NBBI NB-380-1 WORKBOOK

Inservice Inspection

Version 1 - Revision 1

This document is a task-based training workbook designed to help jurisdictions and Authorized Inspection Agencies develop inspector candidates who do not meet the five-point education and experience requirements found in NB-263, *RCI-1, Rules for Commissioned Inspectors*. Completion of the workbook is intended to meet the alternative requirements found in NB-380, *National Board Inservice Inspector Training Program*.

Inspector Candidate: _____

Assigned Mentor: _____

Start Date: _____

Completion Date: _____

Introduction:

This document is a task-based training workbook designed to help inspector candidates meet the requirements of NB-380, *National Board Inservice Inspector Training Program*. Consisting of seven modules, this workbook will guide inspector candidates as they acquire and demonstrate knowledge of the foundations of boiler and pressure vessel inspection. Topics and tasks covered within the workbook are based on NB-380 and NB-331-I, *National Board Body of Knowledge of Inservice Inspectors*.

The workbook contains three types of tasks. The first type is Knowledge Checks, where inspector candidates are to verbally demonstrate satisfactory knowledge and understanding of a specific topic to a commissioned inspector. These checks can be completed in any setting. The second is Practical Applications, where inspector candidates will demonstrate their understanding of inspection methods in the field under the supervision of a commissioned inspector. Examples of Practical Applications include verifying code plate information, verifying or supervising the testing of a low-water cutout device, or assessing the internal condition of a boiler. The final type of task is Module Assessments, where inspector candidates are tested to ensure they are retaining the subject matter for each module. These assessments are to be given by the Chief Inspector or Inservice Inspector Supervisor either verbally or in writing. Module Assessments shall be documented by the Inspection Agency.

Some jurisdictions are limited in the scope of equipment they can inspect, making it difficult for inspector candidates in those areas to perform all the practical applications outlined within this workbook. It is highly encouraged that Inspection Agencies work with one another to allow inspector candidates to complete the Practical Applications they otherwise would be unable to perform. Allowances can be made by the Chief Inspector or Inservice Inspector Supervisor when necessary. In cases where an exception must be made, the Practical Application shall be supplemented by additional training on the relevant topic. The training will be documented and approved by the Chief Inspector or Inservice Inspector Supervisor. Exceptions are subject to prior acceptance of the National Board.

This workbook is designed only to meet the minimum requirements of NB-380. Inspection Agencies are responsible for providing additional instruction to inspector candidates. Instruction should include topics specific to their organization and the jurisdiction(s) in which they will be working. Documentation of additional training may be included with the workbook, though such training shall not take the place of workbook tasks except as allowed above.

An inspection log is provided alongside this workbook. The inspection log is to be used to document the inspector candidate’s participation in 300 boiler and/or pressure vessel inspections, as required by NB-380. Alternative inspection logs may be used,

though the information contained in the provided inspection log should be considered the minimum standard for alternatives. Alternative inspection logs are subject to the acceptance of the National Board prior to implementation in accordance with Part 1 of NB-263, RCI-1, *Rules for Commissioned Inspectors*.

Successful completion of this workbook and inspection log are only one step in the commissioning process. Inspector candidates will also need to successfully complete the National Board Classroom Inservice Commission Course (**IS**) and the following National Board Online Training Courses: National Board Inspection Code, Part 1, Installation; National Board Inspection Code, Part 2, Inspection; and Rules for Commissioned Inspectors. Inspector candidates will also need to successfully pass the Inservice Inspector Commission Exam.

NB-380 Workbook Task Group Members

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The responsibilities of the Task group are to develop and propose a workbook that an applicant/Inspection Agency may use to fulfill the requirements of the NB-380 Program. Source material for the workbook shall include, but not limited to, NB-380 requirements and the National Board Body of Knowledge for Inservice Inspectors (NB-331-I).

Table of Contents:

Module 1

Boiler and Pressure Vessel Fundamentals

Introduction:

This module introduces the Inspector Candidate to the fundamentals of the boiler and pressure vessel industry. Topics include physics, equipment design, corrosion and failure mechanisms, nondestructive examination, and more. This module will include additional foundational activities for the Inspector Candidate to work through with their assigned Mentor. After completing this module, Inspector Candidates should be able to demonstrate a working knowledge and understanding of the fundamentals needed to begin subsequent modules.

Recommended Reference Material:

The following is a list of some materials that contain industry terms and fundamental concepts the Inspector Candidate will need to understand to complete this module:

- ASME Section VI, Recommended Rules for the Care and Operation of Heating Boilers
- ASME Section VII, Recommended Guidelines for the Care of Power Boilers
- ASME Section V, Nondestructive Examination
- U.S. Navy, NAVEDTRA 10535-H, Boiler Technician 3 & 2
- *National Board Inspection Code* (NBIC)
- NFPA 85, Boiler and Combustion Systems Hazards Code
- Pan Global Website https://panglobal.org/
- U.S. Navy, NAPERS 10788-B, Principles of Naval Engineering (PNE)
- Boiler & Pressure Vessel Manufacturers' Technical Publications
- ASTM C64-72(1977) Standard Specification for Refractories for Incinerators and Boilers
- Insulation Outlook https://insulation.org/io/articles/a-different-perspective-refractory-materials-for-the-power-generation-industry-2/
- *Low Pressure Boilers*, Steingress, Walker
- *High Pressure Boilers*, Steingress, Walker
- ASTM D396-21, Standard Specification for Fuel Oils

Activity 1:

The candidate must have an understanding of boiler industry terms found in some of the recommended reference materials listed above. The designated trainer should test the candidate on a preassigned group of terms regularly. To complete Activity 1, the trainer must select at random 50 vocabulary terms from the above publications and conduct a written (not multiple choice) test. A score of 90% or better is required.

Mentor Name	Mentor Signature	Date

Activity 2:

Instruction of the Inspector Candidate following a textbook such as Steingress' "Low Pressure Boilers" and completion of any accompanying training material is required.

Mentor Name	Mentor Signature	Date

Activity 3:

Instruction and review of the listed ASME, NBBI and NFPA documents as well as supplementary instruction related to insulation, refractory, fuels, is required. Specific boiler and pressure vessel literature for objects that will be found in the field must be covered by the designated trainer.

Mentor Name	Mentor Signature	Date

Knowledge Checks:
Boiler and Pressure Vessel Fundamentals

	Boiler Basics and Principles	Initials	Date
1.1	Basic Terms		
1.1.1	Boiler		
1.1.2	Design		
1.1.3	Application		
1.1.4	Thermal energy		
1.1.5	Mechanical energy		
1.2	Thermodynamics		
1.2.1	Explain the first law of thermodynamics.		
1.2.2	Describe an example.		
1.2.3	Explain the second law of thermodynamics.		
1.2.4	Describe an example.		
1.2.5	Define heat.		
1.2.6	Define solids.		
1.2.7	Define liquids.		
1.2.8	Define sensible heat.		
1.2.9	Define latent heat.		
1.2.10	Define specific heat.		
1.2.11	Sketch the relationship between sensible vs latent heat for a lb. of water at atmospheric pressure.		
1.2.12	Describe the differences between Fahrenheit and Celsius.		
1.2.13	What is the formula to convert the terms above?		
1.2.14	Describe conduction.		
1.2.15	Describe radiation.		
1.2.16	Describe convection.		
1.2.17	Describe the properties of saturated steam.		

