SUMMER 2014

BULLETIN

TECHNICAL JOURNAL OF THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

The Technology of Steam


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BULLETIN
TECHNICAL JOURNAL OF THE NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS

The National Board of Boiler and Pressure Vessel Inspectors was organized for the purpose of promoting greater safety by securing concerted action and maintaining uniformity in the construction, installation, inspection, and repair of boilers and other pressure vessels and their appurtenances, thereby ensuring acceptance and interchangeability among jurisdictional authorities empowered to ensure adherence to code construction and repair of boilers and pressure vessels.

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Steam valve under test at the National Board Testing Laboratory.
A steam collection pipe is not shown in this picture but is normally used for discharge of steam to a safe location.

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DEPARTMENTS

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The Symbolism of Safety

BY DAVID A. DOUIN, EXECUTIVE DIRECTOR

Symbols are dynamic means of communication.

In the pressure equipment industry, symbols are particularly important in that they often denote a particular achievement, accomplishment, or stature.

At the National Board, the **R** *Certificate of Authorization* and accompanying **R** stamp symbol are issued to an accredited organization performing repairs and alterations to pressure-retaining items. The **VR** *Certificate of Authorization* and **VR** symbol stamp are provided for repairs to pressure relief devices. The **NR** *Certificate of Authorization* and **NR** symbol stamp are issued for repairs and replacement of nuclear components. All are registered trademarks of The National Board of Boiler and Pressure Vessel Inspectors. And all require significant substantiation that a company is professionally qualified to perform necessary repairs, alterations, and replacement functions.

So that accredited organizations can share their credentials with potential customers, we permit these companies to display National Board stamp facsimiles on their promotional materials. While this practice has been for the most part successful for many, many years, the digital age has revealed a number of instances where several companies are displaying National Board stamps without required authorization.

This goes beyond the use of the National Board logo (prohibited in *all* instances) or wording to the effect a company is "certified" by the National Board. The National Board does not "approve," "rate," or "endorse" specific items, activities, or organizations.

Thanks to the Internet, we are able to regularly review many pressure equipment repair/modification company websites. Those inappropriately displaying the National Board logo (stylized clover leaf) are requested to remove same. Most are cooperative.

An area, however, that remains problematic involves promotional use of our stamps by companies no longer authorized to do so.

So what is the harm?

Those permitted to feature a National Board stamp facsimile in their advertising have undergone a rigorous process that reflects professional capability, responsibility, and significant time and resources. While it is easy to say unauthorized use of National Board stamps is unfair to companies that do abide by our authorization process, there is a more profound and potentially dangerous issue.

A number of former stamp holders have continued to use stamp facsimiles in their advertising beyond the expiration of their certificates. Sustained illegal use of a mark implies the unauthorized organization retains an official National Board connection.

The problem results when an unsuspecting organization begins its search for, say, a company with an **R** stamp. I don't think I have to detail the issues associated with hiring unqualified repair organizations. Suffice it to say, it's all about safety.

In order to affect the timely removal of National Board stamp facsimiles on the promotional materials of those organizations who returned their stamps, we have adopted the following policy:

Once a stamp has been returned to the National Board, the relinquishing company ***must remove within 30 days*** *all facsimiles of the stamp in all company materials, especially those intended to promote and market company services. These materials include – but are not limited to – websites, social media, brochures, signage, and promotional media such as telephone book advertising, and print/electronic ads.*

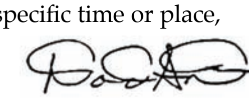
While we hope such a policy will be honored, our staff will continue to monitor the websites of those companies no longer in possession of National Board stamps. Organizations in violation will be personally contacted with a request to cease use of the stamp image in their materials.

So how do companies seeking professional boiler services find a bona fide vendor?

The National Board website has long posted the *Manufacturer and Repair Directory*. It can be found under Resources and includes information on all current National Board stamp holders. These can be located either by company name or city and state. A search feature will identify all stamp holders in the area along with contact information, the type of stamp(s) held (including ASME), and the stamp expiration date.

While we may all witness periodic misuse of commercial symbols, safety industry marks serve specific purposes that are intended to underscore quality assurance and promote public confidence. Any breach in that trust increases the likelihood that something will go wrong. Eventually.

And while "eventually" may not be a specific time or place, it is somewhere none of us wants to be.



2013 Report of Violation Findings

The National Board Annual Violation Tracking Report identifies specific violations (per device type) commonly found on five types of pressure equipment during jurisdiction-required inspections. The following data reflects the reporting period of 1/1/2013 – 12/31/2013 as reported by participating member jurisdictions.

The Violation Tracking Report indicates problem areas and trends related to boiler and pressure vessel operation, installation, maintenance, and repair. The data also identifies problems before adverse conditions occur. This report serves as an important source of documentation for jurisdictional officials, providing statistical data to support the continued funding of inspection programs.

