Date Distributed: **August 3, 2022**

THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

NATIONAL BOARD INSPECTION CODE SUBGROUP INSTALLATION

MINUTES

Meeting of July 12, 2022
Indianapolis, IN

These minutes are subject to approval and are for committee use only. They are not to be duplicated or quoted for other than committee use.

The National Board of Boiler & Pressure Vessel Inspectors
1055 Crupper Avenue
Columbus, Ohio 43229-1183
Phone: (614) 888-8320
FAX: (614) 847-1828

1. **Call to Order**

   Mr. Patten called the meeting to order at 8:00 a.m. (EDT).

2. **Introduction of Members and Visitors**

   Mr. Patten held roll call with the members and visitors. Each member and visitor (in person and remote) introduced themselves with their name and company/interest category. All attendees are listed on **Attachment pages 1 – 3.**

3. **Check for a Quorum**

   With 15 out of 16 members present (in person and remote), a quorum was met.

4. **Awards/Special Recognition**

   There were no awards or special recognitions for this meeting.

5. **Announcements**

   Mr. Patten gave the announcements:

   - The National Board will be hosting a reception on Wednesday evening from 6:30 p.m. to 8:30 p.m. in City Way Gallery at the hotel.
   - The National Board will be hosting breakfast and lunch on Thursday. Breakfast will be served from 7:00 a.m. to 8:00 a.m., and lunch will be served from 11:30 a.m. to 12:30 p.m. Both meals will be served in the Market Table Restaurant at the hotel.
   - This meeting is the last at which items can be approved for inclusion in the 2023 edition of the NBIC.
   - Mr. Robert Smith will give a brief presentation on recent updates found in the 2022 ASME PVHO-1 and PVHO-2 publications.

6. **Mr. Gary Scribner reviewed the letter ballot procedures from NB-240, Section 7.3.** Both the NBIC Letter Ballot Procedures outline and the NB-240 are uploaded to the Cloud. Mr. Patten commented on the importance of responding to ballots in a timely manner.

7. Mr. Patten spoke briefly about the accessibility of the **NBIC Handbook and the NB-240**, both of which are uploaded to the Cloud.

8. **Adoption of the Agenda**

   No revisions to the agenda were suggested. A motion to adopt the agenda as presented was made. The motion was seconded and unanimously approved.

9. **Approval of the Minutes of January 18, 2022, Meeting**

   A motion to approve the minutes from the January 18, 2022, subgroup meeting was made. The motion was seconded and unanimously approved.

10. Review of Rosters

a. Membership Nominations

Mr. Rodger Adams (Authorized Inspection Agencies) and Mr. Jeff Kleiss (Manufacturers) have expressed interest in becoming subgroup members.

Both candidates spoke briefly about their employment history and involvement with the National Board. After this, a motion was made to recommend both nominees. The motion was seconded and unanimously approved.

b. Membership Reappointments

Randy Austin is up for reappointment to the subgroup.

Mr. Austin expressed that he will not be running for reappointment to the subgroup or subcommittee.

c. Officer Appointments

The subgroup discussed candidates to recommend as Chair of the subgroup.

Mr. Patten recommended Mr. Wiggins as Chair. Mr. Wiggins declined, but suggested Mr. Clark. Ms. Wadkinson recommended Mr. Brockman, to which he spoke briefly about his history and involvement with the committee. Both candidates stepped out briefly while the subgroup discussed. During discussion, it was noted that Mr. Clark had not been a member of the committee for at least two years, and therefore, was not eligible for the Chair position (NB-240, 4.3.3b.). A motion was made to recommend Mr. Brockman as Chair of the subgroup. The motion was seconded and unanimously approved.

11. Open PRD Items Related to Installation

- NB15-0305 – Create Guidelines for Installation of Overpressure Protection by System Design – D. Marek (PM).

- NB15-0315 – Review isolation valve requirements in Part 1, 4.5.6 and 5.3.6 – D. DeMichael (PM)

- 17-119 – Part 4, 2.2.5 states that pressure setting may exceed 10% range. Clarify by how much – T. Patel (PM). This item is on hold pending ASME action.

- 19-83 – Address Alternate Pressure Relief Valve Mounting Permitted by ASME CC2887-1 – D. Marek (PM)

- 22-08 – Review and improve guidance for T&P valve installation relating to probe.