1.2	Thermodynamics (Continued)	Initials	Date
1.2.18	Describe how steam is generated.		
1.2.19	What does “change of state” mean?		
1.2.20	Sketch the steam cycle.		
1.3	Boiler Design		
1.3.1	List the most common boiler types.		
1.3.2	Explain how watertube boilers function and their primary use.		
1.3.3	Explain how firetube boilers function and their primary use.		
1.3.4	Explain how cast iron/cast aluminum are constructed and their primary use.		
1.3.5	Sketch each of the boiler types described above.		
1.3.6	Define these boiler classifications and list their expected location:		
1.3.6.1	Low pressure steam		
1.3.6.2	High pressure steam		
1.3.6.3	Hot water heating		
1.3.6.4	Hot water supply		
1.3.6.5	Water heaters		
1.3.6.6	High temperature hot water		
1.3.7	Identify symbols for equipment, piping, and valves.		
1.3.8	Describe a common cause for expansion and concerns related to it.		
1.3.9	Describe the combustion process.		
1.4	Combustion		
1.4.1	Describe the various fuels and fuel firing equipment:		
1.4.1.1	Pumps		
1.4.1.2	Heaters		
1.4.1.3	Burners, sprayer plates, diffusers		
1.4.1.4	Fuel oil		
1.4.1.5	Fuel storage/heaters		
1.4.2	List the components in a fuel oil system.		

1.4	Combustion (Continued)	Initials	Date
1.4.3	Describe the different fuel oil grades.		
1.4.4	Define:		
1.4.4.1	Flash point		
1.4.4.2	Fire point		
1.4.4.3	Pour point		
1.4.4.4	Volatility		
1.4.4.5	Heating value		
1.4.4.6	British thermal unit (BTU)		
1.4.4.7	What fuel oils require heating and under what circumstances?		
1.4.4.8	Combustion air		
1.4.4.9	Identify the parts of a burner.		
1.4.4.10	Identify the parts of a sprayer plate.		
1.4.4.11	Identify the parts of a return flow atomizer.		
1.4.4.12	Settings/casings/stacks/flues		
1.4.4.13	Barometric dampers		
1.4.4.14	Forced draft blowers		
1.4.4.15	Induced fans		
1.4.4.16	Sliding feet		
1.4.4.17	Identify the parts of a header type boiler.		
1.4.4.18	Describe how steam and water circulates in various boiler applications.		
1.5	Materials		
1.5.1	Plate, pipe, tubes, valves, nozzles		
1.5.2	Define “shock systems” and their hazards (feed and blowoff).		
1.5.3	Define slow opening in respect to valves.		
1.5.4	What are the maximum and minimum sizes for blowoffs?		
1.5.5	What are the requirements for drains?		

1.6	Refractory	Initials	Date
1.6.1	What are the purpose of firebrick, fire-block, insulating block, expansion joints?		
1.6.2	Sketch a typical high pressure water tube boiler furnace.		
1.6.3	Describe the failure modes of refractories.		
1.7	Joints		
1.7.1	Describe the following:		
1.7.1.1	Welds		
1.7.1.2	Flanges		
1.7.1.3	Bolting		
1.7.1.4	Gaskets		
1.7.1.5	Threaded connections		
1.8	Boiler Components		
1.8.1	Describe the following:		
1.8.1.1	Steam drum		
1.8.1.2	Water drum		
1.8.1.3	Superheater		
1.8.1.4	Waterwall tubes		
1.8.1.5	Screen wall tubes		
1.8.1.6	Generating tubes		
1.8.1.7	Economizers		
1.8.1.8	Airbox		
1.8.1.9	LP/HP drains		
1.8.1.10	Soot blowers		
1.8.1.11	Water gauge glass (tri-cocks)		
1.8.1.12	Steam smothering system		
1.8.1.13	Saddles/supports		
1.8.1.14	Manways and handholes		
1.8.1.15	Piping marking systems		

1.8	Boiler Components (Continued)	Initials	Date
1.8.16	Sketch a steam drum with internals – cyclone separator type (wrapper sheet/tube sheet).		
1.9	Additional Terminology		
1.9.1	Define the terms contained in the glossaries described below:		
1.9.1.1	ASME Section VI Article 2 (Appendix II)		
1.9.1.2	ASME Section VII Subsection 5 (Appendix III)		
1.9.1.3	Boiler System Component Definitions BT 3&2 4-1 – 4-2, 6-32 - 6-34; Appendix I		
1.9.1.4	ASME Section V Mandatory Appendix I Glossary of Terms for Nondestructive Examination		
1.10	Boiler Operations		
1.10.1	Describe the purpose of the following:		
1.10.1.1	Pressure and temperature gauges		
1.10.1.2	Calibration		
1.10.1.3	Controls		
1.10.1.4	Light-off sequencing		
1.10.1.5	Shut down sequencing		
1.10.1.6	Appurtenances		
1.11	Maintenance		
1.11.1	Describe the following terms:		
1.11.1.1	Lay-ups – wet and dry, desiccants		
1.11.1.2	Boiler tube cleaners		
1.11.1.3	Water wash		
1.11.1.4	Plugging of tubes		
1.11.2	Describe the importance of documentation.		
1.11.3	Logs		
1.11.4	Describe the following terms:		
1.11.4.1	Deaerating feed tanks (DFT)		
1.11.4.2	Feed pump		
1.11.4.3	Condensate pump		

1.11	Maintenance (Continued)	Initials	Date
1.11.5	Describe the following terms:		
1.11.5.1	Condenser		
1.11.5.2	Blow piping		
1.11.5.3	Surface blow		
1.11.5.4	Bottom blow		
1.11.5.5	Personnel training		
1.11.5.6	Preventing explosions		
1.11.5.7	Water level/GG		
1.11.5.8	Furnace pressure		
1.11.5.9	Expansion – sliding feet/pipe hangers		
1.11.5.10	Chemical cleaning		
1.11.5.11	Pressure testing		
1.11.5.12	Start-up		
1.11.5.13	Online operation (casualties)		
1.11.6	Why are hydrostatic tests performed and why is water the preferred/required medium?		
1.11.7	Describe the hazards associated with hydrostatic and pneumatic tests and how the code mitigated some of them.		
1.12	Corrosion and Failure		
1.12.1	Describe the following:		
1.12.1.1	How boilers and boiler components fail		
1.12.1.2	Causes		
1.12.1.3	Case history		
1.12.2	Describe some boiler casualties and what immediate action should be taken or not taken.		
1.12.3	Describe water treatment program.		
1.12.4	Describe steam and water deposit-related problems.		
1.12.5	Describe why a boiler may overheat.		
1.12.6	Describe the causes of waterside corrosion.		

1.12	Corrosion and Failure (Continued)	Initials	Date
1.12.7	Describe corrosion fatigue cracking.		
1.12.8	Describe stress corrosion cracking.		
1.12.9	Describe creep.		
1.12.10	Describe fireside erosion.		
1.12.11	Describe fireside corrosion and damage.		
1.12.12	Describe destructive testing and when is it used.		
1.13	Miscellaneous		
1.13.1	Write a description for an inspection report based on a scenario determined by the trainer.		
1.13.2	Describe basic tools and measuring equipment.		
1.13.3	Describe a scenario that requires in-trade critical thinking.		
1.14	Nondestructive Examination		
1.14.1	Define:		
1.14.1.1	Nondestructive examination (NDE)		
1.14.1.2	Inspection		
1.14.1.3	Examination		
1.14.1.4	Technique		
1.14.2	Describe the following NDE methods and the imperfections/ discontinuities each of the following NDE method can identify:		
1.14.2.1	RT — Radiography UT — Ultrasonics MT — Magnetic Particle PT — Liquid Penetrants VT — Visual LT — Leak Testing ET — Electromagnetic (Eddy Current) AE — Acoustic Emission		

