

Body of Knowledge For
State of Ohio
Historical Boiler Operators License Exam

Licensed operators of a Historical Steam Boiler must have knowledge on a variety of subjects relating to boiler operation and safety including; steam boilers, boiler construction, boiler types and components, statutory & administrative rules, firing procedures, and safe operation to prevent injury or damage.

The State of Ohio Historical Boiler Operators License Examination is designed to determine if individuals have such knowledge. This packet of information provides a list of specific topics of which the Historical Boiler Operator should be knowledgeable.

Only information covered in the categories outlined in this Body of Knowledge will be utilized for the examination questions. The examination may not cover every topic of the Body of Knowledge.

This body of knowledge, and the examination will center on information and topics not specific to any make, model, or type of historical boiler. References to specific models or makes of boiler may be made if the information is deemed commonplace in industry, or critical for safe operation.

Suggested reference materials include the following:

1. American Thresherman, *Steam Engine Guide*, Madison, WI 1906. 1954 Farm Collector Books, 1503 SW 42nd St., Topeka, KS 66609
2. SteamGas Publishing, *Case Steam Engine Manual*, order # BK-0728, Martin J. Donnelly Antique Tools, PO Box 281, Bath, NY 14810-0281
Telephone: 607-566-2617 Internet: www.mjdtools.com
3. Woodruff, Lammers and Lammers, *Steam Plant Operation 7th Edition*, order # ISBN# 0-07-036150-9, McGraw Hill Publishing, PO Box 548, Blacklick, OH 43004
Telephone: 1-800-334-7344 Email: customer.service@mcgraw-hill.com

Books are not to be brought to the examination site.

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Body of Knowledge for State of Ohio Historical Boiler Operators License Exam

Part 1 – General

- 1) A history of the development of the steam engine from the first experiments by Hero, to the end of the steam era, about 1923.
- 2) A short commentary on the modern uses of steam, from 1923 to the present.
- 3) A discussion of steam
 - a) Properties
 - b) Generation
 - c) What it really is
 - d) Pressure/temperature relationship

Part 2 – Boilers

- 1) Boilers
 - a) Various types and their uses
 - i) Vertical / Upright
 - ii) Horizontal
 - (1) Locomotive
 - (a) Wet / Closed bottom
 - (b) Dry / Open bottom
 - (2) Return flue / Marine style
 - iii) Fire tube
 - iv) Water tube

Part 3 – Construction

- 1) Construction
 - a) Lap seam
 - b) Butt strap
 - c) The various boiler components
 - i) Crownsheet
 - ii) Wagon top / wrapper
 - iii) Shell / barrel
 - iv) Front / rear heads
 - v) Throat sheet
 - vi) Tube sheets
 - vii) Fire box
 - viii) Water leg
 - ix) Smoke box
 - x) Steam dome / Main valve
 - xi) Hand holes / clean-outs
 - xii) Ash pit
 - xiii) Grates

- xiv) Stay bolts
- xv) Through stays and supports
- xvi) Rivets

Part 4 – Engineering and Design

- 1) Engineering and design
 - a) Materials
 - i) Thickness and strength of
 - ii) Ultrasonic testing
 - b) Heating surface calculations for relief valve sizing
 - c) Hydrostatic testing

Part 5 - Repairs and Standards

- 1) Repair considerations
 - a) Material
 - b) Welders
 - c) Inspector involvement
 - d) Valve standards
 - e) Fittings

Part 6 – Operational Components

- 1) Detailed discussion of the operational components
 - a) Identification, purpose, location, adjustment, use of and requirements for
 - b) Fusible plug - required
 - c) Safety valve – required
 - d) Pressure (steam) gauge - required
 - e) Water level indicators
 - i) Water glass (gauge) - required
 - (1) How to check operation
 - ii) Try cocks - required
 - (1) Water column, if so equipped
 - iii) Feed water components - any two required
 - (1) Injectors
 - (2) Pumps
 - (a) Crosshead
 - (b) Gear driven
 - (c) Steam
 - iv) Accessories - not required
 - (1) Siphon or ejector
 - (2) Pre-heaters
 - f) What conditions each can indicate
 - g) Fire draft components
 - i) Blower

- ii) Draft doors
- iii) Engine exhaust nozzle

Part 7 – Boiler Care and Maintenance

- 1) Boiler care & maintenance
 - a) Preparing for a period of non-use
 - b) Preparing for use after an extended period of non-use
 - c) Before firing after a short period of non-use

Part 8 – Firing Principles

- 1) Principles of firing a boiler
 - a) Startup checklist
 - b) Starting the fire
 - c) Maintaining the fire
 - i) Cold air entering the firebox
 - ii) When to add fuel
 - iii) The effect of holes or open spaces, in the fire bed
 - iv) Firing with different fuels
 - v) Proper firing methods