Overall Totals for Each Type of Pressure Equipment

Type of Pressure Equipment	Total Number of Inspections	Total Number of Violations	Percent of Violations
High-Pressure/High-Temperature Boilers (S)(M)(E)	64,198	4,517	7.0%
Low-Pressure Steam Boilers (H)	51,274	8,334	16.3%
Hot Water Heating/Supply Boilers (H)	264,086	33,158	12.6%
Pressure Vessels (U)(UM)	217,518	7,770	3.6%
Potable Water Heaters (HLW)	45,531	4,484	9.8%
Totals	**642,607**	**58,263**	9.1%

NUMBER OF JURISDICTION REPORTS: 117

High-Pressure/High-Temperature Boilers (S)(M)(E)

Device Type	Number of Violations	*V/I	**V/V
1) Safety Relief Devices	666	1.0%	14.7%
2) Low-Water Cutoffs/Flow Sensing Devices	239	0.4%	5.3%
3) Pressure Controls	124	0.2%	2.7%
4) Temperature Controls – Operator or High Limit	21	<0.1%	0.5%
5) Burner Management	546	0.9%	12.1%
6) Level Indicators – Gage Glasses, Bulls Eyes, and Fiber Opticals	316	0.5%	7.0%
7) Pressure/Temperature Indicators	104	0.2%	2.3%
8) Pressure-Retaining Items (PRI) / Boiler-Piping, Pumps, Systems Valves, Expansion Tanks	2,501	3.9%	55.4%

Summary:

- Number of Jurisdiction Reports: 117
- Total Number of Inspections: 64,198
- Total Number of Violations: 4,517
- Percent Violations: 7.0%

***V/I** Total number of Violations for Category divided by Total Inspections for this device type

****V/V** Total number of Violations for Category divided by Total Violations for this device type

Low-Pressure Steam Boilers (H)

Device Type	Number of Violations	*V/I	**V/V
1) Safety Relief Devices	1,327	2.6%	15.9%
2) Low-Water Cutoffs/Flow Sensing Devices	713	1.4%	8.6%
3) Pressure Controls	709	1.4%	8.5%
4) Temperature Controls – Operator or High Limit	163	0.3%	2.0%
5) Burner Management	1,020	2.0%	12.2%
6) Level Indicators – Gage Glasses, Bulls Eyes, and Fiber Opticals	563	1.1%	6.8%
7) Pressure/Temperature Indicators	201	0.4%	2.4%
8) Pressure-Retaining Items (PRI) / Boiler-Piping, Pumps, Systems Valves, Expansion Tanks	3,638	7.1%	43.7%

Summary:

- Number of Jurisdiction Reports: 117
- Total Number of Inspections: 51,274
- Total Number of Violations: 8,334
- Percent Violations: 16.3%

***V/I** Total number of Violations for Category divided by Total Inspections for this device type

****V/V** Total number of Violations for Category divided by Total Violations for this device type

Hot Water Heating/Supply Boilers (H)

Device Type	Number of Violations	*V/I	**V/V
1) Safety Relief Devices	6,599	2.5%	19.9%
2) Low-Water Cutoffs/Flow Sensing Devices	2,152	0.8%	6.5%
3) Pressure Controls	187	0.1%	0.6%
4) Temperature Controls – Operator or High Limit	2,909	1.1%	8.8%
5) Burner Management	4,941	1.9%	14.9%
6) Level Indicators – Gage Glasses, Bulls Eyes, and Fiber Opticals	654	0.2%	2.0%
7) Pressure/Temperature Indicators	1,213	0.5%	3.7%
8) Pressure-Retaining Items (PRI) / Boiler-Piping, Pumps, Systems Valves, Expansion Tanks	14,503	5.5%	43.7%

Summary:

- Number of Jurisdiction Reports: 117
- Total Number of Inspections: 264,086
- Total Number of Violations: 33,158
- Percent Violations: 12.6%

***V/I** Total number of Violations for Category divided by Total Inspections for this device type

****V/V** Total number of Violations for Category divided by Total Violations for this device type

Pressure Vessels (U) (UM)

Device Type	Number of Violations	*V/I	**V/V
1) Safety Relief Devices	3,758	1.7%	48.4%
2) Low-Water Cutoffs/Flow Sensing Devices	7	<0.1%	0.1%
3) Pressure Controls	18	<0.1%	0.2%
4) Temperature Controls – Operator or High Limit	6	<0.1%	0.1%
5) Burner Management	18	<0.1%	0.2%
6) Level Indicators – Gage Glasses, Bulls Eyes, and Fiber Opticals	14	<0.1%	0.2%
7) Pressure/Temperature Indicators	250	0.1%	3.2%
8) Pressure-Retaining Items (PRI) / Boiler-Piping, Pumps, Systems Valves, Expansion Tanks	3,699	1.7%	47.6%

Summary:

- Number of Jurisdiction Reports: 117
- Total Number of Inspections: 217,518
- Total Number of Violations: 7,770
- Percent Violations: 3.6%

***V/I** Total number of Violations for Category divided by Total Inspections for this device type

****V/V** Total number of Violations for Category divided by Total Violations for this device type

Potable Water Heaters (HLW)

Device Type	Number of Violations	*V/I	**V/V
1) Safety Relief Devices	1,149	2.5%	25.6%
2) Low-Water Cutoffs/Flow Sensing Devices	75	0.2%	1.7%
3) Pressure Controls	12	<0.1%	0.3%
4) Temperature Controls – Operator or High Limit	122	0.3%	2.7%
5) Burner Management	772	1.7%	17.2%
6) Level Indicators – Gage Glasses, Bulls Eyes, and Fiber Opticals	1	<0.1%	<0.1%
7) Pressure/Temperature Indicators	608	1.3%	13.6%
8) Pressure-Retaining Items (PRI) / Boiler-Piping, Pumps, Systems Valves, Expansion Tanks	1,745	3.8%	38.9%

Summary:

- Number of Jurisdiction Reports: 117
- Total Number of Inspections: 45,531
- Total Number of Violations: 4,484
- Percent Violations: 9.8%

***V/I** Total number of Violations for Category divided by Total Inspections for this device type

****V/V** Total number of Violations for Category divided by Total Violations for this device type

Rating of Boiler Steaming Capacity Using NBIC Tables 2.9.1.3 and 3.9.2 in Part 1

BY ROBERT FERRELL, SENIOR STAFF ENGINEER

The National Board Inspection Code (NBIC) Part 1, *Installation*, has incorporated two tables which owners and inspectors can use to determine a required minimum capacity for the pressure relief devices on a steam boiler. The American Society of Mechanical Engineers (ASME) construction codes, ASME Section I, *Rules for Construction of Power Boilers*, PG-106; and ASME Section IV, *Rules for Construction of Heating Boilers*, HG-530.2, presently require the maximum designed steaming capacity and minimum relief valve capacity, respectively, to be permanently marked on the boiler. If a boiler is missing this mark, the boiler manufacturer should be contacted to obtain this important information; if the information cannot be obtained from the manufacturer, one of the tables in Part 1 of the NBIC can be used to determine a minimum required relief capacity. Understanding the purpose and history of these tables will help inspectors and owners use the tables to calculate the minimum rated capacity of the steam pressure relief devices on boilers.