- 22-15 – What is the meaning of "service limitations" as used in Part 4, 2.4.5?
  - Mr. Clark spoke about the NBIC's use of the phrase, "service limitations" and its references within Part 4 and Part 1. The issue is that Part 1 does not specify any service limitations.

- 22-16 – Allow the use of pressure relief valves on potable water heaters.
  - Mr. Clark gave a brief overview of PRD's progress with this item, and some discussion followed.

12. Interpretations

There are no Part 1 interpretation requests to address.

13. Action Items

Item Number: 20-27	**NBIC Location: Part 1, 1.6.9 & S6.3**	**No Attachment**
General Description: Carbon Monoxide Detector/Alarm NBIC 2019		
Subgroup: SG Installation **Task Group:** E. Wiggins (PM), G. Tompkins R. Spiker, R. Smith, S. Konopacki, R. Austin, T. Creacy, and Jeff Kleiss **Explanation of Need:** These codes are being enforced by some jurisdictions on existing installations. Inspectors need to know what codes we need to enforce. Do the detectors have specific levels of CO when an alarm is to go off? Is there a requirement for an audible alarm or decibel level of the alarm? Where in the boiler room should the alarm/monitor be mounted?		
July 2022 Meeting Action: Progress Report		
Ms. Wadkinson will move this item to the Executive Committee's agenda for January 2023 to discuss whether to incorporate this topic as a standalone document or to revise the NBIC Introduction to include terms other than pressure-retaining devices (e.g., CO alarms and controlled equipment).		

Item Number: 20-33	**NBIC Location: Part 1**	**No Attachment**
General Description: Flow or Temp Sensing Devices forced Circulation Boilers **Subgroup:** SG Installation **Task Group:** M. Downs (PM), D. Patten, and M. Wadkinson **Explanation of Need:** Incorporation of applicable CSD-1 requirements.		
July 2022 Meeting Action: Progress Report		
Ms. Wadkinson will email Mr. Downs for a report on this item.		

Item Number: 20-44	**NBIC Location: Part 1**	**No Attachment**
General Description: CW Vacuum Boilers **Subgroup:** SG Installation **Task Group:** R. Spiker (PM), M. Washington, and J. Byrum **Explanation of Need:** Incorporation of applicable CSD-1 requirements.		
July 2022 Meeting Action: Progress Report		
Mr. Byrum and Mr. Spiker reported that the manufacturer is no longer communicating with the task group, so they are looking for another source.		

Item Number: 20-62	NBIC Location: Part 1, 1.4.5.1	No Attachment

General Description: Update the National Board Boiler Installation Report

Subgroup: SG Installation

Task Group: T. Clark (PM), E. Wiggins, R. Spiker, T. Creacy, P. Jennings, G. Tompkins, and D. Patten.

Explanation of Need: The form has not been updated in years. The form will be part of the National Board's Jurisdictional Reporting System which is currently under development.

July 2022 Meeting Action: Progress Report

Mr. Clark gave an overview of his proposed changes and the challenges facing it—primarily the varying jurisdictional requirements. JRS intends to use this form as a generic base for reports that they will eventually modify specific to each jurisdiction's requirements. Mr. Clark will prepare this item for review and comment by the Chiefs.

Item Number: 20-86	NBIC Location: Part 1, 2.10.1 a)	No Attachment

General Description: Testing and Acceptance: Boil-out Procedure

Subgroup: SG Installation

Task Group: E. Wiggins (PM), D. Patten, M. Washington, and S. Konopacki

Explanation of Need: This was brought to my (Mr. Eddie Wiggins) attention by Ernest Brantley. Mr. Brantley indicated during an acceptance inspection, he found boiler with excessive oil on the tubes and tube sheet after boiler was delivered and installed. He could not find any reference to boil-out to remove this extraneous material.

July 2022 Meeting Action: Progress Report

Mr. Wiggins spoke about a few of the revisions he made to the initial proposal; Ms. Wadkinson recommended moving this proposal to a new location: Part 1, Section 1.6.10. After Mr. Wiggins revises the proposal and it is reviewed by again, this item is to be retitled to be included in Part 1, Section 1, to apply to both power and heating boilers.