Part 9 – Water

- 1) The water level
 - a) Too low
 - i) Overheat the Crownsheet
 - b) Too high
 - i) Priming (pulling over)
 - (a) What it is
 - (b) Causes
 - (c) Possible results
 - ii) Foaming
 - (a) What it is
 - (b) Causes
 - iii) How to control each condition
 - (a) Blow down
 - (1) Surface
 - (2) Bottom
- 2) Water quality and treatment

Part 10 – Steam Pressure

- 1) The steam pressure
 - a) Too high
 - b) Too low
 - c) How to control
 - i) Draft
 - ii) Feed water
 - iii) Fuel
 - d) Checking the safety valve
 - e) Blow down
 - i) Surface
 - ii) Bottom

Part 11 – Emergency Procedures

- 1) Extinguishing the fire
 - a) When to
 - b) Pulling vs. covering
 - c) How to
- 2) Controlling leaks
 - a) Broken water glass
 - b) Broken pipe nipples
 - c) Blown hand hole gaskets

Part 12 – Ohio Laws and Rules

General

The 124th General Assembly passed H.B. 344 which mandated the establishment of “standards for operating historical boilers and testing operators of those boilers”.

Sections 4104.31 to 4104.37 of the Ohio Revised Code established these standards by creating the Historical Boiler Licensing Board, who then developed the specific administrative rules for operators of historic boilers, and the inspection and certification requirements for historical boilers.

The historical licensing board consists of seven members, three of whom are appointed by the governor, two appointed by the president of the senate and two members appointed by the speaker of the house of representatives.

Definitions and Limitations

“Historical boiler” means a steam boiler of riveted construction that is preserved, restored, or maintained for hobby or demonstration.

“Open to public” shall mean any event that is attended by 125 or more people at any time or takes place within five hundred yards of 125 or more people.

The smallest historical boilers that are subject to the historical boiler rules are those in excess of 16 inches interior drum diameter.

Attendance of Historical Boilers, Proper Use, Maintenance and Logbook

A historical boiler shall not be left unattended when in operation and members of the public are present.

A traction engine may be considered as not being in operation when all of the following conditions exist:

The water level is at least one-third of the water gage glass;

The header or dome valve is in a closed position, if applicable;

The draft doors are closed;

The fire is banked or extinguished;

The boiler is at least 20 pounds per square inch below the safety valve relieving pressure.

All piping components shall be used in the manner for which they were designed and shall not exceed manufacturer’s marked rating. Below the water line, schedule 80 black pipe shall be used from the boiler to the first valve.

The owner of each historical boiler shall keep and maintain a maintenance logbook, which shall be furnished upon request, to the inspector. The logbook shall include, but is not limited to, the following information:

Boiler information, including,

The number and location of a boiler serial number, identification number or other permanent marking on the boiler sufficient to identify the boiler with specificity;

The number and location of a safety valve serial number, identification number or other permanent marking on the safety valve sufficient to identify the set pressure and capacity of the safety valve;

The heating surface of the boiler reported in the manufacturer’s specifications or calculated by a method acceptable to the inspector.

Inspection dates and findings;

Events and dates attended by the general public where boiler was operated;

Failures;

Repairs; and

Performed maintenance, including, but limited to, the replacement of a fusible plug or a safety valve.

No historical boiler and its appurtenances shall be operated at a pressure in excess of the safe working pressure for the boiler stated on the certificate of operation for that boiler.

Operating Criteria – Required Equipment

All historical boilers shall be equipped with the following:

A safety valve set at or below the safe working pressure of the boiler. The safety valve shall be certified by the national board of boiler and pressure vessel inspectors. The safety valve shall be sealed in a manner that does not allow tampering with the valve setting without destroying the seal. The boiler may be equipped with a y-base or an unrestricted tee to accommodate the installation of multiple safety valves. During the required operational inspection, it shall be demonstrated to the inspector that the required pressure relief valve capacity shall not be less than 7 pounds per hour per square foot of heating surface of the boiler;

A pressure gage connected to its steam space. The gage shall contain some form of a siphon device, which shall develop and maintain a water seal that shall prevent steam from entering the gage tube. The gage shall be proven accurate each year by being tested with a dead weight tester or an approved calibrated test gage. The results of the test shall be documented in the logbook and shall be furnished to the inspector;

A fusible plug must be manufactured to conform to section I appendix A-19 of the 2004 ASME Boiler and Pressure Vessel Code with “ASME Std.” stamped on the filler material. Fusible plugs shall be replaced every three years, and the replacement shall be witnessed by the inspector. Fireside fusible plugs shall protrude a minimum of one inch into the water. Waterside fusible plugs shall not protrude into the fire area more than three quarters of an inch. Fusible plugs shall not be refilled;

A fully operational gage glass fitted with a protective guard. The gage glass shall indicate the minimum safe operating water level, and shall be provided with a drain valve or petcock;

Fully operational try-cocks correctly located in reference to the minimum required water level.