The Purpose of the Tables

It is understood that the pressure-relieving devices for commercial boilers are not usually rated to the exact capacity of the boiler. That is, the relief valves for the boilers are purchased "off the shelf" and not manufactured for a specifically sized boiler. The NBIC tables provide an objective, uniform method to determine pressure relief capacity. The calculation of specific boiler capacities is not simple, as many factors must be considered. The purpose, regarding capacity, of the tables in Part 1 is to provide a minimum required capacity of pressure relief device(s). It is not to determine a specific boiler output. In the past, organizations such as the Steel Boiler Institute and the American Boiler Manufacturers Association provided boiler rating charts based on common standards; however, those charts are no longer published. Both ASME Section I and Section IV codes in the past have included similar tables at the request of jurisdictions. The present tables in NBIC Part 1 were created based on those tables.

The History of Boiler Capacity Rating

In the 1800s as steam boilers were coming of age, there were no industry standards for ratings. Every boiler was designed and rated as a unique unit, which was determined by the manufacturer, user, or by an accumulation test. The industry did not have a recognized standard to rate boilers until 1876.

In 1876, the committee of judges at the Centennial Exposition in Philadelphia, Pennsylvania, established the standard of boiler horsepower, which was defined as the evaporation of 30 pounds of water from feedwater at 100°F to 70 pounds-per-square-inch steam pressure. This is equivalent to the evaporation of 34.5 pounds of water from 212°F at atmospheric pressure. ASME adopted this definition as a standard in 1889. Depending upon the source of information consulted, this meant the quantity of Btu's/hour in a one-hp boiler was between 33,327 and 33,520. This definition of boiler horsepower still did not address calculating boiler capacity. Since boilers were being fired with solid fuels, some were rated by using grate surface while others used actual heat transfer surface in their calculations.

In his 1903 book, *Heating and Ventilating Buildings*, R.C. Carpenter wrote, "It is the general practice to consider 10 square feet of heating surface in watertube boilers or 15 square feet in plain tubular boilers as equivalent to one horsepower." He continues: "The actual power of the boiler depends more upon the method and management of the fires than upon the size. Either of the above classes of boilers can be made to develop under favorable circumstances from two to three times the capacity for which they are rated."[1] This statement is significant because its

1966 ASME Table:
Minimum Pounds of Steam Per Hour, Per Square Feet of Surface

Boiler Heating Surface	Firetube Boilers	Watertube Boilers
Hand-Fired	5	6
Stoker-Fired	7	8
Oil, Gas, or Pulverized Fuel-Fired	8	10

Note 1: When a boiler is fired only by a gas having a heating value not in excess of 200 Btu per cu. ft., the minimum safety valve or safety relief valve relieving capacity may be based on the values given for the hand-fired boilers above.

Note 2: The minimum safety valve or safety relief valve relieving capacity for electric boilers shall be 3.5 pounds per hour per kilowatt input.

rationale is still true today. He was noting that there is more than one factor affecting capacity.

Prior to 1927[2], ASME Section IV, *Rules for Construction of Heating Boilers*, was changed to base the minimum relief valve capacity from grate area to heat transfer surface. In 1941, the ASME codes again changed. The needed capacity would be determined by dividing the maximum output at the boiler nozzle in Btu's per hour by 1,000, or by multiplying the boiler heating surface by five. In many cases a greater relieving capacity than the minimum specified by these rules had to be provided.

These requirements remained unchanged until the 1965 Edition, 1966 Addenda, of the ASME Section IV, *Rules for Construction of Heating Boilers*. The minimum safety valve capacity was still determined by Btu output at the boiler nozzle with the additional option of determining valve required capacity on the basis of pounds of steam per hour per square foot of boiler heating surface as given by the 1966 ASME table. The type of fuel and method of firing is noted in the table, as well as whether the heating surface is of a firetube or watertube boiler.

Reviewing this information, it would be safe to say that for 100 years heating surface has played a part in determining what is used as a minimum requirement for safety/relief valve capacity. However, actual firing rate has continually been noted as a potentially higher capacity requirement.

Today, the Tables in Part 1 of the NBIC have accounted for modern combustion technology by providing adjustments to the factors of its tables.

Special attention should be given to the notes below the table. These notes allow for adjustment of the table factors based on the burner input/total square footage of boiler heating surface. No matter what input burner is installed, the relief capacity can be adjusted on the boiler. This is especially helpful when an old boiler has a retrofit burner added or a change in fuel type.

The heating surface table in ASME Section I has been removed for some time and the table in ASME Section IV will be removed in the 2015 Edition. The only source of this time-tested method of using heat transfer surface for calculating required pressure relief capacity will be in Part 1 of the NBIC.

