policy [here](#)

9.0 REFERENCE MATERIALS

- ☐ Legislation of the governing jurisdiction
- ☐ CSA B51-15
- ☐ National Board Inspection Code 2017
- ☐ ASME Section I, and Section VII
- ☐ Training manuals from a recognized training institution

10.0 CERTIFICATE RENEWAL:

An Antique Show Boiler Operator's Certificate of Qualification expires 3 years from the date of issue.

11.0 BODY OF KNOWLEDGE (EXAMINATION SYLLABUS):

The topics that follow are intended to be a study guide, and do not imply that additional knowledge obtained from experience is not needed to successfully challenge the examination. The candidate is expected to understand, identify and describe the function and use as indicated in each of the topics listed below.

Historical boiler – A steam boiler of riveted or welded construction, including steam tractors, traction engines, hobby steam boilers, portable steam boilers, steam locomotive boilers, and other such boilers built prior to 1955 that is preserved, restored, and maintained for demonstration, viewing, or educational purposes. (CSA B51-14)

As per BC Reg. 104/ 2004 "antique show boiler" means a boiler forming part of a traction engine, threshing machine, steam locomotive, steam crane, donkey boiler plant or other plant of historical interest. Technical Safety BC has established this Syllabus to identify the examination subjects for the Antique Show Boiler Operator's Examination.

Objective:

Operators responsible for the operation of steam-powered locomotive engines should have the knowledge and ability to apply that knowledge in the following areas:

- a. Legislation of the governing jurisdiction
- b. Basic calculations
- c. Types of Boilers
- d. Process for determining the maximum allowable pressure allowed in the boiler
- e. Operation
- f. Inspection
- g. Non destructive testing
- h. Pressure testing
- i. Certification
- j. Controls and Safety devices
- k. Pressure relief devices
- l. Water treatment and maintenance of water treatment
- m. Causes of Corrosion

THE EXAMINATION SHALL BE BASED ON THE FOLLOWING TOPICS:

12.1 Repair requirements LEGISLATION:

- a. Act and Regulation applicable sections of the governing jurisdiction
- b. CSA B-51
- c. ASME Section 1, Section VII
- d. National Board Inspection Code
- e. CRN (Canadian Registration Number)
- f. Registration
- g. Certificate of Inspection Permit
- h. Operator Certification
- i. Log Book

12.2 SAFETY:

The candidate is expected to be able to fully explain the dangers associated with the operation of a steam locomotive and all its components, and state the precautions to be taken thus minimizing or preventing such dangers.

- a. Low water level
- b. High water level
- c. Broken governor belt
- d. Braking
- e. Broken gauge glass
- f. Piping failure
- g. Safety valve stuck open or stuck closed
- h. Leaking Hand hole gasket
- i. Tightening of components under pressure
- j. Fusible plug activation
- k. Driving on grades
- l. Putting out fire in the furnace
- m. Burns
- n. Cuts
- o. Fires due to sparks
- p. Driving in public demonstration
- q. Chemical handling
- r. Use of personal protective equipment

12.3 CALCULATIONS:

- a. Conversion from Imperial units to Metric units and visa-versa in particular for pressure, temperature and linear measurement.
- b. Engine horsepower
- c. Heating surface

12.4 THERMODYNAMICS:

- a. Temperature
- b. Measurement of heat (BTU, KW)
- c. Specific heat
- d. Sensible heat
- e. Latent heat
- f. Vapourization
- g. Expansion properties of water to steam
- h. Pressure and its effects
- i. Heat characteristics and methods of heat transmission (radiation, conduction, convection)
- j. Steam (wet steam, dry steam, saturated steam, superheated steam)
- k. Condensate

12.5 BOILERS:

- a. Firetube
- b. Watertube
- c. Locomotive Type
- d. Vertical
- e. Advantages and disadvantages of each type of boiler
- f. Boiler parts and terminology: Shell, tubes, heads, stays, fusible plug, firebox, smokebox, tubesheet, crown sheet, telltale holes, combustion chamber, combustion arch, mudring, smoke stack, dome, siphon, ash pit, grates, maximum allowable working pressure (MAWP), spark arrester, hand holes, man hole, washout plugs, grates, ash pan, dampers
- g. Auxiliary Components: Safety valve(s), steam pressure gauge, water level indicator, gauge glass, water column, try cocks, blow off valve(s), steam and water valves, whistle, throttle, governor, overspeed trip, feedwater pump. Feedwater injector, safety valve, pressure relief device, oil burners