	Pressure Vessel Basics and Principles	Initials	Date
1.15	Codes		
1.15.1	Describe the following:		
1.15.1.1	ASME Section VII		
1.15.1.2	NBIC Part 1		
1.15.1.3	NBIC Part 2		
1.15.1.4	ASME Section V		
1.15.1.5	OSHA confined space entry		
1.16	Vessel Types		
1.16.1	Describe the following types of pressure vessels and describe the usage and hazards associated with each:		
1.16.1.1	Air tanks		
1.16.1.2	Air oil separators		
1.16.1.3	CO2 vessels		
1.16.1.4	Ammonia vessels		
1.16.1.5	Refrigeration vessels		
1.16.1.6	Autoclaves/sterilizers		
1.16.1.7	Dryer rolls (including corrugated, yankee, etc.)		
1.16.1.8	Deaerator tanks		
1.16.1.9	Rendering vessels		
1.16.1.10	Process vessels		
1.16.1.11	Pressure cookers/retorts		
1.16.1.12	Steam platens		
1.16.1.13	Shell and tube heat exchangers		
1.16.1.14	Plate and frame heat exchangers		
1.16.1.15	Economizers		
1.16.1.16	Expansion tanks		
1.16.1.17	Blowdown tanks		

1.17	Vessel Construction	Initials	Date
1.17.1	Demonstrate knowledge on the following types of vessel construction and materials, uses, and limitations:		
1.17.1.1	Welded Riveted Lined Cast iron Wire wound		
1.18	Corrosion and Failure		
1.18.1	Demonstrate knowledge on cause and effects of degradation of vessels and how to monitor.		
1.18.2	Demonstrate calculations of corrosion allowances, how they apply and how to calculate MAWP.		
1.18.3	Describe the effects of corrosion.		
1.18.4	Describe the considerations/concerns with UPV's usage with corrosive materials and corrosive environments.		
1.18.5	Describe the effects of thinning – internal and external.		
1.18.6	Describe the issues with vessels being used in applications not designed for.		
1.18.7	Describe minimum design metal temperatures and environments where this may be most problematic.		
1.19	Nondestructive Examination (NDE)		
1.19.1	Demonstrate knowledge on material testing (NDE) of UPV's and techniques applicable for various discontinuities.		
1.19.2	Describe when you would use UT straight beam thickness testing and why.		
1.19.3	Describe when you would use UT angle beam testing on vessels and why.		
1.19.4	Describe when you would use wet fluorescent magnetic particle exam and why.		
1.19.5	Describe when you would use liquid penetrant testing on a vessel and why.		
1.20	Overpressure Protection		
1.20.1	Demonstrate knowledge of proper overpressure protection for pressure vessels.		
1.20.2	Describe types of pressure relief devices for various pressure vessels.		

1.20	Overpressure Protection (Continued)	Initials	Date
1.20.3	Demonstrate capacity calculations for different types of pressure vessels.		
1.20.4	Demonstrate capacity calculations for different types of pressure vessels.		
1.20.5	Demonstrate knowledge of overprotection protection by system design and when it is acceptable.		

Boiler and Pressure Vessel Fundamentals Module Review:

Supervisor Name	Supervisor Signature	Date

Module 2

Code References Overview

Introduction:

This module introduces the Inspector Candidate to the codes and standards throughout the boiler and pressure vessel industry. Each code has a specific, unique scope that impacts safety. National Board codes establish rules for inspectors and inspections. ASME codes govern the construction of boilers, pressure vessels and piping systems. The codes addressed in this module are only the foundation of what standards the Inspector Candidate will need to know. Inspector Candidates will need to familiarize themselves with additional standards (such as ASME Section II - Materials, ASME Section V - Nondestructive examination and/or ASME Section IX – Welding) for a fuller understanding of the reference material. After completing this module, Inspector Candidates should be able to demonstrate a working knowledge and understanding of the core codes and standards related in inservice inspection.

Reference Material:

- RCI-1, NB-263, *Rules for Commissioned Inspectors*
- *National Board Inspection Code* (NBIC), Parts 1 and 2
- ASME Section I, Power Boilers
- ASME B.31.1, Power Piping
- ASME Section IV, Heating Boilers
- ASME Section V, Nondestructive Examination
- ASME Section VIII, Division 1, Pressure Vessels
- ASME Section IX, Welding Brazing and Fusing Qualifications
- ASME CSD-1, Controls and Safety Devices for Boilers

Knowledge Checks:
Code References Overview

NBIC Forward

At this point the forward of NBIC should be read:

The National Board of Boiler and Pressure Vessel Inspectors is an organization composed of chief inspectors for the states, cities, and territories of the United States and provinces and territories of Canada. It is organized for the purpose of promoting greater safety to life and property by securing concerted action and maintaining uniformity in post-construction activities of pressure-retaining items, thereby ensuring acceptance and interchangeability among jurisdictional authorities responsible for the administration and enforcement of various codes and standards.

	NBIC Forward	Initials	Date
2.1	Discuss the forward to the NBIC.		

NB-263: *Rules for Commissioned Inspectors* (RCI-1)

Rules for Commissioned Inspectors will govern the requirements for issuance and renewal of commissions and endorsements, along with testing requirements. The rules also describe the duties and responsibilities.

Participants should be asked to complete the free RCI-1 training in the NBBI Business Center and be asked by the instructor to read Part 7 in its entirety.

Part 1 of RCI-1 should be reviewed with the Inspector Candidate, who will then go through the exercise of determining how many points they have in experience and education. Inspector Candidates will discuss the examination process. The duties for an inspector in Part 3 should be reviewed.

Discussion of Part 7 should address:

- Conflict of interest
- Good faith actions
- Public perception
- Independence, impartiality, and integrity

Inspectors must act in good faith, should be objective and immediately report safety hazards.

	NB-263: *Rules for Commissioned Inspectors* (RCI-1)	Initials	Date
2.2	Demonstrate a thorough understanding of RCI-1.		

National Board Inspection Codes (NBIC), Part 1, 2, and 3

The NBIC recognizes three important areas of post-construction activities where information, understanding, and following specific requirements will promote public and personal safety. These areas include:

- Installation
- Inspection
- Repairs and Alterations

The NBIC provides rules, information, and guidance for post-construction activities, but does not provide details for all conditions involving pressure-retaining items. Where complete details are not provided in this code, the code user is advised to seek guidance from the Jurisdiction and from other technical sources.

Part 1 provides requirements and guidance to ensure all types of pressure retaining items are installed and function properly. Installation includes meeting specific safety criteria for construction, materials, design, supports, safety devices, operation, testing, and maintenance. Part 1 Sections include:

- General Section
- Power Boilers
- Heat and Hot Water Boilers
- Pressure Vessels
- Piping
- Supplements for specific types of equipment

Part 2, one that will be used most by members and inservice inspectors, provides information and guidance needed to perform and document inspections for all types of pressure-retaining items. This part includes information on personnel safety, nondestructive examination, tests, failure mechanisms, types of pressure equipment, fitness for service, risk-based assessments, and performance-based standards. Part 2 includes:

- General Section for Inservice Inspection of Pressure-Retaining Items
- Detailed Requirements for Inservice Inspection of Pressure Retaining Items
- Corrosion and Failure Mechanisms
- Examinations, Test Methods and Evaluations
- Stamping Documentation and Forms
- Supplements

Part 3 provides information and guidance needed to perform and document repairs and alterations to boilers and pressure vessels. This part includes information on quality control systems, welding procedures and qualifications, repairs, alterations, examination, testing, documentation, and stamping. Part 3 includes:

- General Section for Administrative Requirements
- Welding, Brazing, Fusing, and Heat Treatment
- Requirements for Repairs and Alterations
- Examination and Testing
- Certification/Documentation and Stamping
- Supplements

The instructor should open Parts 1, 2, and 3 during the class showing participants the structure of the code books. Read the forward and the scope in each code.

	National Board Inspection Code Parts 1, 2, and 3	Initials	Date
2.3	Demonstrate a thorough understanding of NBIC Parts 1, 2, & 3.		