NBIC, Part 1, *Installation*, Table 3.9.2 - Minimum Pounds of steam per hour per square foot of Heating Surface 1 lb steam/hr/sq.ft (kg/hr/sq m)

	Firetube Boilers	Watertube Boilers
Boiler heating surface		
hand-fired	5 (24)	6 (29)
stoker-fired	7 (34)	8 (39)
oil, gas, or pulverized fuel-fired	8 (39)	10 (49)
Waterwall heating surface		
hand-fired	8 (39)	8 (39)
stoker-fired	10 (49)	12 (59)
oil, gas, or pulverized fuel-fired	14 (68)	16 (78)
Copper-finned watertubes		
hand-fired		4 (20)
stoker-fired		5 (24)
oil, gas, or pulverized fuel-fired		6 (29)

NOTES:

- When a boiler is fired only by a gas having a heat value not in excess of 200 Btu/cu.ft. (7.5MJ/cu. m), the minimum relieving capacity should be based on the values given for hand-fired boilers above.

- The heating surface shall be computed for that side of the boiler surface exposed to the products of combustion, exclusive of the superheating surface. In computing the heating surface for this purpose only the tubes, fireboxes, shells, tubesheets, and the projected area of headers need to be considered, except that for vertical firetube steam boilers, only that portion of the tube surface up to the middle gage cock is to be computed.

- For firetube boiler units exceeding 8000 Btu/ft.^{2} (9085 J/cm.^{2}) (total fuel Btu (J) Input divided by total heating surface), the factor from the table will be increased by 1 (4.88) for every 1000 Btu/ft.^{2} (1136 J/cm.^{2}) above 8000 Btu/ft.^{2} (9085 J/cm.^{2}) For units less than 7000 Btu/ft.^{2} (7950 J/cm.^{2}), the factor from the table will be decreased by 1 (7950 J/cm.^{2}).

- For watertube boiler units exceeding 16000 Btu/ft.^{2} (18170 J/cm.^{2})(total fuel Btu input divided by the total heating surface) the factor from the table will be increased by 1 (4.88) for every 1000 Btu/ft.^{2} (1136 J/cm.^{2}) above 16000 Btu/ft.^{2} (18170 J/cm.^{2}). For units with less than 15000 Btu/ft.^{2} (17034 J/cm.^{2}), the factor in the table will be decreased by 1 (4.88) for every 1000 Btu/ft.^{2} (1136 J/cm.^{2}) below 15000 Btu/ft.^{2} (17034 J/cm.^{2}).

References

1. Carpenter R.C. *Heating and Ventilating Buildings*, fourth edition. John Wiley and Sons, 1903.
2. Greene, Jr., *A.M. History of the ASME Boiler Code*, second edition. American Society of Mechanical Engineers International, 1953.

Field Repairs of Pressure Relief Valves

Part 2: Testing

BY JOSEPH F. BALL, P.E., DIRECTOR, PRESSURE RELIEF DEPARTMENT

This is the second in a two-part series on field repairs of pressure relief valves. Part One: Quality Control Concerns, appeared in the winter 2014 BULLETIN.

One of the most important areas of pressure relief valve repair is setting and testing the devices to ensure their proper operation. The need to perform these activities in the field results in some unique challenges.

The most obvious test we will look at is establishing set pressure, but other test requirements must also be considered to ensure proper valve operation.

Keeping in mind that the field repair scenario presents challenging working conditions, field repair technicians should first use all possible "pre-setting" aids at their disposal to help minimize the number of tests needed. These include recording a measurement of the position of the set pressure adjusting part of the valve (compression screw or bolt), and careful re-establishment of that position after the valve has been inspected, repaired, and reassembled. If this dimension is accurately reset, the set pressure should be close to where it was previously. For a valve that was removed from the system, an additional aid can be to pre-set a steam valve with air, which can further close in on the set pressure. Note that pre-setting on air cannot substitute for a *National Board Inspection Code* (NBIC) mandated steam test, but is just a variation of the pre-setting process.

The position of all adjusting rings and other adjustment devices should also be documented as the valve is being disassembled. What is found at this point of the repair process should be carefully evaluated. A first check is to compare the "as-found" positions to those included in the manufacturer's maintenance manual. The maintenance manual positions are recommended starting points, and if the "as-found" positions are slightly different, they probably reflect the results of previous testing where valve performance was fine-tuned. If they are significantly different, a mistake may have been made during previous repairs, and going back to the specified positions should be considered. Remember, most valves will have one or two adjusting rings; however, some designs include an additional back pressure closing adjustment. Lift stop adjustments may also be present.

Once all of the mechanical adjustments are made, the final testing is performed. NBIC requires this testing to be done on specified test media (steam valves with steam, air/gas valves with air or other gas, and liquid valves with water or other suitable liquid). The system's fluid may certainly be used and automatically meets the NBIC requirement.

Not widely used but certainly the best method of testing is to "live set" the valves using the system pressure. A full "pop" test on the unit shows all important parameters, including set pressure, true valve blowdown, and stability (lack of chatter or flutter). This was once the industry standard and veterans of the repair industry will talk about "Navy setting" (ship board valves are still often set live). Concerns about noise will often rule out this testing, and equipment limitations (particularly on older units) are also a concern because the system pressure must be raised to the valve set pressure, which imposes a full stress cycle on the unit.

The system fluid that will be released is also a concern, so live setting is most often done on boilers and steam systems. Careful coordination of boiler operation with the tester is critical to safely perform the test. Safety tips include making adjustments with the valve "gagged" and attaching a rope to the lifting lever so if the valve does exhibit chatter during the test, the rope can be pulled to hold the valve wide open until the pressure decays enough for it to reclose. The boiler is operated at a low steady firing rate, and pressure increased by slowly closing the non-return valve until the pressure increases enough to pop open the valve under test. Pressure should be observed on a test quality calibrated pressure gage since the system gage is usually not of sufficient accuracy, and the gage used must be included in the calibration program of the repair organization.

