NBIC
Inspection Tools for Historical Boilers

Joel T. Amato
Chief Boiler Inspector
Minnesota
History

• “Those who fail to learn from history are condemned to repeat it.”

• Winston Churchill, 1948 speech to the House of Commons
Historical Boilers

- Historical boilers are boilers that are being preserved, restored and maintained for demonstration, viewing or educational purposes.
How it all started...

• The Aeolipile (ee-ol-uh-pahyl)
• Created by Hero of Alexandria
• 10-70 AD
Introduction of the steam traction engine

- The self-propelled steam engine became popular in industrialized countries around 1850 and lasted until about 1930.
- Uses included threshing grain, plowing, mining, construction, sawmill operation, and the “hot pond”.
Increased Production

• Not only did the steam engine allow greater production for farming and lumber, the number of steam traction engines produced grew in great numbers.

• 91 Manufacturers of steam traction engines just in the United States between 1850 and 1930
This cut illustrates a section of the Patent Detachable Boiler Flue Device, and the method of inserting the same in a fire box boiler.

These Flues have given excellent satisfaction to users everywhere, and by reason of the ease with which they can be removed, cleaned and replaced, are especially desirable in those localities where operators are compelled to use bad and dirty water.

3. Boilers equipped with Detachable Flues will be charged with an extra price. Quotations made upon application.

Address all Communications to
THE MINNEAPOLIS THRESHING MACHINE CO.
West Minneapolis, Hopkins P.O., Minn.

ANNOUNCEMENT

"The Great Minneapolis Line" has taken over and removed to its works at West Minneapolis, Minn., the entire plant, machinery, tools and stock of the Detachable Boiler Flue Manufacturing Co., of Minneapolis, Minn., and will manufacture Detachable Boiler Flues under its patents for all makes, sizes and styles of boilers.

Circulars describing this Patent Detachable Flue will be sent free on application.
The Buffalo Pitts Boiler—The Boiler of Quality
History

• Prior to 1913 there were no construction standards in the U.S.
• Very few inspection programs prior to 1881
• No water treatment programs
• Operator Training was limited, very few licensed operators
Incidents and Accidents

• Between 1850 and 1930 there were many explosions that resulted in loss of life
• Many of these were due to improper repairs and untrained operators
Today

- Many of these historical boilers still exist as a reminder of our history
- Minnesota has approximately 160 operating historical boilers
So, How do you keep a 100 year old boiler operating safely?
National Board Inspection Code (NBIC)

• First Published in 1945 it was 27 pages.
• Provided guidance and rules for the inservice repair and alteration of boilers
• 2017, now in 4 parts, Installation, Inspection, Repairs and Alterations, and Pressure relief devices, now over 800 pages.
• Public Safety, Maintain pressure retaining items by providing rules for the installation, inspection and repair, thereby ensuring that these items may continue to operate safely
RECOMMENDED RULES FOR REPAIRS BY FUSION WELDING TO POWER BOILERS AND UNFIRED PRESSURE VESSELS (over 15 lb. pressure)
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Today
2015 NBIC Part 2, Inspection

• General and Detailed requirements for the inspection of Pressure Retaining items
  • Historical Boilers
## NBIC Subgroup Historical

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<tr>
<td>Joel Amato</td>
<td>Jurisdictional Authorities</td>
<td>Chair</td>
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<td>Tom Dillon</td>
<td>Owners and Operators General Interest</td>
<td>Vice Chair</td>
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<td>Jim Getter</td>
<td>Manufacturers</td>
<td>Member</td>
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<td>Frank Johnson</td>
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<td>David Rose</td>
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<td>Robert Underwood</td>
<td>Authorized Inspection Agencies</td>
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<td>Mike Wahl</td>
<td>Owners and Operators General Interest</td>
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NBIC Historical Subgroup

• Meets twice per year
• Reports to:
  • Part 2, Inspection
  • Part 3, Repairs and Alterations
NBIC Part 2, Supplement 2
Historical Boiler

• Inspection Requirements
  • Inspectors
  • Owners
  • Operators
Supplement 2, Historical Boiler Inspections

• Provides Inspector guidance and requirements on inspection and examination methods