ASME Section I: Rules for Construction of Power Boilers

This Code covers rules for construction of power boilers, electric boilers, miniature boilers, high-temperature water boilers, heat recovery steam generators, solar receiver steam generators, certain fired pressure vessels, and liquid phase thermal fluid heaters to be used in stationary service and includes those power boilers used in locomotive, portable, and traction service. Reference to a paragraph includes all the subparagraphs and subdivisions under that paragraph. The Code does not contain rules to cover all details of design and construction. Where complete details are not given, it is intended that the manufacturer, subject to the acceptance of the Authorized Inspector, shall provide details of design and construction which will be as safe as otherwise provided by the rules in the Code. The construction code will pull into the process other codes such as material properties (ASME Section II, PG-5.1), Non Destructive Examination (ASME Section V, PW-50.1) and Welding Processes (ASME Section IX, PW-28.1). The code is composed of the main parts:

- Part PG General Requirements for All Methods of Construction
- Part PW Requirements for Boilers Fabricated by Welding
- Part PR Requirements for Boilers Fabricated by Riveting
- Part PB Requirements for Boilers Fabricated by Brazing
- Part PL Requirements for Locomotive Boilers
- Part PA Alternative Rules for Boiler Construction
- Part PWT Requirements for Watertube Boilers
- Part PFT Requirements for Firetube Boilers
- Part PFH Optional Requirements for Feedwater Heater
- Part PMB Requirements for Miniature Boilers

- Part PEB Requirements for Electric Boilers
- Part PVG Requirements for Organic Fluid Vaporizers
- Part PFE Requirements for Feed water Economizers
- Part PTFH Requirements for Liquid Phase Thermal Fluid Heaters
- Part PHRSG Requirements for Heat Recovery Steam Generators
- Numerous Appendices

	ASME Section I: Power Boilers	Initials	Date
2.4	Demonstrate a thorough understanding of ASME Section I.		

ASME B31.1: Power Piping

The general philosophy underlying this Power Piping Code is to parallel those provisions of Section I, Power Boilers, of the ASME Boiler and Pressure Vessel Code, as they can be applied to power piping systems. The allowable stress values for power piping are generally consistent with those assigned for power boilers. This Code is more conservative than some other piping codes, reflecting the need for long service life and maximum reliability in power plant installations.

	ASME B31.1: Power Piping	Initials	Date
2.5	Demonstrate a thorough understanding of ASME B31.1.		

ASME Section IV: Heating Boilers

The rules of this Section of the Code cover minimum construction requirements for the design, fabrication, installation, and inspection of steam heating, hot water heating, and hot water supply boilers that are directly fired with oil, gas, electricity, coal, or other solid or liquid fuels, and for operation at or below the pressure and temperature limits set forth in this document. Similar rules for potable water heaters are also included.

	ASME Section IV: Heating Boilers	Initials	Date
2.6	Demonstrate a thorough understanding of ASME Section IV.		

ASME Section V: Nondestructive Examination

This Section of the Code contains requirements and methods for nondestructive examination (NDE), which are Code requirements to the extent they are specifically referenced and required by other Code Sections or referencing documents. These

NDE methods are intended to detect surface and internal imperfections in materials, welds, fabricated parts, and components. They include radiographic examination, ultrasonic examination, liquid penetrant examination, magnetic particle examination, eddy current examination, visual examination, leak testing, and acoustic emission examination.

	ASME Section V: Nondestructive Examination	Initials	Date
2.7	Demonstrate a thorough understanding of ASME Section V.		

ASME Section VIII Division 1 : Pressure Vessels

This Division contains mandatory requirements, specific prohibitions, and non-mandatory guidance for pressure vessel materials, design, fabrication, examination, inspection, testing, certification, and pressure relief. The Code does not address all aspects of these activities, and those aspects which are not specifically addressed should not be considered prohibited. Engineering judgment must be consistent with the philosophy of this Division, and such judgments must never be used to overrule mandatory requirements or specific prohibitions of this division.

	ASME Section VIII Div. 1: Pressure Vessels	Initials	Date
2.8	Demonstrate a thorough understanding of ASME Section VIII.		

ASME Section IX: Welding Brazing and Fusing Qualifications

Section IX of the ASME Boiler and Pressure Vessel Code relates to the qualification of welders, welding operators, brazers, brazing operators, and fusing operators, and the procedures employed in welding, brazing, or plastic fusing in accordance with the ASME Boiler and Pressure Vessel Code and the ASME B31 Code for Pressure Piping. As such, this is an active document subject to constant review, interpretation, and improvement to recognize new developments and research data. Section IX is a document referenced for the qualification of material joining processes by various construction codes such as Section I, III, IV, VIII, XII, etc. These particular construction codes apply to specific types of fabrication and may impose additional requirements or exemptions to Section IX qualifications. Qualification in accordance with Section IX is not a guarantee that procedures and performance qualifications will be acceptable to a particular construction code. Review of ASME Section IX should result in an understanding that this code works in conjunction with construction codes.

	ASME Section IX: Welding, Brazing, and Fusing Qualifications	Initials	Date
2.9	Demonstrate a thorough understanding of ASME Section IX.		

ASME CSD-1 Controls and Safety Devices for Automatically Fired Boilers

The rules of this Standard cover requirements for the assembly, installation, maintenance, and operation of controls and safety devices on automatically operated boilers directly fired with gas, oil, gas-oil, or electricity, subject to the service limitations, exclusions, and acceptance of other listings in CG-120, CG-130, and CG-140, respectively. Burners or burner assemblies installed on boilers or as replacement burners shall comply with the requirements of CF-110 and CF-410 for gas and oil firing, respectively. The use of a gaseous or oil fuel not listed in the definitions has not been evaluated, and special considerations may be required. The major perils in operating automatically fired boilers are loss of water (low water), furnace explosion, overpressure, and over temperature. Principal causes of accidents to automatically fired boilers are lack of proper controls and safety devices, lack of adequate maintenance, improperly trained operators, failure to test controls and safety devices, and complacency on the part of the operator due to long periods of trouble-free operation. It is believed that improved instrumentation, controls and safety devices, proper operating procedures, and a clearer understanding of installation requirements by the manufacturers, installers, and operators can greatly reduce the chances of personal injury, damage to property, and loss of equipment from accidents. The rules of this Standard cover requirements for the assembly, installation, maintenance, and operation of controls and safety devices on automatically operated boilers directly fired with gas, oil, gas-oil, or electricity, subject to the service limitations stated in the scope.

	ASME CSD-1: Controls and Safety Devices	Initials	Date
2.10	Demonstrate a thorough understanding of ASME CSD-1.		

How to Become an Inspector

The instructor should ensure that each participant has reviewed each section of "How to Become a Commissioned Inspector" on the National Board Website. https://www.nationalboard.org/Index.aspx?pageID=392&ID=28

	How to Become an Inspector	Initials	Date
2.11	Review “How to Become a Commissioned Inspector”.		

Code Reference Overview Module Review:

Supervisor Name	Supervisor Signature	Date

Module 3

Safety

Within the scope of the National Board Inspection Code, personal safety is addressed in the first sentence. Personal and public safety is not just something that we need to pay attention to; it is the reason for the entire organization.

SCOPE

The NBIC recognizes four important areas of post-construction activities where information, understanding, and following specific requirements will promote public and personal safety.

Within the organization description the word safety appears in the description of Part 1 and Part 2;

This part includes information on personnel safety, non-destructive examination, tests, failure mechanisms…

In the FORWARD to the NBIC the purpose of the National Board makes it clear; It (meaning NBBPVI) is organized for the purpose of promoting greater safety to life and property by securing concerted action and maintaining uniformity in post-construction activities of pressure-retaining items…

NBIC Part II Section 1.1 (the SCOPE of the section) states, “The safety of the public and the Inspector is the most important aspect of any inspection activity.” That same section contains an additional section devoted to personal safety.

At this point, the instructor and the associate shall go through the scope of section 1 of NBIC Part II.