When multiple valves are tested, the lowest set pressure valve is tested first, and then gagged while the higher-pressure valves are tested.

The author has witnessed this activity several times, and the procedure was safely accomplished with careful planning and coordination between the repairer and the boiler operators. The end results are absolute assurance that valve operation is correct.

A second method of testing is the use of a test stand. This can be a mobile test stand brought to the repair site by the repair organization, or a test stand owned by the user. Most commonly, these test stands will be for air/gas or liquid service (mobile steam test stands are rare). If the National Board Valve Repair (**VR**) stamp holder will employ the user's test equipment, he or she must ensure that the test equipment has been qualified as required by NBIC rules. This is a process to verify the test stand achieves accurate results, and is done by comparing a valve set on the test stand to qualified equipment elsewhere, and demonstrating similar results. The repair organization must also ensure that the equipment meets other NBIC requirements, including having adequate volume to demonstrate the set pressure characteristic (usually the popping pressure). Older test stands found in some user plants, consisting of a flange with a small tube supplying pressure, will probably not comply with this requirement.

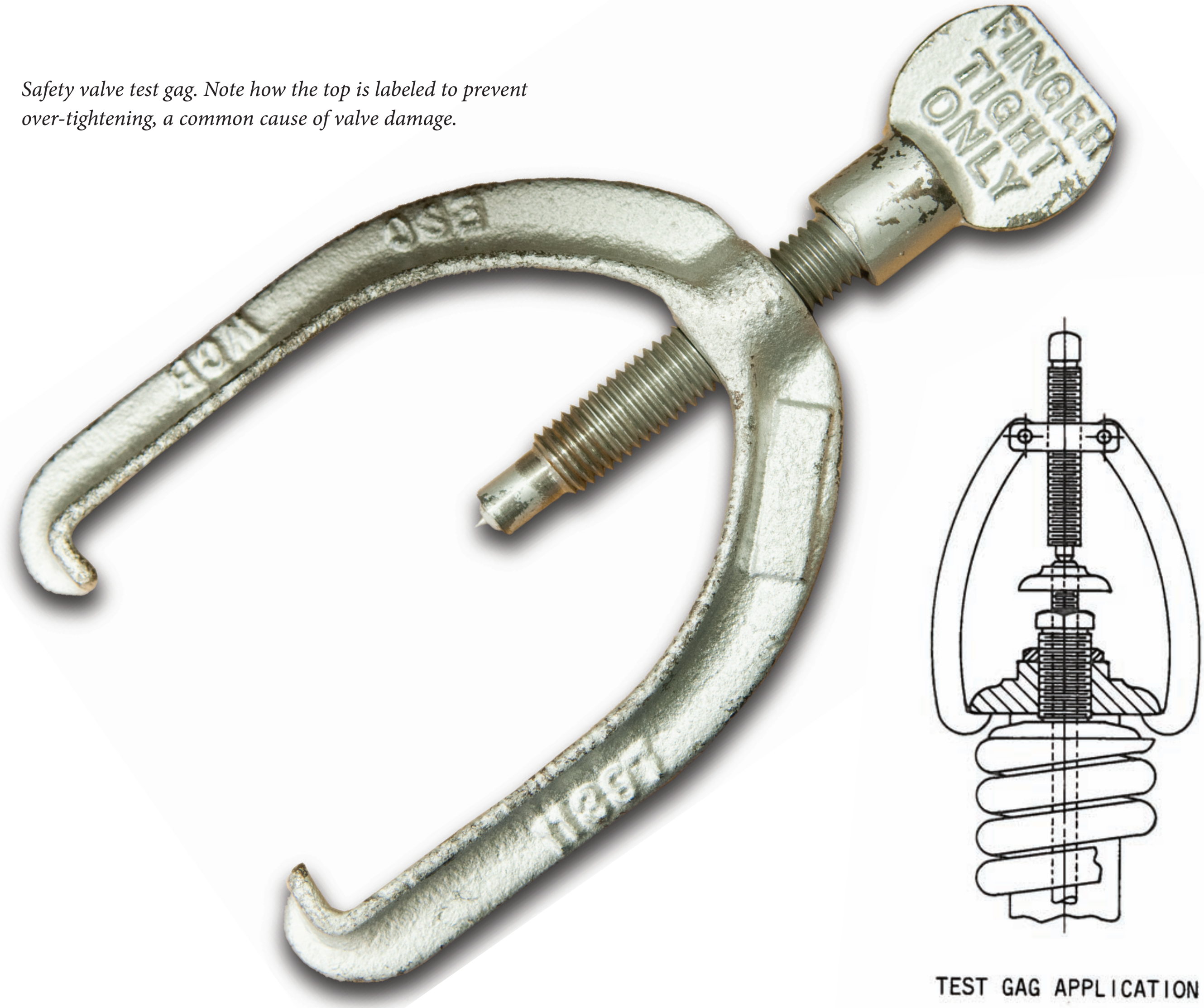
If a test stand is not available and a live test is not practical, a common method of set pressure testing is to use a Lift Assist Device (LAD). The valve under test is installed on the unit and the inlet pressure is maintained at a steady level, usually at 60% to 80% of the required valve set pressure. The LAD applies a force in the upward direction on the valve stem, often with a hydraulic cylinder. The force is usually measured with a force transducer. When the valve starts to crack open, the line pressure and applied force are simultaneously recorded. Using these measurements and valve dimensional information, the actual set pressure can be estimated. Adjustments are then made and the valve is retested to achieve the final required set pressure.