14. New Items:

Item Number: 22-10	NBIC Location: Part 1, S1	Attachment Pages 4 – 9

General Description: Changes to Yankee Dryer P1_S1

Subgroup: SG Installation

Task Group: J. Jessick (PM), M. Richards, and R. Spiker

Explanation of Need: Various updates, including to recognize steel in addition to cast iron, and to promote consistency of Supplements among each Part.

July 2022 Meeting Action: Proposal

Mr. Jerry Jessick (Part 2) gave a presentation on the Yankee Dryer references within Part 1 and Part 3, as well as his recommended changes. The subgroup also reviewed this item's ballot comments. After a break, Mr. Patten presented a revised proposal. A motion was made to recommend acceptance of the revised proposal. The motion was seconded and unanimously approved.

Task Group Update: Add M. Richards and R. Spiker

Item Number: 22-13	NBIC Location: Part 1, 3.8.2.2	No Attachment

General Description: Align hot water boiler thermometer requirements with ASME Section IV

Subgroup: SG Installation

Task Group: T. Clark (PM), P. Jennings, G. Tompkins, Rodger Adams, and David Zalusky

Explanation of Need: NBIC Part 1 does not expressly permit the use of temperature sensors or digital displays as thermometers for hot-water heating or supply boilers, even though they are permitted under ASME Section IV, HG-612. NBIC Part 1 also does not address the required temperature range of thermometers, inconsistent with ASME Section IV.

July 2022 Meeting Action: Progress Report

Mr. Clark explained two approaches that could be made regarding this item. The first approach is to utilize vague verbiage that would allow for the use of digital thermometers. The second approach is to incorporate verbiage that aligns with ASME Section IV. A task group was assigned.

15. Mr. Robert Smith, P.E., gave a presentation on recent updates from the 2022 ASME PVHO-1 and PVHO-2 publications. A copy of the PowerPoint presentation is uploaded to the Cloud.

16. Future Meetings

- January 2023 – Charleston, SC
- July 2023 – TBD

17. Adjournment

Mr. Patten made a motion to adjourn the meeting at 3:12 p.m. (EDT). The motion was seconded and unanimously approved.

Respectfully submitted,

Michelle Vance

Michelle Vance
Subgroup Installation Secretary

Subgroup Installation Attendance: July 12, 2022

MEMBERS:	Interest Category	In Person	Remote	Not In Attendance
Don Patten	Manufacturers	x		
Edward Wiggins	Jurisdictional Authorities		x	
Gene Tompkins	Manufacturers	x		
H. Michael Richards	General Interest		x	
J. Matt Downs	Manufacturers			x
Jim Byrum	Authorized Inspection Agencies	x		
Joe Brockman	Authorized Inspection Agencies	x		
Melissa Wadkinson	Manufacturers	x		
Milton Washington	Jurisdictional Authorities	x		
Patrick Jennings	Authorized Inspection Agencies	x		
Randy Austin	Users		x	
Rex Smith	Authorized Inspection Agencies	x		
Ron Spiker	Jurisdictional Authorities	x		
Stanley Konopacki	Users		x	
Todd Creacy	Authorized Inspection Agencies	x		
Tom Clark	Jurisdictional Authorities	x		
Michelle Vance	Secretary	x		

VISITORS:	Company / Interest	In Person	Remote
Bryan Ahee	Bradford White Corporation	x	
David Warshall	New York City		x
David Zalusky	CNA Insurance	x	
Jeff Kleiss	Lochinvar, LLC.		x
Jerry Jessick	Fusion Integrated Solutions	x	
Joseph Beauregard	Los Alamos National Laboratory	x	
Rob Troutt	BOT Chair / State of Texas	x	
Rodger Adams	Zurich Resilience Solutions	x	
Sean Skiles	Fulton Pacific Boiler Solutions	x	
Gary Scribner	NBBI staff	x	
Luis Ponce	NBBI staff	x	