- h. Riveted joints (lap, butt strap)
- i. Welding
- j. Installation of stays
- k. Installation of boiler tubes
- l. Piping
- m. Pipe fittings: types and application
- n. Valves: types, construction and application (gate, globe, plug, etc)
- o. Gaskets: types and applications
- p. Thermal stress

12.6 INSPECTION:

- a. Manufacturer's Data Report
- b. Specification sheet
- c. Canadian Registration Number
- d. Certificate of inspection Permit
- e. Boiler cleaning and preparation for inspection
- f. Visual internal and external
- g. Non destructive testing: Ultra-sonics (UT), mag-particle(MPI), liquid penetrant (LPI), radiographic (RT)
- h. Using the NDE results to determine the MAWP of the boiler by referencing the principles identified in CSA B51 and NBIC
- i. Causes of deterioration and possible failures: corrosion, mechanical damage.
- j. Riveted joints: Lap-seam, butt-strap seam and welded seams and their advantages and disadvantages
- k. Stay inspection (NDE and hammer test)
- l. Weld inspection

12.7 OPERATION:

- a. Pressure relief valve: its purpose, code markings, capacity verification, and certification
- b. Boiler startup
- c. Boiler shutdown
- d. Boiler bottom blowoff (procedure, purpose)
- e. Safety Procedures
- f. Boiler layup and Storage (wet and dry)

- g. Water level: verification of proper level, causes of fluctuation (foaming, priming, incline, tube rupture)
- h. Throttle and Governor operation
- i. Water Hammer
- j. Removing condensate from the engine
- k. Thermal Expansion
- l. Certificate of Inspection Permit
- m. Operator Certification
- n. Principles of combustion: fuel (coal, wood, gas, oil), air, ignition, draft systems, furnace door closed, purging, draft control, soot, ash, clinker formation, furnace grate, ash removal, furnace explosions,
- o. Starting out, getting off dead centre
- p. Driving
- q. Hills and grades
- r. Stopping
- s. Powering a stationary load
- t. Water level control
- u. Priming and knocking
- v. Leaking joint or seam

12.8 TESTING:

- a. Hydro testing,
- b. Test pressure verification
- c. Test pressure (psi, kPa)
- d. Water temperature

12.9 WATER TREATMENT:

- a. Dissolved gases (oxygen, Carbon dioxide)
- b. Dissolved solids
- c. Suspended matter
- d. pH control
- e. Scale formation: calcium, magnesium
- f. Sludge
- g. Foaming
- h. Effects of scale

- i. Effects of oil in the water
- j. Acidic attack
- k. Water testing
- l. Oxygen scavenger
- m. Selecting a water treatment program
- n. Safe handling of water treatment chemicals
- o. Purpose of boiler bottom blowoff

12.10 STEAM ENGINES:

- a. Simple engine
- b. Compound engine
- c. Engine components (cylinder, crankshaft, connecting rod, crosshead, flywheel, piston, steam chest, valves, lag, lead)
- d. Valve gears (Stephenson & Walshaert)
- e. Slide valve
- f. Lubricants (solid, semi-solid, liquid)
- g. Engine dead center
- h. Reversing gear
- i. Governor
- j. Throttling governor
- k. Governor problems (belt slipping, stem sticking, gears slipping, bent valve stem, belt breaking)
- l. Friction clutch
- m. Indicator diagrams

12.11 EMERGENCY PROCEDURES:

- a. Principle causes of boiler explosions
- b. Loss of water level
- c. Tube rupture
- d. Governor malfunction
- e. Stopping and starting
- f. Water Hammer
- g. Safety valve will not open at the determined maximum allowable pressure of the boiler
- h. Safety valve sticks open
- i. Signaling devices and procedures

12.12 REPAIRS:

- a. Standards used for doing repairs: CSA B51, NBIC
- b. Code requirements: (ASME)
- c. Requirements of the local jurisdiction
- d. Inspection and certification requirements
- e. Quality control program