The equation for Lift Assist Device is: **Set Pressure = Measured Force/Effective Area + Measured Inlet Pressure.**

The equation for set pressure shows the two measurements taken and a third variable called the "effective area." In looking at the seat configuration of the seat of a pressure relief valve, it first appears that the inside diameter of the seat would determine the area that the pressure is acting against; however, through extensive testing it has been determined that the inlet pressure is actually working on a slightly larger area somewhere close to the center of the seating surface. Knowing this "effective area" is one key to ensuring an accurate set pressure measurement. While this area difference is only a small percentage, considering the accuracy of the force and line pressure measurements and the final set pressure tolerance to be met (1% for ASME Section I valves with set pressures over 1000 psig), the area must be known with high precision.

Effective areas have been determined for many valves by comparing actual set pressure to that predicted by the LAD, and are incorporated into software used in most current LADs. For some older units, graphs or charts for each tested valve type are sometimes used. With suitable controls from software, this equipment has been shown to be very accurate, but its use is dependent on knowledgeable operators and has some other limitations:

1. All equipment used must be calibrated. This includes the force-measuring instrument and the equipment used to measure the line pressure.
2. The valve must be installed on the service medium and should be at a stable temperature. This ensures that the temperature effects on the valve are taken into account. Testing a steam valve using air, where the lift assist test is already one step removed from the live test, does not give the accuracy needed.
3. The point at which the valve cracks open must be observed. It is sometimes visually observed (where discharge piping does not obscure the valve outlet). It can also be audibly observed; however, ambient noise can obscure this observation. Newer LADs have incorporated ultrasonic transducers to measure the audible opening. The observation can also be made by reviewing the force data, because the cracking pressure will cause the force curve to exhibit a peak value followed by a decrease in the force trace.
4. The valve must be in mechanically sound condition, which one hopes the repair process provides. A leaking valve seat will obscure the cracking pressure point. A bent valve spindle will cause excess frictional forces in the valve and can cause the force data to be incorrect.
5. The test procedure should not damage the valve in any way. The most common cause of valve damage is testing with the inlet pressure too low. This causes the applied lifting force to be higher, which at some point can damage the valve stem.
6. LADs cannot set valve blowdown; therefore, accurate re-establishment of adjusting ring positions during valve reassembly is a critical repair step that cannot be overlooked. If the manufacturer's maintenance manual information is used, the blowdown obtained during valve operation may be slightly longer than expected because the manufacturer's recommendations are typically designed to ensure a strong pop action and full valve lift, and that the valve will not chatter.



Safety valve test gag. Note how the top is labeled to prevent over-tightening, a common cause of valve damage.

Sketch of test gag in use to keep valve from lifting during field service adjustments. Courtesy of Dresser Inc.

In consideration of different issues relating to LAD testing, the NBIC added a requirement to qualify LADs in the 2013 Edition. Qualification gives objective evidence of the entire system accuracy of the device, including a check that accurate effective areas are incorporated into the calculations.

Once the set pressure has been established, the test work is not yet complete. A seat leakage evaluation must still be performed. For most valves this will be a visual or audible verification of the absence of leakage.

Valves designed to discharge into a closed system must also have a 30-psig back pressure test performed to ensure the secondary (outlet) portion of the valve does not leak. This test usually applies to ASME Section VIII valves, which would mostly be tested on a test stand. Most steam valves will have an open test lever and this test will not apply.

Considering the environment where the work will be done (e.g., in hot or cold temperatures or outside) and the different test procedures employed, detailed training of field repair personnel is critical to achieving a quality outcome. And although training is important, there can be no substitute for experience. Pairing a new employee with a senior technician to perform field repairs is a sound investment in the future outcome of the new employee's work.

Finally, worker safety concerns in the field environment cannot be overstated. When working on live equipment, every action should be carefully considered because there may be no second chances if a mistake is made. ✚

NBIC Resources:

Testing requirements: NBIC Part 3, paragraph 4.5.1

Lift Assist Device (LAD) requirements: NBIC Part 3, paragraph 4.5.3

One-of-a-Kind Boiler Donated to National Board

BY JOHN HOH, SENIOR STAFF ENGINEER

The National Board's Inspection Training Center features a comprehensive collection of boiler and pressure vessel equipment that provides students who attend National Board courses a hands-on experience with the machinery and tools inspectors may encounter in the field.

Equipment is acquired through the generous donations of various companies. The National Board continues to add to its collection and welcomes interested companies to contact the organization for more information.

Recently, the National Board received a donation of a slightly different nature: CNA Insurance Companies donated a Babcock & Wilcox watertube boiler. The company had the boiler in their possession for a number of years (although it was never "used") and wished to ensure the boiler's longevity and availability to a broader audience through the donation.

What makes this boiler so unique? It's a handmade model.