NBIC Subgroup Installation Attendance - 7/12/2022					
First Last	**Email**	**Company**	**Phone #**	**Signature**	**Attending Reception?**
Joe Brockman	Ronald.Brockman@FMGlobal.com	FM Global	573-821-2227	[signature]	yes ✓
Edward Wiggins	Edward.Wiggins@labor.alabama.gov	State of Alabama	334-549-3201		
Marvin Byrum	Marvin.byrum@gmail.com	ARISE	334-640-3047	[signature]	✓
Randy Austin	rdaustin@lanl.gov	Los Alamos National Laboratory	505 667-6740		
Don Patten	dpatten@baycityboiler.com	Bay City Boiler	510 786-3711	[signature]	✓
Michelle Vance	mvance@nationalboard.org	The National Board	614-888-8320	[signature]	✓
Stanley Konopacki	Stanley.Konopacki@nrg.com	NRG	847 599-2214		
Melissa Wadkinson	Melissa.wadkinson@fulton-management.com	Fulton	315 298-7112	[signature]	✓
Todd Creacy	todd.creacy@zurichna.com	Zurich	817 403-4601	[signature]	✓
H. Michael Richards	Hmichaelrichards.pe@gmail.com	Southern Co.	205 706-0748		
James Downs	mdowns@weil-mclain.com	Weil-McLain	219-879-6561		
Milton Washington	milton.washington@doi.nj.gov	State of New Jersey	609 292-2345	[signature]	✓
Patrick Jennings	patrick_jennings@hsb.com	HSB	860-722-5582	[signature]	✓
Rex Smith	RSmith@aiallc.org	Authorized Inspection Associates, LLC	281 751-1150	[signature]	No
Ron Spiker	ronndj@gmail.com	State of South Carolina	803-608-1630	[signature]	Yes
Gene Tompkins	gtomp76000@hotmail.com	ABMA	920-289-0245	[signature]	✓
Jerry Jessick	gjessick@fusion-etc.com	Fusion Integrated Solutions	9208198570	[signature]	✓
Joseph Beauregard	jbeauregard@lanl.gov	LANL	505 412 8155	[signature]	✓
Rodger Adams	Rodger.Adams@zurichna.com	Zurich	704-258-8073	[signature]	✓
Tom Clark	thomas.g.clark@dcbs.oregon.gov	State of Oregon	971-209-7082	[signature]	✓
David Zalusky	David.Zalusky@cna.com	CNA Insurance	410-841-9781	[signature]	✓
Bryan Ahee	BAHEE@BRADFORDWHITE.COM	Bradford White Corporation	269-795-3364	[signature]	✓

NBIC Subgroup Installation Attendance - 7/12/2022					
First Last	Email	Company	Phone #	Signature	Attending Reception?
Sean Skiles	sean.skiles@fulton-pacific.com	fulton pacific	(559) 647-9917	[illegible]	✓

SUPPLEMENT 1
INSTALLATION OF YANKEE DRYERS (ROTATING PRESSURE VESSELS) WITH FINISHED SHELL OUTER SURFACES

S1.1 SCOPE

(21)

This supplement provides guidelines for the installation of a yankee dryer. -Additional guidelines are found in Part 2 for Inspection, and Part 3 for Repair and Alteration.

A yankee dryer has the following characteristics:

a) A yankee dryer It is a rotating steam-pressurized cylindrical vessel commonly used in the paper industry, and is typically made of cast iron, finished to a high surface quality, and.- It is characterized by a center shaft connecting the heads. While traditionally made of cast iron, bolted or welded steel vessels are in use.

b) Yankee dryers are primarily used in the production of tissue-type paper products. When used to produce machine-glazed (MG) paper, the dryer is termed an MG cylinder. A wet paper web is pressed onto the finished dryer surface using one or two pressure (pressing) rolls. Paper is dried through a combination of mechanical dewatering by the pressure roll(s),); thermal drying by the pressurized Yankeeyankee dryer,; and a steam-heated or fuel-fired hood. After drying, the paper web is removed from the dryer.

