



# REFERENCE SYLLABUS

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For

**SPECIAL STEAM-POWERED TRACTION  
ENGINE'S OPERATOR'S  
CERTIFICATE of COMPETENCY  
EXAMINATION**

**November 2018**



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**GENERAL INFORMATION**

**Introduction:**

This syllabus has been approved by the Standardization of Power Engineers' Examinations Committee (SOPEEC) and the Association of Chief Inspectors (ACI).

This syllabus is intended to assist candidates studying for the Special Steam-powered Traction Engine's Operator's Certificate of Competency.

The requirements to qualify for a Special Steam-powered Traction Engine's Operator's Examination are outlined in applicable jurisdictional Act and Regulations.

A candidate may write the exam, provided, the candidate meets the jurisdictional requirements.

**Recommended Study Program:**

It is recommended that the candidate becomes familiar with the publications listed in the reference material for Power Engineering Students and Examination Candidates posted on the SOPEEC web site.

**Application to Undertake Examination:**

A candidate must submit an application and the prescribed fee at least twenty-one (21) days before the date of examination.

**Examination Instructions:**

The examination consists of one (1) examination paper, of 3½ hours duration. The paper consists of one hundred (100) questions.

To pass a Special Steam-powered Traction Engine's Operator's Competency examination, a candidate must obtain at least 65% of the total marks for each examination paper.



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A candidate is allowed to use, and may be provided, the following items in the examination room:

- A non-technical English language dictionary provided by the local jurisdiction;
- Handbook of Formulae and Physical Constants, Steam Tables and Refrigeration Tables are normally provided;
- ASME Boiler & Pressure Vessel Codes except for Sections VI and VII;
- The 2007 ASME Boiler & Pressure Vessel Code Academic Extract and Supplement produced by PanGlobal Training Systems;
- ASME/ANSI B31.1 Pressure Piping Code and B31.3 Process Piping Code;
- CSA B51, Boiler, Pressure Vessel and Pressure Piping Code;
- CSA B52, Mechanical Refrigeration Code;
- Extract for CSA B51 and CSA B52 Codes;
- Act and Regulations for the examining Jurisdiction;
- Pens and pencils;
- Non-programmable calculator <sup>see important note</sup> and
- (Normally, the above items are useful for all classes of examination.)
- Drawing instruments and drawing templates.

**Note**

- The candidate must provide picture ID to the Examiner prior to the examination.
- No cell phone or any electronic communication devices are allowed to be brought into the examination room.
- The items referenced above must be shown to the examiner for approval.
- No other reference material is allowed.
- **Important:** If your calculator is programmable, you must reset it in the company of the examiner so that the examiner is sure that all memories are clear. Or the examiner may request that you remove the battery to erase all memory. This may be done during your examination time, so be aware that you may have less time to complete your exam. If the memories do not clear by resetting the calculator or by removing the battery, the calculator shall not be used. Also, if your calculator fails to function after reset or battery removal, the examiner is not responsible and you may be at a significant disadvantage.
- The information in the 1983 Edition of the ASME Boiler and Pressure Vessel Code Academic Extract is outdated. Using this 1983 Edition of the ASME Extract for any power engineering examination is not recommended. Besides using the 2007 Edition of the ASME Academic Extract and Supplement, candidates may use the current edition of the ASME Code.

Contact your local jurisdiction to find out the details.



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**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)

**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
- n. Repair requirements



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**THE EXAMINATION SHALL BE BASED ON THE FOLLOWING TOPICS:**

**1.0 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

**1.2 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



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- m. Burns
- n. Cuts
- o. Fires due to sparks
- p. Driving in public demonstration
- q. Chemical handling
- r. Use of personal protective equipment

**1.3 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

**1.4 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



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## 1.5 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
- g. maximum allowable working pressure (MAWP), spark arrester, hand holes, man hole, washout plugs, grates, ash pan, dampers
- h. 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
- i. Riveted joints (lap, butt strap)
- j. Welding
- k. Installation of stays
- l. Installation of boiler tubes
- m. Piping
- n. Pipe fittings: types and application
- o. Valves: types, construction and application (gate, globe, plug, etc)
- p. Gaskets: types and applications
- q. Thermal stress



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**1.6 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

**1.7 OPERATION:**

- a. Pressure relief valve: its purpose, code markings, capacity verification, and certification
- b. Boiler startup
- c. Boiler shutdown
- d. Blow off (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





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- 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

**1.8 TESTING:**

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

**1.9 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



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- m. Selecting a water treatment program
- n. Safe handling of water treatment chemicals
- o. Purpose of blowdown

**1.10 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

**1.11 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



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**1.12 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