Introduction:

This module introduces the Inspector Candidate to safety equipment and practices. By completing this module, Inspector Candidates will demonstrate a working knowledge and the practical application of safety practices related to inservice inspection.

Knowledge Checks:
Safety

3.1	Safety Basics	Initials	Date
3.1.1	Discuss or define the following:		
3.1.1.1	Where is personnel safety referenced in the NBIC?		
3.1.1.2	Who is responsible for your safety?		
3.1.1.3	What are the owner's/client's responsibilities?		
3.1.1.4	What precautions should be taken around pressure relief devices?		
3.1.1.5	Precautions when working in industrial areas		
3.1.1.6	What is PPE and what are some examples?		
3.1.1.7	What is "lock out tag out"? How is it used?		
3.1.1.8	Who is responsible for the lock out tag out system?		
3.1.1.9	Electrical safety – identify the possible dangers.		
3.1.1.10	Possible issues with standing water and electricity?		
3.1.1.11	What is required for confined space entry?		
3.1.1.12	What does the term "gas free" mean, in relation to gas.		
3.1.1.13	At what percentage of oxygen by volume does hypoxia start? Hypoxia is a lack of oxygen to live tissue.		
3.1.1.14	What items are used for fall protection? What PPE should be inspected before using?		
3.1.1.15	How high can someone go before requiring fall protection?		
3.1.1.16	Concerns with inadequate lighting in the work area?		
3.1.1.17	Concerns with low voltage electrical wiring?		
3.1.1.18	Safety concerns and considerations regarding carbon monoxide (CO)		
3.2	CPR and First Aid		
3.2.1	Describe and discuss the following:		

3.2	CPR and First Aid (Continued)	Initials	Date
3.2.1.1	The purpose of CPR and First Aid		
3.2.1.2	Heat stroke		
3.2.1.3	Heat exhaustion		
3.2.1.4	Hyperthermia		
3.2.1.5	Hypothermia		
3.2.1.6	Frost bite		
3.2.2	Describe the immediate actions and methods for treating the following conditions:		
3.2.2.1	Cuts/scrapes/bleeding		
3.2.2.2	Heat stroke		
3.2.2.3	Heat exhaustion		
3.2.2.4	Hyperthermia		
3.2.2.5	Hypothermia		
3.2.2.6	Frost bite		

Practical Applications:

Safety

3.3	Safety	Initials	Date
3.3.1	At a field location, identify and review the following:		
3.3.1.1	Emergency evacuation plan		
3.3.1.2	Emergency exits		
3.3.1.3	First aid kits		
3.3.1.4	AED devices		
3.3.1.5	Eyewash station(s)		
3.3.1.6	MSDS		
3.3.1.7	Dawn and doff safety harness (or discuss if PPE not provided).		
3.3.1.8	Identify 10 safety concerns at a shop or field location.		

3.3	Safety (Continued)	Initials	Date
3.3.1.9	Complete 10 inspections wearing safety shoes, safety glasses, and a hard hat (and/or other PPE as required).		
3.3.1.10	Identify slip hazards.		
3.3.1.11	Perform signing into lock out tag out (simulate if necessary).		
3.3.1.12	Perform a confined space entry when permissible.		

Safety Module Review:

Supervisor Name	Supervisor Signature	Date

Module 4

Power Boilers and Power Piping

Introduction:

This module introduces the Inspector Candidate to inspection techniques related to power boilers and power piping. By completing this module, Inspector Candidates will demonstrate a working knowledge and the practical application of inspection techniques and methods related to inservice inspection.

Knowledge Checks:

Power Boilers

4.1	Jurisdictional Requirements	Initials	Date
4.1.1	Permitting		
4.1.2	Licensing		
4.1.3	Inspection frequency		
4.1.4	Exemptions		
4.1.5	Variances		
4.1.5	Violations		
4.2	Installation Inspection		
4.2.1	Boiler room condition		
4.2.2	Equipment clearances		
4.2.3	Combustion air intake		
4.2.4	Breaching/flue		
4.2.5	Fuel train (gas, oil) & certification		
4.2.6	Burner management systems		
4.2.7	Boiler blowdown tank size (capacity) and piping		
4.2.8	Feedwater piping		
4.2.9	Feedwater pumps' energy sources (solid & biomass fuels)		
4.2.10	Code stamping/nameplates and certification documents (boiler, BD Vessel, BEP)		

4.2	Installation Inspection (Continued)	Initials	Date
4.2.11	Safety valves (set pressure, capacity, size, mounting)		
4.2.12	SV discharge piping		
4.2.13	Jurisdictional identification, recording of pertinent information/inspection reports		
4.3	Steam Power Boilers - Inservice External Inspection		
4.3.1	Verification of boiler stamping, jurisdictional identification, and inspection history		
4.3.2	Water column blowdown, gauge glass condition		
4.3.3	Low water fuel cut off device operation and reset		
4.3.4	High temperature limit		
4.3.5	High pressure limit		
4.3.6	Flame scanner/fire eye		
4.3.7	Safety valve operation/testing. Discharge piping		
4.3.8	Condition of valves and piping (drain, feedwater, blowdown, main steam)		
4.3.9	Pressure gauge		
4.3.10	Condition of boiler external surfaces		
4.4	Steam Power Boilers - Internal Inspection		
4.4.1	Verification of boiler stamping, jurisdictional identification, and inspection history		
4.4.2	Water column & LWCO piping internal condition		
4.4.3	Low water fuel cut off device floats and chambers		
4.4.4	Condition of refractory		
4.4.5	Condition of tubes (fireside)		
4.4.6	Condition of tubes (waterside)		
4.4.7	Condition of tubesheets		
4.4.8	Condition of stays (tubesheet, crownsheet, waterlegs)		
4.4.9	Condition of steam drum		
4.4.10	Condition of mud drum		
4.4.11	Condition of furnace/generating bank		

4.4	Steam Power Boilers – Internal Inspection (Continued)	Initials	Date
4.4.12	Condition of handhole/manhole covers, sealing surfaces & gaskets		
4.4.13	Prior to entry		
4.4.14	Parts and appurtenances		
4.5	High-Pressure, High-Temperature Water Boilers - Inservice External Inspection		
4.5.1	Verification of boiler stamping, jurisdictional identification, and inspection history		
4.5.2	Condition of boiler casing		
4.5.3	Low water fuel cut off device operation and reset		
4.5.4	High temperature limit		
4.5.5	High pressure limit		
4.5.6	Flame scanner/fire eye		
4.5.7	Safety valve operation/testing. Discharge piping		
4.5.8	Pressure/temperature gauge		
4.5.9	Condition of valves and piping (supply and return, drain)		
4.6	High-Pressure, High-Temperature Water Boilers - Internal Inspection		
4.6.1	Verification of boiler stamping, jurisdictional identification, and inspection history		
4.6.2	Low water fuel cut off device floats and chambers		
4.6.3	Condition of refractory		
4.6.4	Condition of tubes (fireside)		
4.6.5	Condition of tubes (waterside)		
4.6.6	Condition of tubesheets		
4.6.7	Condition of stays (tubesheet, crownsheet, waterlegs)		
4.6.8	Condition of furnace		
4.6.9	Condition of handhole/manhole covers, sealing surfaces & gaskets		
4.6.10	Prior to entry		
4.6.11	Parts and appurtenances		

4.7	Boiler External Piping		
4.7.1	Definition, jurisdictional/code limits (BP, BEP, Non-BEP)		
4.7.2	ASME code stamping requirements		
4.7.3	Condition of isolation valves		
4.7.4	Condition drain/telltale valve		
4.7.5	Condition and effectiveness of supports and hangers		
4.7.6	Condition of flanged connections		

Practical Applications:

Power Boilers and Power Piping

4.8	Inspection	Initials	Date
4.8.1	Perform an installation inspection of a power boiler.		
4.8.2	Perform an inservice inspection of a power boiler.		
4.8.3	Perform an internal inspection of a power boiler.		
4.8.4	Perform an installation inspection of a miniature boiler.		
4.8.5	Inspect a firetube power boiler.		
4.8.6	Inspect a watertube power boiler.		
4.8.7	Inspect a scotch marine power boiler.		
4.8.8	Verify adequate clearances on a newly installed power boiler.		
4.8.9	Verify adequate combustion air for a power boiler.		
4.8.10	Verify adequate feedwater supply.		
4.8.11	Verify functionality of a high-pressure limit switch (with manual reset).		
4.8.12	Verify functionality of a low-water cutout (float type).		
4.8.13	Verify functionality of a low-water cutout (probe type).		
4.8.14	Verify functionality of a low or high gas pressure switch.		