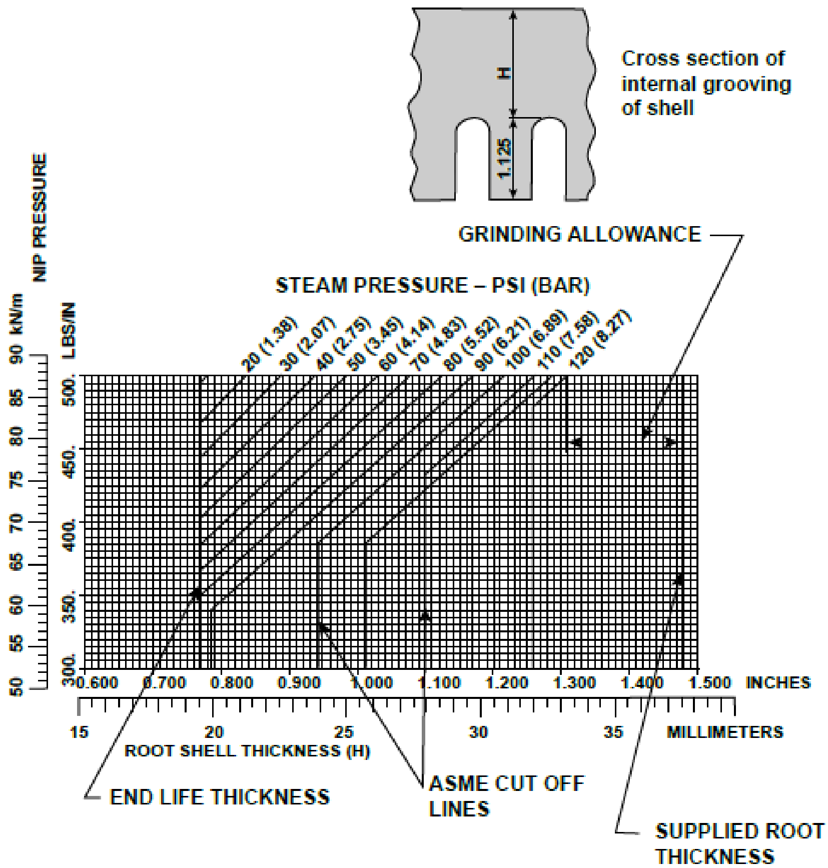
c) A yankeeThe dryer is typically manufactured in a range of outside diameters from 8 to 23 ft. (2.4 m to 7 m), widths from 8 to 28 ft. (2.4 m to 8.5 m), pressurized and heated with steam up to 160 psi (1,100 kPa), and rotated at speeds up to 7,000 ft/./min (2,135 m/min). Typical pressure roll loads against the Yankeeyankee dryer are up to 600 pounds per linear inch (105 kN/m). A thermal load results from the drying process due to difference in temperature between internal and external shell surfaces. The dryer has an internal system to remove steam and condensate. These vessels can weigh up to 220 tons (200 tonnes).

d) The typical yankee dryer is an assembly of several large components. The cylindrical shell is commonly ASME SA-278 gray cast iron, or SA-516 steel. Shells internallyInternally, shells may be smooth bore or ribbed. Heads, center shafts, and journals may be gray cast iron, ductile cast iron, or steel.

FIGURE S1.1

A TYPICAL MANUFACTURER'S "DE-RATE CURVE"

NOTE: There are several safe operating pressures for a given shell thickness.



S1.2 ~~ASSESSMENT OF~~ INSTALLATION ASSESSMENT

a) The Inspector verifies that the owner or user is prepared to properly ~~controlling~~control the operation of the dryer such that maximum operating conditions ~~of the dryer.~~are not exceeded. The maximum operating conditions are provided by the dryer manufacturer or a source acceptable to the Inspector ~~does this by reviewing the owner's comprehensive assessments~~and can be in the form of ~~the complete installation~~a derate curve or drawing with listed parameters.

b) The dryer is subjected to a variety of loads over its life. Some of the loads exist individually, while others are combined. Considerations of all the loads that can exist on a Yankee dryer are required to determine the maximum allowable operating parameters. There are four loads that combine during normal operation to create the maximum operating stresses, usually on the outside surface of the shell at the axial center line. These loads and the associated protection devices provided to limit these loads are:

1) Pressure load due to internal steam pressure. Overpressure protection is provided by a safety relief valve;

2) Inertial load due to dryer rotation. Over-speed protection is usually provided by an alarm that indicates higher-than-allowable machine speed;

3) Thermal gradient load due to the drying of the web. Protection against unusual drying loads is usually provided by logic controls on the machine, primarily to detect a "sheet-off" condition that changes the thermal load on the shell exterior from being cooled by the tissue sheet to being heated by the hot air from the hood; and