Initial Certification of Historical Boilers

Before the initial certification of an historical boiler, the boiler and its appurtenances shall be subjected to a nondestructive design evaluation at the boiler's maximum allowable working pressure. The maximum allowable working pressure shall be no more than the current safety valve setting which shall be no more than 180 pounds per square inch. The hydrostatic test pressure shall be one and one-quarter of the safety valve setting, but in no case greater than 225 pounds per square inch, except for railway locomotives for which the safety valves may be set in accordance with manufacturer's specifications.

Before the initial certification of an historical boiler, all historical boilers and their appurtenances shall be inspected thoroughly, internally and externally, and under operating conditions by the inspector. The internal and external inspection under operating conditions shall, at a minimum, include an inspection of all of the following:

- Smoke box;
- Barrel;
- Wrapper sheet;
- Water column and water glass;
- Firebox;
- Stays;
- Fusible plug;
- Threaded openings;
- Inspection openings;
- Pressure gage;
- External plumbing and piping;
- Injectors;
- Pipe schedule and valve ratings;
- Tubes;
- Tube sheets; and
- Steam safety valve.

During the initial certification of an historical boiler, the inspector may ultrasonically evaluate a historical boiler or any portion thereof for cause.

Standards for Conducting and Reporting Hydrostatic Tests

All historical boilers shall pass a hydrostatic test at one and one-quarter of the boiler's maximum allowable working pressure every three years or more frequently if required by the inspector. The triennial hydrostatic test shall be conducted in the presence of a safety committee and inspector. Upon successful completion of the test, the historical boiler board shall issue a sticker indicating the approved boiler's maximum allowable working

pressure and the year and month the test was performed. The sticker shall be prominently displayed on the boiler.

A hydrostatic test of an historical boiler shall be conducted at a pressure one and one-quarter of the maximum allowable working pressure of the boiler. An accurate calibrated test gage shall be used when hydrostatically pressure testing an historic boiler. The water temperature during the test shall be between 60-120 Fahrenheit. The test pressure shall be maintained for the duration of the inspection without distortion or leakage in any of the pressure retaining boundaries or appurtenances of the boiler.

Repairs and Alterations

All welded repairs or alterations to any historical boiler shall be made by a person certified as a welder in accordance ASME Section IX, welding and brazing qualifications.

All welded, riveted repairs or alterations to any historical boiler shall be made in conformity with or shall exceed generally accepted engineering standards in place at the time of original construction or current standards.

Certificate of Operation

The owner of a historical boiler that is operated in public shall maintain a current valid certificate of operation for the historical boiler.

At least once every three years, inspectors shall inspect thoroughly, internally and externally, and under operating conditions, all historical boilers that are operated in public and their appurtenances. Inspectors shall examine the smoke box, barrel, wrapper sheet, dome, water column and water glass, firebox, external plumbing, fusible plug, pressure relief valve, and pressure gage.

After conducting the inspection required, the inspector shall evaluate whether the historical boiler is in safe operating condition according to rules adopted by the historical boiler licensing board. If the inspector finds that the historical boiler is in safe operating condition, the inspector shall recommend that the board issue a certificate of operation for the historical boiler. If the board concurs with the recommendation of the inspector, the board shall issue a certificate of operation for the historical boiler inspected by that inspector. A certificate of operation is valid for a period of three years after the date of issuance.

If an inspector does not recommend the issuance of a certificate of operation for the historical boiler or if the board decides not to issue a certificate of operation, the owner of the historical boiler may file an appeal with the board, and the board shall conduct a hearing in accordance with Chapter 119 of the Revised Code.

The owner of a historical boiler that is operated in public shall display the certificate of operation in a prominent place on the historical boiler during its operation.

There is a \$150.00 fee charged to the owner for conducting the three year inspection on a historical boiler.

License to Operate Historical Boiler

Any person may apply to the historical boiler licensing board to become licensed to operate historical boilers in public. The board shall issue a license to any person who satisfies the following criteria:

Is sixteen years of age or older;

Has completed a historical boiler operator's course that is approved by the board;

Passes a written or verbal examination that is approved by the board;

Has at least 100 hours of actual operating experience or training in the operation of historical boilers.

A person, who satisfies the criteria to become licensed to operate historical boilers, shall pay a one-time fee of \$50.00 for the issuance of the license. The license is valid for the lifetime of the operator unless the license is revoked by the board.

Persons under the age of sixteen may be trained in the operation of historical boilers by serving as apprentices to operators who are licensed, in order to obtain the training required for licensure of historical boiler operators.

Grandfathering

The Historical Boilers Licensing Board shall issue a license to an operator of historical boilers who has been engaged in operating historical boilers in public for at least two of the five twelve month periods prior to October 24, 2002 if the operator passes the written or verbal examination approved by the board that tests for competence in operating historical boilers and pays a one-time fee of fifty dollars for the issuance of the license.

Out-of-State Operators

The Standards for the public display and operation of historical boilers by historical boiler operators who reside outside of this state shall be the same as those for historical boiler operators who reside in this state, except that the historical boiler board may accept by order the licensing of operators and the inspection of boilers from any other state that has requirements substantially equivalent to Ohio.