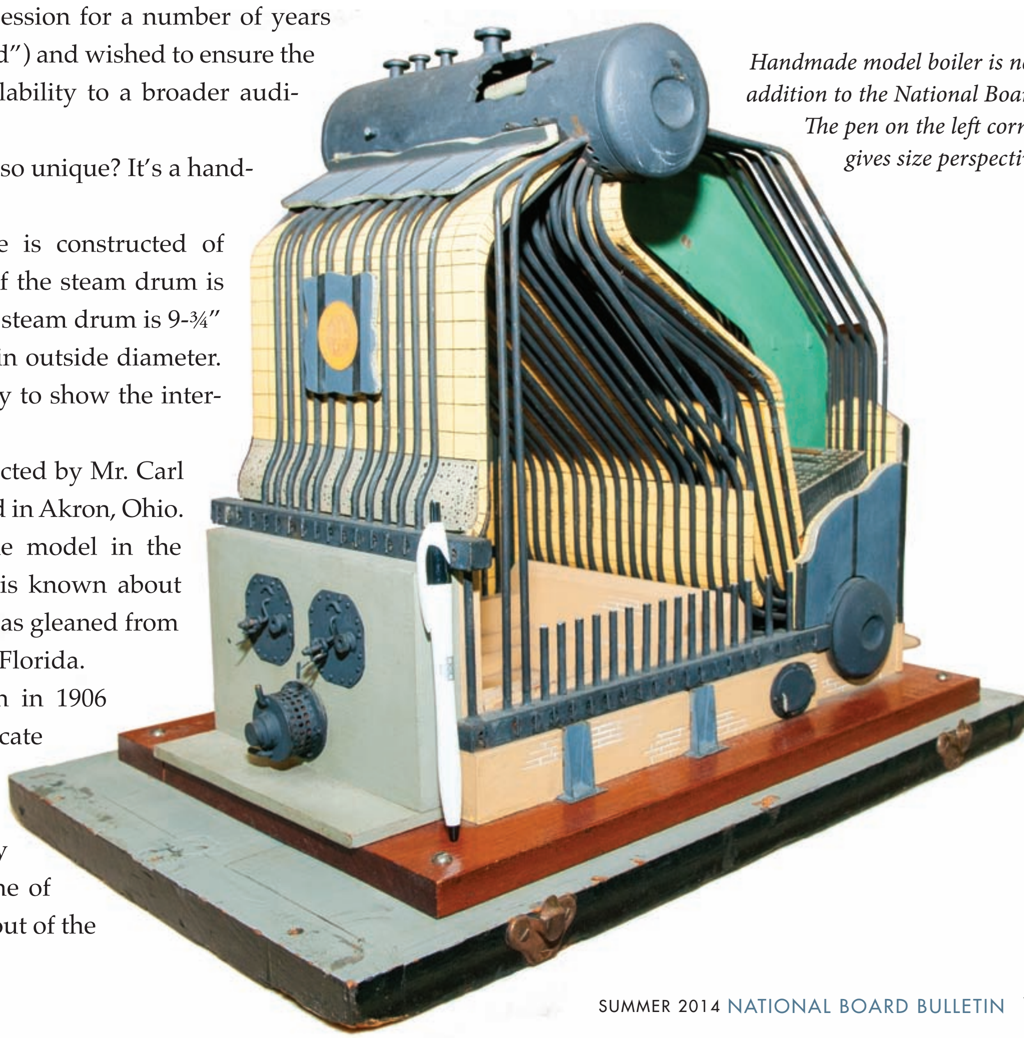
The detailed miniature is constructed of wood and metal. The top of the steam drum is 14-¼" from the "floor." The steam drum is 9-¾" in overall length and 2-⅞" in outside diameter. The steam drum is cut away to show the internal structure.

The model was constructed by Mr. Carl F. H. Schrader while he lived in Akron, Ohio. It is estimated he built the model in the 1940s or 1950s. Not much is known about Mr. Schrader except what was gleaned from a death certificate issued in Florida.

Mr. Schrader was born in 1906 and died in 1993. The certificate states he was an engineer in boiler manufacturing. Since Akron, Ohio, is very close to Barberton, the home of Babcock & Wilcox, it is not out of the question to speculate Mr. Schrader had worked there at one time; however, an inquiry to Babcock & Wilcox regarding his possible employment produced no definitive answers. Also, an inquiry was made to a gentleman believed to be Mr. Schrader's son, but again, there were no additional details available. While Carl F. H. Schrader the man remains somewhat of a mystery, what is known is that he had an eye for detail and was a skilled craftsman.

Mr. Schrader's one-of-a-kind model will be displayed in public view at National Board facilities. The National Board thanks CNA for the unique donation.

Companies interested in donating equipment to the National Board for educational use may contact John Hoh at jhoh@nationalboard.org for more information. Contributions are not deductible as charitable gifts for federal income tax purposes. ✤



Handmade model boiler is new addition to the National Board. The pen on the left corner gives size perspective.

High-Pressure Composite Pressure Vessels (15,000 psi)

BY FRANCIS BROWN, SENIOR STAFF ENGINEER

Fluids at relatively high pressure (higher than 3,000 psi) no longer require metallic pressure vessels for storage. With the publication of the 2010 Edition of the ASME Boiler and Pressure Vessel Code*, 2010 Addendum of Section X of the composite pressure vessels, also known as fiber-reinforced plastic pressure vessels (FRP), may be used for storage of gaseous hydrogen at pressures up to and including 15,000 psi.*

The Code Committee via Code Case 2745 now includes helium, nitrogen, water, and hydraulic oils as fluids that can be stored in high-pressure FRP vessels. Other fluids are expected to become acceptable for storage at high pressures in these vessels in the near future.

Section X Class III FRP high-pressure vessels (above 3,000 psi) consist of reinforcing fibers such as glass or carbon combined with a resin (plastic). The finished material, called laminate, and the vessel are manufactured simultaneously. High-pressure FRP vessels use a laminate where the fibers are wound circumferentially and longitudinally over a metallic or nonmetallic liner. The liner is non-load sharing and is used to prevent permeation of the contained fluid through the laminate. Only two nozzles are permitted, and both must be on the vessel longitudinal centerline as shown in Figure 1.

Section X Class III vessels were developed for the storage of gaseous hydrogen for installation at vehicle service stations.

The design pressure for Class III vessels shall not be less than 3,000 psi nor greater than 15,000 psi with a maximum design temperature of 185°F. The minimum vessel design temperature is -65°F. Vessel design is by nonlinear stress analysis with qualification of the design by destructive testing.