4) Pressure roll load (line or nip load) due to pressing the wet web onto the dryer. Overload protection is usually provided by a control valve that limits the pneumatic or hydraulic forces on

the roll loading arms such that the resultant nip load does not exceed the allowable operating nip load.

c) Steam pressure, inertial, and thermal gradient loads impose steady-state stresses. These stresses typically change when the dryer shell thickness (effective thickness for ribbed dryers) is reduced to restore a paper-making surface, the grade of tissue is changed or speed of the dryer is changed.

d) The pressure roll(s) load imposes an alternating stress on the shell face. The resulting maximum stress is dependent on the magnitude of the alternating and steady-state stresses.

e) ASME Section VIII, DivisionDiv. 1, of the ASME Code only provides specific requirements for the analysis of pressure loads. Although the Code requires analysis of other loads, no specific guidance for thermal, inertial, or pressure roll loads is provided. Hence, additional criteria must be applied by the manufacturer to account for all the steady-state and alternating stresses.

f) To maintain product quality, the dryer surface is periodically refurbished by grinding. This results in shell thickness reduction. Therefore, the manufacturer does not provide a single set of maximum allowable operating parameters relating steam pressure, rotational speed, and pressure roll load for a single design shell thickness. The manufacturer, or another qualified source acceptable to the Inspector, instead provides a series of curves that graphically defines these maximum allowable operating parameters across a range of shell thicknesses. This document is known as the "De-rate Curve." (See NBIC Part 1, Figure S1.1).. In cases where no derate curve is provided the manufacturer, or another qualified source, may provide a set of operating conditions and a minimum shell thickness.

g) Thermal spray (metallizing) materials may be applied to extend and improve dryer operations and provide a more wear resistant surface. Thermal spray coatings are often applied to the exterior of steel shells and may be applied to cast iron shells. Once applied, the metallization may be ground periodically before it is removed or replaced. Thermal spray coatings do not add strength to the component and are not included in shell thickness calculation. Grinding that reduces thickness of the pressure containing shell material to which metallization has been applied must be evaluated for any necessary pressure and safety device re-settings.

g)h)In addition to the loads on the Yankeeyankee dryer due to operation, other nonstandard load events can occur during shipment and installation into the paper machine. These nonstandard load events should be recorded in an incident log. Examples of nonstandard load events include:

1) Damage to the protective packaging of the Yankee dryer during transport; and installation

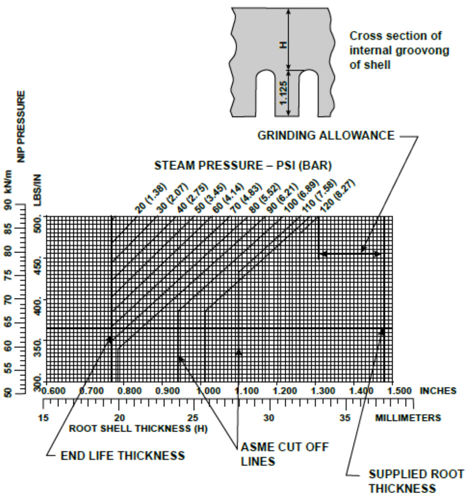
2) Scratches, gouges, dents inof the Yankeeyankee dryer shell during packaging removal or installation into the paper machine;, or undesirable mechanical contact between the yankee and other surfaces

3) Excessive heating of the Yankeeyankee dryer shell during the installation and testing of the hot air hood. If the hot air hood will be generating air that is hotter than the Yankeeyankee dryer shell material's maximum allowable working temperature (MAWT), then temperature sensors should be installed to monitor and record the Yankeeyankee dryer shell temperature during the hood testing; and

4) Impact load from improperly installed rolls, wires, nuts, dropped wrenches, etc., that may travel through the pressure roll nip causing external impact loads on the Yankeeyankee dryer shell.

h)i) If nonstandard load events (incidents) have occurred during installation, then the Inspector should ensure that an appropriate assessment of the structural integrity of the Yankeeyankee dryer has been performed. For additional details see Yankeeyankee dryer supplements in NBIC Part 2 and Part 3.

