

# Antique Show Boiler Operator's Certificate of Qualification syllabus

Effective: December 2018

## General information

This edition of harmonized requirements for the Antique Show Boiler Operator's examination Body of Knowledge (Examination Syllabus) was developed in cooperation with:

- ABSA the pressure equipment safety authority
- Technical Safety BC
- Technical Safety Authority of Saskatchewan
- Manitoba Office of the Fire Commissioner

In addition to the regulatory authorities, this syllabus had also included input from the historical boiler association (from their respective jurisdictions).

This Body of Knowledge (Examination Syllabus) is intended to assist candidates in their preparation for writing the Antique Show Boiler-Traction Engine 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 traction engines in general.

The operation of steam locomotives is not covered by this document. A steam locomotive operating on a railroad is subjected to the provincial legislation.

## Certification requirement

A historic boiler that is operating in a display or for the purpose of entertainment must be supervised by a person who holds an Antique Show Boiler Operator's certificate of qualification.

## Supervision

A steam power traction engine that is operating in a display or for the purpose of entertainment must be supervised by a person who holds an Antique Show Boiler-Traction Engine Operator's certificate of qualification.

During the operation of the Antique Show boiler, the certified operator must:

- a. provide constant supervision of the boiler,
- b. put the boiler into a safe shutdown condition before leaving it,
- c. update and maintain the log book,

- d. ensure the boiler is supervised in accordance with the recommendations set out in the ASME Boiler and Pressure Vessel Code, Section VII,
- e. ensure that an accurate record is kept of the boiler's checks as set out in the ASME Boiler and Pressure Vessel Code, Section VII, and
- f. notify the owner of the boiler and the Safety Manager of any unsafe condition, accident or fire involving the boiler.

## 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.

## 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

## 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.

## 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 traction 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 traction plant operator, (if not one and the same) that documents the candidate's experience. Attach these to the application form.

## Antique Show Boiler practical test

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

- a. Bring the traction 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 traction engine, or  
(ii) Explain the emergency shutdown of the traction engine.

## 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](#)

## 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

## Certificate renewal

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

## 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 traction 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

#### 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

## **2. Safety**

The candidate is expected to be able to fully explain the dangers associated with the operation of a steam traction plant 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

## **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

## **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

## 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

## 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

## 7. Operations

- 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

## **8. Testing**

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

## **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

## **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

## **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. 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