4.8	Inspection (Continued)	Initials	Date
4.8.15	Verify functionality of a manually operated remote shutdown switch.		
4.8.16	Inspect the blowoff piping and valves of a power boiler.		
4.8.17	Use a borescope as part of an internal inspection.		
4.8.18	Calculate the minimum relief valve capacity for a power boiler.		
4.8.19	Verify adequate overpressure protection for a power boiler.		
4.9	Documentation		
4.9.1	Document a new installation inspection for a power boiler.		
4.9.2	Document an inservice inspection for a power boiler.		
4.9.3	Document a violation for a power boiler.		
4.9.4	Review a manufacturer's data report for any power boiler.		
4.9.5	Review a CSD-1 report for any power boiler.		

Power Boilers and Power Piping Module Review:

Supervisor Name	Supervisor Signature	Date

Module 5

Low Pressure and Heating Boilers

Introduction:

This module introduces the Inspector Candidate to code requirements and inspection techniques related to low pressure and heating boilers. By completing this module, Inspector Candidates will demonstrate a working knowledge and the practical application of inspection techniques and methods related to inservice inspection.

Knowledge Checks:
Low Pressure and Heating Boilers

5.1	Jurisdictional Requirements	Initials	Date
5.1.1	Permitting		
5.1.2	Inspection frequency		
5.1.3	Contractor licensing		
5.1.4	Operator licensing		
5.1.5	Exemptions		
5.1.6	Construction standards		
5.1.7	Variances		
5.1.8	Violations		
	ASME Section IV		
5.2	Part HG, Articles 1 & 2		
5.2.1	Scope & service restrictions		
5.2.2	Material requirements		
5.2.3	Part HG, Article 3		
5.2.4	Design pressure		
5.2.5	Thickness calculations		
5.2.6	Openings in boilers, general		

5.2	Part HG, Articles 1 & 2 (Continued)	Initials	Date
5.2.7	Reinforcement for openings		
5.2.8	Flanged-in openings		
5.2.9	Inspection & access openings		
5.2.10	Stayed surfaces		
5.2.11	Ligaments		
5.2.12	Tube holes/attachments		
5.2.13	External piping connections		
5.3	Part HG, Articles 4 & 5		
5.3.1	Overpressure protection		
5.3.2	Proof tests		
5.3.3	Hydrostatic test		
5.3.4	Pneumatic test		
5.3.5	Inspection by AI		
5.3.6	Master data report		
5.3.7	Partial data report		
5.3.8	Marking of boilers		
5.3.9	Marking of parts		
5.4	Part HG, Article 6 (Steam)		
5.4.1	Steam gauge		
5.4.2	Water gauge glass		
5.4.3	Water column		
5.4.4	Water level control pipes		
5.4.5	Pressure control		
5.4.6	Low water fuel cutoff		
5.4.7	Water feeding devices		
5.4.8	Modular steam heating boiler		
5.5	Part HG, Article 6 (HWH & HWS)		
5.5.1	Pressure/altitude gauge		

5.5	Part HG, Article 6 (HWH & HWS) (Continued)	Initials	Date
5.5.2	Thermometer/sensor		
5.5.3	Temperature control		
5.5.4	Low water fuel cutoff		
5.5.5	Modular HWH & HWS boilers		
5.6	Part HG, Article 6 (All)		
5.6.1	Controls inside jackets		
5.6.2	Electrical wiring		
5.6.3	Primary safety control		
5.6.4	Safety limit switches		
5.6.5	Burners		
5.6.6	Electric elements		
5.7	Part HG, Article 7		
5.7.1	PRV mounting		
5.7.2	Piping		
5.7.3	Feed/makeup water		
5.7.4	Storage tanks		
5.7.5	Thermal expansion		
5.7.6	Stop valves		
5.7.7	Bottom blow/drains		
5.7.8	Modular boilers		
5.7.9	Settings		
5.7.10	Method of support		
5.7.11	Part HC		
5.7.12	General		
5.7.13	Material requirements		
5.7.14	Design		
5.7.15	Tests		
5.7.16	Quality control/inspection		

5.8	Part HA	Initials	Date
5.8.1	General		
5.8.2	Material requirements		
5.8.3	Design		
5.8.4	Tests		
5.8.5	Quality control/inspection		
5.9	Part HLW, Article 1		
5.9.1	Scope & service restrictions		
5.9.2	Service limits		
5.9.3	Permissible markings		
5.10	Part HLW, Article 2		
5.10.1	Lining		
5.10.2	Primary pressure parts		
5.10.3	Misc. pressure part materials		
5.10.4	Flanges & pipe fittings		
5.10.5	Non-pressure part materials		
5.11	Part HLW, Article 5		
5.11.1	Proof test		
5.11.2	Testing of parts		
5.11.3	Witnessing tests		
5.11.4	Recording tests		
5.11.5	Certifying tests		
5.11.6	Hydrostatic test		
5.12	Part HLW, Article 6		
5.12.1	Inspection and certification		
5.12.2	Manufacturer’s data reports		
5.12.3	Marking		
5.13	Part HLW, Article 7		
5.13.1	Temperature control		
5.13.2	Limit controls		

5.13	Part HLW, Article 7 (Continued)	Initials	Date
5.13.3	Heat generating apparatus		
5.13.4	Electrical wiring		
5.14	Part HLW, Article 8		
5.14.1	Pressure relief valves		
5.14.2	Water supply		
5.14.3	Thermal expansion		
5.14.4	Bottom drain valve		
5.14.5	Thermometer		
5.15	Part HLW, Article 9		
5.15.1	General		
5.15.2	Marking		
5.15.3	Manufacturer’s data reports		
5.15.4	Pressure relief valves		
5.15.5	Supply/return headers		
5.15.6	Bottom drain valve		
5.15.7	Thermometers		
5.15.8	Scope & service restrictions		
5.15.9	Definitions		
5.15.10	General requirements		
5.15.11	Machine room requirements		
5.15.12	Source requirements		
5.15.13	Discharge requirements		
5.15.14	Operating systems		
5.15.15	Instruments/fittings/controls		
5.15.16	Pressure relief valves		
5.15.17	Testing and acceptance		

	NBIC Part 1	Initials	Date
5.16	Section 3		
5.16.1	Scope		
5.16.2	Service restrictions		
5.16.3	Definitions		
5.16.4	General requirements		
5.16.5	Equipment room requirements		
5.16.6	Source requirements		
5.16.7	Discharge requirements		
5.16.8	Operating systems		
5.16.9	Instruments, fittings, and controls		
5.16.10	Pressure relief valves		
5.16.11	Testing and acceptance		
	NBIC Part 2	Initials	Date
5.17	Section 1		
5.17.1	Scope		
5.17.2	Administration		
5.17.3	References to other codes		
5.17.4	Personnel safety		
5.17.5	Inservice inspection activities		
5.17.6	Pre-inspection activities		
5.17.7	Inspection planning		
5.17.8	Prep for internal inspection		
5.17.9	Post inspection activities		
5.17.10	Change of service		
5.18	Section 2.2, Boilers		
5.18.1	Service conditions		