FIGURE S1.1



S1.3 DETERMINATION OF ALLOWABLE OPERATING PARAMETERS

a) A ~~Yankee~~yankee dryer is designed and intended to have its shell thickness reduced over the life of the vessel through routine wear and grinding~~ and machining.~~. The ~~Yankee~~yankee dryer shell is ground ~~or machined~~ on the outside surface to restore the quality or shape of the papermaking surface, essential to the manufacturing of tissue or other paper products.

b) Design documentation~~, called the "De-rate Curve,"~~ is required ~~and~~that dictates the maximum allowable operating parameters as shell thickness is reduced~~ (see NBIC Part 1, Figure S1.1).~~. Calculations~~,~~ used to determine those parameters~~,~~ are in accordance with ASME Code requirements for primary membrane stress ~~by the vessel manufacturer or~~and design criteria based ~~on~~upon other relevant stress categories~~,~~; (e.g., fatigue and maximum principal stress~~.~~). Calculation of these parameters requires that the respective stresses, resulting from the imposed loads, be compared to the appropriate material strength properties. Hence, knowledge of the applied stresses in the shell and the tensile and fatigue properties of the material are essential.

c) Yankee dryers are subjected to a variety of loads that create several categories of stress. Yankee dryers are designed such that the stress of greatest concern typically occurs on the outside surface at the axial centerline of the shell.

1) Steam Pressure Load — The internal steam pressure is one of the principal design loads applied to the ~~Yankee~~yankee dryer. The steam pressure expands the shell radially, causing a predominately circumferential membrane tensile stress. Because the shell is constrained radially by the heads at either end of the shell, the steam pressure also causes a primary bending stress in the vicinity of the head-to-shell joint. The ends of the shell are in tension on the inside and compression on the outside due to the steam pressure. The steam pressure also causes a bending stress in the heads.

2) Inertia Load — The rotation of the ~~Yankee~~yankee dryer causes a circumferential membrane stress in the shell similar to that caused by the steam pressure load. This stress is included in the design of the shell and increases with dryer diameter and speed.

3) Thermal Gradient Load — The wet sheet, applied to the shell, causes the outside surface to cool and creates a thermal gradient through the shell wall. This thermal gradient results in the outside surface being in tension and the inside surface in compression. With this cooling, the average shell temperature is less than the head temperature, which creates bending stresses on the ends

of the shell and in the heads. The ends of the shell are in tension on the outside and compression on the inside.

a. Other thermal ~~loadings~~loading also ~~occur~~occurs on a ~~Yankee~~yankee dryer. The use of full~~-~~width showers for a variety of papermaking purposes affects the shell similar to a wet sheet. The use of edge sprays ~~produce~~produces high bending stress in the ends of the shell due to the mechanical restraint of the heads.

b. Warm-up, cool-down, hot air impingement from the hood, moisture profiling devices, ~~fire fighting~~firefighting, and wash-up can all produce non-uniform thermal stresses in the pressure-~~retaining~~containing parts of the ~~Yankee~~yankee dryer. Heating or cooling different portions of the ~~Yankee~~yankee dryer at different rates causes these non-uniform stresses.

4) ~~Nip~~Line Load — The ~~nip~~line load from the contacting pressure roll(s) results in an alternating, high cycle, bending stress in the shell. This stress is greatest at the centerline of the shell. The load of the pressure roll deflects the shell radially inward causing a circumferential compressive stress on the outside surface and a tensile stress on the inside. Because the shell has been deflected inward at the pressure roll nip, it bulges outward about 30 degrees on each side of the nip. The outward bulge causes a tensile stress on the outside shell surface at that location and a corresponding compressive stress on the inside. Since the shell is passing under the pressure roll, its surface is subjected to an alternating load every revolution.