• Examination Methods
  • Visual
  • Ultrasonic
  • Liquid Penetrant
  • Magnetic Particle
  • Radiographic
  • Hydrostatic test
  • Inservice inspection
Supplement 2, Historical Boiler Inspections

- Required Examinations
  - Ultrasonic
  - Visual
  - Inservice Inspection
  - Hydrostatic
Supplement 2, Historical Boiler Inspections

• Initial inspection requires all required examination types
  • Ultrasonic
  • Visual examination
  • Hydrostatic test
  • Inservice Inspection

• Establish Maximum Allowable Working Pressure (MAWP) for each component
Subsequent Inspections

• Following year after initial inspection
  • First year: Inservice Inspection
  • Second year: Visual Inspection
  • Third year: Hydrostatic pressure test
  • Fourth year: Inservice Inspection
  • Fifth year: Ultrasonic thickness testing
  • Sixth year: Hydrostatic pressure test
  • Seventh year: back to first year
Supplement 2, Historical Boiler Inspections (Ultrasonic)

• Inspectors no longer perform calculations for cylindrical components (barrels)

• \[ P = \text{TS} \times t \times E \times \frac{R}{FS} \]

• This helps prevent errors

• Allows owner/operator to double check results
Supplement 2, Historical Boiler Inspections (Ultrasonic)

- Based on the joint type, Shell ID, and Shell Thickness they can use a chart to determine the MAWP
Supplement 2, Historical Boiler Inspections (Ultrasonic)

- Inspectors no longer perform calculations for areas with stayed surfaces (firebox, wrapper sheet)

\[ P = \frac{t^2 \cdot S \cdot C}{P^2} \]
Supplement 2, Historical Boiler Inspections (Ultrasonic)

- Also provides inspector guidance and requirements for locally thinned areas
Supplement 2, Historical Boiler Inspections (Hydrostatic Testing)

• Leak tightness testing
• Pressure for test shall be 1.25 times MAWP
• Held for 10 minutes or as long as it takes to perform a complete visual inspection
• Water temperature must be between 60 and 120 degrees F
Supplement 2, Historical Boiler Inspections
(Visual Examination)

- Fusible plugs
- Openings or connections in the boiler
- Mechanical attachment points
- Boiler sheets
- Tubes
Supplement 2, Historical Boiler Inspections (Inservice Inspection)

- Demonstration of:
- Two means of boiler feedwater delivery
- Tri-cocks and correlation with gage glass level
- Gage glass upper and lower shutoff valves
- Gage glass blowdown
- Pressure gage
- Safety valve test, and verify stamping and set pressure
NBIC Part 3, Repairs and Alterations

- Part 3, Supplement 2, Specifically for repairs and alterations to Historical Boilers
- Repairs to stayed surfaces, riveted seams, unstayed surfaces, tubes, staybolts and all parts of historical boilers
Inspectors, Owners, and Operators

All welded repairs must be performed by an National Board Certified “R” stamp company
Part 3, Supplement 2, Repairs

• Provides detailed diagrams and illustrations for examples of repair methods.
FIGURE S2.13.8
ACCEPTABLE FORMS OF TUBE ATTACHMENTS

(a)

(b)

(c)

Not over 2 t nor less than t but in no case more than 1/4 in. (6.3mm) nor less than 1/8 in. (3.2 mm)

(d)

(e)

(f)

Not less than t and in no case less than 1/8 in. (3.2 mm)
FIGURE S2.13.9.1
WELD BUILDUP

Original thickness of boiler shell

Wasted area

Minimum required thickness

60% of minimum required thickness

Cross-sectional view of boiler shell

Repair by weld buildup is permitted when area is not greater than 3 sq. in. (1950 sq. mm)
NBIC Note:

- It should be recognized that safety of these boilers is dependent upon the knowledge and training of the operator in proper use, repair, maintenance, and safe operation of each specific boiler.
University of Rollag
Rollag, Minnesota

- Two day school for Historical Boiler Operators
- Annually on Father’s Day Weekend
- 16 hours of credit toward your Minnesota Historical Boiler Engineers License
- Chief Inspectors may attend for free!
- Open to all
- There are also steam traction schools in Wisconsin, Iowa and Oklahoma
How many Chief Boiler Inspectors does it take to safely operate a Historical Boiler?
At least two...