5.18	Section 2.2, Boilers (Continued)	Initials	Date
5.18.2	Pre-inspection activities		
5.18.3	Condition of boiler room		
5.18.4	External inspection		
5.18.5	Internal inspection		
5.18.6	Evidence of leakage		
5.18.7	Corrosion considerations		
5.18.8	Waterside deposits		
5.18.9	Piping/parts/appurtenances		
5.18.10	Miscellaneous		
5.18.11	Gauges		
5.18.12	PRDs		
5.18.13	Controls		
5.18.14	Records review		
5.18.15	Cast iron boilers		
5.18.16	Firetube boilers		
5.18.17	Watertube boilers		
5.18.18	Electric boilers		
5.18.19	Fired coil water heaters		
5.18.20	Fired storage water heaters		
5.18.21	Thermal fluid heaters		
5.18.22	Waste heat boilers		
5.18.23	Recovery boilers		
5.19	Section 3, Corrosion and Failure		
5.19.1	General corrosion		
5.19.2	Macroscopic corrosion		
5.19.3	Microscopic corrosion		
5.19.4	Control of corrosion		
5.19.5	Process variables		

5.19	Section 3, Corrosion and Failure (Continued)	Initials	Date
5.19.6	Protection		
5.19.7	Material selection		
5.19.8	Coatings		
5.19.9	Engineering design		
5.19.10	Failure mechanisms		
5.19.11	Fatigue		
5.19.12	Creep		
5.19.13	Temperature effects		
5.19.14	Hydrogen embrittlement		
5.19.15	Hi-temp hydrogen attack		
5.19.16	Hydrogen damage		
5.19.17	Bulges/blisters		
5.19.18	Overheating		
5.19.19	Cracks		
5.20	Section 4, Inspection		
5.20.1	Examinations, Test Methods, and Evaluations		
5.20.1.1	Scope		
5.20.1.2	Nondestructive exam (NDE)		
5.20.1.3	Visual		
5.20.1.4	Magnetic particle		
5.20.1.5	Liquid penetrant		
5.20.1.6	Ultrasonic		
5.20.1.7	Radiography		
5.20.1.8	Eddy current		
5.20.1.9	Metallographic		
5.20.1.10	Acoustic emission		
5.20.1.11	Pressure testing		
5.20.1.12	Liquid pressure testing		

5.20	Section 4, Inspection (Continued)	Initials	Date
5.20.1.13	Pneumatic pressure testing		
5.20.2	Damage Mechanism Assessment and Inspection Frequency		
5.20.2.1	Scope		
5.20.2.2	General requirements		
5.20.2.3	Responsibilities		
5.20.2.4	Remaining service life		
5.20.2.5	ID damage mechanisms		
5.20.3	Estimate Inspection Intervals and Evaluate the Following:		
5.20.3.1	Subject to erosion/corrosion		
5.20.3.2	Exposure to corrosion		
5.20.3.3	Corrosion not a factor		
5.20.3.4	Creep		
5.20.3.5	Brittle fracture		
5.20.3.6	Bulges/blisters/lamination		
5.20.3.7	Crack like indications		
5.20.3.8	Fire damage		
5.20.3.9	Cyclic fatigue		
5.20.3.10	Local thin areas		
5.20.4	Risk Based Assessment Programs		
5.20.4.1	Scope		
5.20.4.2	Definitions		
5.20.4.3	General		
5.20.4.4	Considerations		
5.20.4.5	Key elements		
5.20.4.6	RBI assessment		
5.20.4.7	Probability of failure		
5.20.4.8	Consequence of failure		
5.20.4.9	Risk evaluation		
5.20.4.10	Risk management		

5.20	Section 4, Inspection (Continued)	Initials	Date
5.20.4.11	Jurisdictional relationships		
5.21	Section 5, Documentation		
5.21.1	Scope		
5.21.2	Replace stamping/nameplate		
5.21.3	National Board Inspection Code Report Forms		
5.21.4	NB-136		
5.21.5	NB-4		
5.21.6	NB-5		
5.21.7	NB-6		
5.21.8	NB-7		
5.21.9	NB-403		

Practical Applications:
Low Pressure and Heating Boilers

5.22	Inspection	Initials	Date
5.22.1	Perform an installation inspection of a low-pressure steam boiler.		
5.22.2	Perform an external inservice inspection of a low-pressure steam boiler.		
5.22.3	Perform an internal inservice inspection of any low-pressure steam boiler.		
5.22.4	Perform an installation inspection of a hot water heating boiler.		
5.22.5	Perform an installation inspection of a hot water supply boiler.		
5.22.6	Perform an external inservice inspection of any hot water boiler.		
5.22.7	Perform an internal inservice inspection of any hot water boiler.		
5.22.8	Inspect a watertube boiler.		
5.22.9	Inspect a firetube boiler.		
5.22.10	Inspect a cast boiler (cast iron or aluminum).		

5.22	Inspection (Continued)	Initials	Date
5.22.11	Inspect a vertical tube boiler.		
5.22.12	Inspect a condensing boiler.		
5.22.13	Verify functionality of a high-temperature limit (with manual reset).		
5.22.14	Verify functionality of a low or high gas pressure switch.		
5.22.15	Verify functionality of a low-water cutout (float type).		
5.22.16	Verify functionality of a low-water cutout (probe type).		
5.22.17	Verify functionality of a flame eye sensor.		
5.22.18	Verify functionality of a manually operated remote shutdown switch.		
5.22.19	Calculate the minimum relief valve capacity for a sectional boiler.		
5.22.20	Verify adequate overpressure protection.		
5.23	Documentation		
5.23.1	Document a new installation inspection for a heating boiler.		
5.23.2	Document an inservice inspection for a heating boiler.		
5.23.3	Document a new installation inspection for a steam boiler.		
5.23.4	Document an inservice inspection for a steam boiler.		
5.23.5	Review a manufacturer’s data report for any boiler.		
5.23.6	Review a CSD-1 report.		

Low Pressure and Heating Boilers Module Review:

Supervisor Name	Supervisor Signature	Date

Module 6

Pressure Vessels

Introduction:

This module introduces the Inspector Candidate to code requirements and inspection techniques related to pressure vessels. By completing this module, Inspector Candidates will demonstrate a working knowledge and the practical application of inspection techniques and methods related to inservice inspection.

Knowledge Checks:

Pressure Vessels

6.1	Jurisdictional Requirements	Initials	Date
6.1.1	Permitting		
6.1.2	Inspection frequency		
6.1.3	Contractor licensing		
6.1.4	Operator licensing		
6.1.5	Exemptions		
6.1.6	Construction standards		
6.1.7	Variances		
6.1.8	Violations		
6.2	Code Requirements - Installation		
6.2.1	Clearances		
6.2.2	Piping connections and bolting • Ensure pressure vessel has a drain valve installed. • Piping of the drain line will depend upon location and type of vessel, but it must always discharge to a safe and proper location.		
6.2.3	Level and pressure indicating devices		
6.2.4	Overpressure protection		
6.2.5	Vessel Specific Requirements:		

6.2	Code Requirements – Installation (Continued)	Initials	Date
6.2.5.1	Hot water and potable hot water storage tanks		
6.2.5.2	Yankee dryers		
6.2.5.3	Liquid carbon dioxide storage vessels		
6.2.5.4	Graphite pressure equipment		
6.2.5.5	Pressure vessels for human occupancy		
6.3	Code Requirements - Inservice		
6.3.1	External Inspection:		
6.3.1.1	Inspection methods and devices		
6.3.1.2	Insulation and coverings		
6.3.1.3	Material condition		
6.3.1.4	Structure and attachments		
6.3.1.5	Gauges, piping and valves • Ensure the automatic or manual drain valves are tested regularly ◦ If possible, observe discharge of condensate to drains • Observe and report the general condition of the piping		
6.3.1.6	Controls and safety devices		
6.3.2	Internal Inspection:		
6.3.2.1	Inspection methods and devices		
6.3.2.2	Vessel connections		
6.3.2.3	Vessel closures		
6.3.2.4	Potential corrosion and failure mechanisms		
6.3.3	Vessel Specific Requirements:		
6.3.3.1	Deaerators		
6.3.3.2	Compressed air vessels		
6.3.3.3	Expansion tanks		
6.3.3.4	Liquid ammonia vessels		
6.3.3.5	Pressure vessels with quick acting closures		
6.3.3.6	Transport tanks		