S1.4 ASME CODE PRIMARY MEMBRANE STRESS CRITERIA

a) Yankee dryers are typically designed and fabricated in accordance with ASME Section VIII, Division 1~~, The maximum allowable stress for cast iron is specified in UCI-23 and UG-22 of the ASME Code~~.

b) ASME Section VIII, Division 1, requires design stresses to be calculated such that any combination of loading expected to occur simultaneously during normal operation of the ~~Yankee~~yankee dryer will not result in a general primary stress exceeding the maximum allowable stress value of the material. In the ASME Code, the combination of loading resulting in the primary membrane stress in the shell is interpreted to be only composed of the circumferential stress from steam pressure. Sometimes, the stress from the inertial loading is included in this consideration.

c) In ASME Section VIII, Division 1, it is very important to note that no formulas are given for determining the stresses from thermal operating loads and pressure roll nip load(s). Hence, additional criteria need to be incorporated to establish the maximum allowable operating parameters of the ~~Yankee~~yankee dryer. Two such additional criteria are based upon the maximum principal and fatigue stress.

1) Maximum Principal Stress Criteria

The maximum principal stress in a ~~Yankee~~yankee dryer shell is the sum of the stresses that are simultaneously applied to the shell and is always aligned in the circumferential direction. The purpose of these criteria is to recognize the paper making application of the ~~Yankee~~yankee dryer and to prevent catastrophic failure by including all stresses. The ASME Code does not provide specific formulas for the full array of ~~Yankee~~yankee dryer shell stresses encountered in tissue making.

2) Fatigue Stress Criteria

Under normal operation, the stresses due to the steam pressure, inertial and thermal operating loads are considered to be steady-state stresses. When acting simultaneously, the sum of these stresses must be judged against the cyclic, or alternating, stress due to the pressure roll nip load. Fatigue stress criteria limit the alternating stress at a given mean stress using fatigue failure criteria~~ described by the Goodman or Smith Diagram.~~. The purpose of this limitation is to prevent crack initiation in the outside wall due to the combination of stresses. As the thickness of the shell is reduced, one or more of these criteria will control the various operating parameters.

S1.5 PRESSURE TESTING

a) Water pressure testing in the field is not recommended because of the large size of Yankeeyankee dryers and the resulting combined weight of the Yankeeyankee dryer and the water used in the testing. This combined weight can lead to support structure overload. Several failures of Yankeeyankee dryers have occurred during field pressure testing using water. If this test must occur, the following review is recommended:

   1) The testing area should be evaluated for maximum allowable loading, assuming the weight of the Yankeeyankee dryer, the weight of the water filling the Yankeeyankee dryer, and the weight of the support structure used to hold the Yankeeyankee dryer during the test; and

   2) The manufacturer should be contacted to provide information on building the Yankeeyankee dryer support structure for the water pressure test. Typically, the Yankeeyankee dryer is supported on saddles that contact the Yankeeyankee dryer shell at each end near the head-to-shell joint. The manufacturer can provide information on saddle sizing and location so that the Yankeeyankee dryer is properly supported for the test.

b) When pressure testing is desired to evaluate the Yankeeyankee dryer for fitness for service, an alternative to water pressure testing is acoustic emission testing using steam or air pressure. Typically, the test pressure used is the operating pressure. Caution needs to be exercised to ensure personnel safety. Entry to the test area needs to be controlled and all personnel need to maintain a safe distance from the Yankeeyankee dryer during the test. The steam or air test pressure should never exceed the maximum allowable working pressure (MAWP) of the Yankeeyankee dryer.

S1.6 NONDESTRUCTIVE EXAMINATION

a) Nondestructive examination (NDE) methods should be implemented by individuals qualified and experienced with the material to be tested using written NDE procedures. For Yankee dryers, cast iron knowledge and experience are essential.

b) Typical nondestructive examination methods should be employed to determine indication length, depth, and orientation (sizing) of discontinuities in Yankeeyankee dryers. Magnetic Particle, specifically the wet fluorescent method, and Dye Penetrant methods are applicable in the evaluation of surface-breaking indications. Ultrasound testing is the standard method for evaluation of surface-breaking and embedded indications. Radiographic methods are useful in the evaluation of embedded indications. Acoustic EmmissionEmission Testing can be used to locate and determine if a linear indication is active, e.g., propagating crack. Metallographic Analysis is useful in differentiating between original casting discontinuities and cracks.

c) When nondestructive testing produces an indication, the indication is subject to interpretation as false, relevant, or nonrelevant. If it has been interpreted as relevant, the necessary subsequent evaluation will result in a decision to accept, repair, replace, monitor, or adjust the maximum allowable operating parameters.