6.3	Code Requirements – Inservice (Continued)	Initials	Date
6.3.3.7	Anhydrous ammonia nurse tanks		
6.3.3.8	Pressure vessels for human occupancy		
6.3.3.9	Static vacuum insulated cryogenic vessels		
6.3.3.10	Wire wound vessels		
6.3.3.11	Graphite pressure equipment		
6.3.3.12	Fiber reinforced plastic pressure equipment		
6.3.3.13	Yankee dryers		
6.3.3.14	DOT transport tanks		
6.3.3.15	Pressure vessels in liquified petroleum gas service		
6.3.3.16	Stationary high-pressure composite pressure vessels		
6.3.3.17	Liquid carbon dioxide storage vessels		
6.4	Code Requirements - Documentation		
6.4.1	Nameplate markings		
6.4.2	Manufacturer's data report		
6.4.3	Nameplate replacement – NB-136		
6.4.4	Fitness for service assessment – NB-403		

Practical Applications:
Pressure Vessels

6.5	Inspection	Initials	Date
6.5.1	Perform an installation inspection of any pressure vessel.		
6.5.2	Perform an inservice inspection of any pressure vessel.		
6.5.3	Perform an internal inspection of any pressure vessel.		
6.5.4	Inspect a compressed air vessel.		
6.5.5	Inspect a CO2 vessel.		
6.5.6	Inspect a deaerator.		

6.5	Inspection (Continued)	Initials	Date
6.5.7	Inspect a heat exchanger.		
6.5.8	Inspect a hot water storage tank.		
6.5.9	Inspect a sterilizer or autoclave.		
6.5.10	Demonstrate or witness the application of a non-visual NDE method.		
6.5.11	Calculate the volume of a pressure vessel.		
6.5.12	Verify adequate overpressure protection for a pressure vessel.		
6.6	Documentation	Initials	Date
6.6.1	Document a new installation inspection for a pressure vessel.		
6.6.2	Document an inservice inspection for a pressure vessel.		
6.6.3	Document a violation for a pressure vessel.		
6.6.4	Review a manufacturer's data report for any pressure vessel.		
6.6.5	Demonstrate the use of the NB-136 form.		
6.6.6	Demonstrate the use of the NB-403 form.		

Pressure Vessels Module Review:

Supervisor Name	Supervisor Signature	Date

Module 7

Pressure Relief Devices

Introduction:

This module introduces the Inspector Candidate to code requirements and inspection techniques related to pressure relief devices. By completing this module, Inspector Candidates will demonstrate a working knowledge and the practical application of inspection techniques and methods related to the inservice inspection of a wide variety of pressure relief devices.

Knowledge Checks:

Pressure Relief Devices

7.1	ASME Section XIII	Initials	Date
7.1.1	1.1 Scope		
7.1.2	Mandatory Appendix I, all definitions		
7.1.3	Part 13 Overpressure Protection by System Design		
7.2	NBIC Part 4		
7.2.1	Define and discuss the following terms:		
7.2.1.1	Capacity certification		
7.2.1.2	Changeover valve		
7.2.1.3	Pilot operated pressure relief valve		
7.2.1.4	Pressure relief device		
7.2.1.5	Pressure relief valve		
7.2.1.6	Relief valve		
7.2.1.7	Safe point of discharge		
7.2.1.8	Safety relief valve		
7.2.1.9	Safety valve and Rupture Disk		

	NBIC Part 4 (Continued)	Initials	Date
7.2.1.10	Part 4, Section 2 – Installation Quantity, Location, Capacity, and Set Pressure(s) for • Power Boilers • Heating (Steam, Hot Water and Hot Water Supply Boilers) • Pressure Vessels		
7.2.1.11	Part 4, Section 3 - Inspection • PRD Inspection Requirements • PRD Testing Requirements		
7.2.2	Part 4, Section 4 – Repair:		
7.2.2.1	4.1 Scope		
7.2.2.2	4.1 General Requirements		
7.2.2.3	4.7 Stamping Requirements for Pressure Relief Devices		
7.2.3	Part 4, Section 6 – Supplements:		
7.2.3.1	Supplement 1- Pressure relief valves on the low pressure side of steam pressure reducing valves.		
7.2.3.2	Supplement 2 - Pressure differential between pressure relief valve setting and boiler or pressure vessel operating pressure.		
7.2.3.3	Supplement 3 - Pressure relief and pilot valve storage & shelf life.		

Practical Applications:

Pressure Relief Devices

7.3	Installation	Initials	Date
7.3.1	Verify adequate overpressure protection for a boiler.		
7.3.2	Verify adequate overpressure protection for a pressure vessel.		
7.3.3	Demonstrate ability to calculate discharge pipe size for manifolding of discharge pipes.		
7.4	Inspection		
7.4.1	Demonstrate ability to read and understand a **VR** nameplate.		

7.4	Inspection(Continued)	Initials	Date
7.4.2	Demonstrate ability to review SV test report.		
7.4.3	Demonstrate the ability to calculate the reducing capacity required for a UPV PRD.		
7.4.4	Demonstrate the ability to calculate the reducing capacity required for the low-pressure side of a steam pressure reducing station.		

Additional Training:

Online Training	Initials	Date
Successfully complete the NBBI online training course National Board Inspection Code, Part 4, Pressure Relief Devices.		

Pressure Vessels Module Review:

Supervisor Name	Supervisor Signature	Date

Training Courses and Examination

NBBI Online Training Courses:

NBIC Part 1 Online Course		
Successfully complete the online training course for NBIC Part 1		
Verified by:	Signature	Date
NBIC Part 2 Online Course		
Successfully complete the online training course for NBIC Part 2		
Verified by:	Signature	Date
Rules for Commissioned Inspectors (RCI-1) Online Course		
Successfully complete the online training course for RCI-1		
Verified by:	Signature	Date

National Board Classroom Inservice Commission Course (IS):

Inservice Commission Course (IS)		
Successfully complete the classroom commission course		
Verified by:	Signature	Date

National Board Inservice Inspector Commission Exam:

Inservice Inspector Commission Exam		
Achieve a passing score on the Inservice Commission exam		
Verified by:	Signature	Date

List of Qualified Trainers

The following is a list of all commissioned Inservice Inspectors or Inservice Inspector Supervisors who contributed to the training of the Inspector Candidate. The initials used to indicate verified completion of a Knowledge Check or Practical Application must match one of the Inspector initials provided here.

Inspector Name	Commission Number	Initials	Signature

Signature Page

Inspector Candidate:

By signing this document, I affirm that I have completed the program requirements as outlined in NB-380 and detailed in this workbook. The dates and signatures in this workbook accurately reflect the training I have received and knowledge I have demonstrated.

Inspector Candidate's Acknowledgement		
	Signature	Date

Chief Inspector or Inspector Supervisor:

By signing this document, I affirm that I have reviewed the workbook for accuracy and completeness. I affirm that the Inspector Candidate has completed the program requirements as outlined in NB-380 and detailed in this workbook. The dates and signatures in this workbook accurately reflect the training given under my supervision.

Supervisor's Acknowledgement		
	Signature	Date

Comments and Notes

The following pages are reserved for comments, notes, or any other additional information to be shared with National Board staff.