The extensive testing program demonstrates production vessels will have adequate fatigue life, and if damaged, will not violently disintegrate. Some of the tests include:

- Burst test: Three vessels shall be tested hydraulically to destruction. The pressure at failure shall be 3.5 times design pressure for glass reinforcing fiber and 2.25 times design pressure for carbon reinforcing fiber. This test demonstrates the vessel design has the specified design margin.

Figure 1: Class III Vessel

- Fatigue test: Multiple vessels (2 to 5) shall be subjected to a hydraulic pressure cycle test from 10% of design pressure to the design pressure. As a minimum, 10% of the test cycles shall be performed at the minimum design temperature. The number of vessels to be tested is based on the fatigue design margin, which ranges from 4 to 2.6. A service life of 20 years requires hundreds of thousands of pressure cycles.
- Temperature creep test: Two vessels shall be pressurized to 1.25 times design pressure for 2,000 hours. The test vessels shall be maintained at 185°F. After 2,000 hours, the two vessels shall be subjected to the specified leak test and the burst test as described earlier. This test demonstrates vessel integrity is retained for vessels operated above ambient temperatures.
- Flaw test: Two vessels shall be used for this test. A longitudinal cut is made in each vessel at mid-length. The cut shall be made with a 0.039-inch-thick cutter to a minimum depth of 0.050 inches. The length of the cut shall be 5 times thickness of the laminate. A second transverse cut of the same dimensions shall be made at the vessel mid-length, 120° around the circumference from the first cut. One vessel shall be burst tested, and the other vessel shall be fatigue tested. This test demonstrates vessels are resistant to surface damage.
- Penetration test: A vessel pressurized to design pressure with nitrogen shall be shot at with a 30-caliber or greater armor piercing bullet. The bullet shall impact the vessel wall at an approximate angle of 45°. Full penetration is not required, and the vessel shall not fail catastrophically.

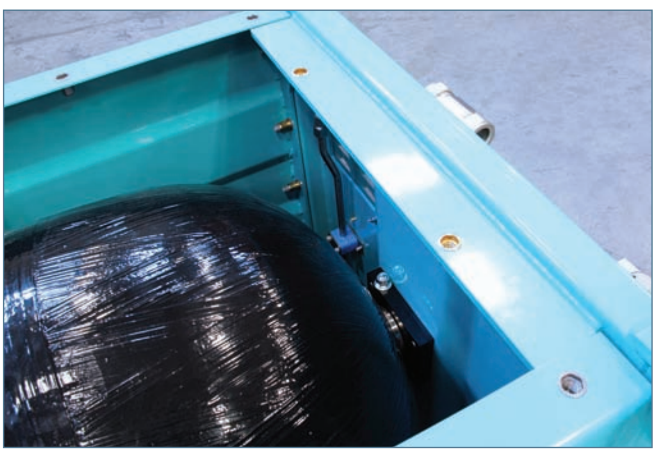


Photo courtesy of Hexagon Lincoln. Carbon/epoxy vessel inside its protective shell, used as part of a refueling cascade.

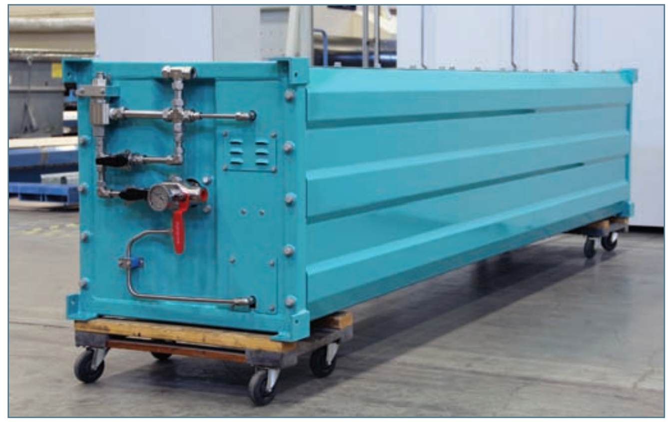


Photo courtesy of Hexagon Lincoln.

There are a number of other required tests not described above. The above tests are described to show that vessels stamped with the Section X designator are Class III, are durable, safe, and will withstand considerable abuse. ✤

Follow Up

By James R. Chiles

This January brings the 10th anniversary of a remarkable success in deep space: man's first unmanned landing anywhere in the outer solar system. In December 2004, not far from Saturn, the tiny robot probe called Huygens punched loose from its mother ship Cassini *and coasted toward the mysterious moon called Titan. A month later the probe parachuted to a safe landing on a strange and frosty shore, allowing the first sneak peeks under the orange cloak of methane. The probe's data is still being studied today.*

Mr. Chiles writes extensively about technology and history. Contact him at j.chiles2015@gmail.com or at his blog: Disaster-wise.

The happy landing almost didn't happen. Were it not for a handful of pesky individuals that got the ball rolling between launch and arrival, the most dramatic part of the $3.3-billion mission would have failed.

What ball was that?

The follow-up ball. That's the ball put in play by people who are totally dedicated to mission success – maintainers, operators, engineers, and inspectors – and who press on when more "reasonable" people might falter in the face of resistance. First a pitch for why follow-up work makes a big difference here on Earth, and then we'll look at how it worked near Saturn.

To me, following up means *taking action* after *information has raised a concern about quality*. The day-to-day work of safety inspectors has a lot in common with investigators, so let's look at how excellent follow-up contributed to the investigative effort known as the Truman Committee, a US Senate panel that probed allegations of defense waste and fraud during World War II. Chairman Harry S. Truman had been in the Army during World War I and knew about how much waste had gone un-policed through 1918; in fact, Congress had never followed up on complaints until after the Armistice, and then only as a political weapon.

The Truman Committee began its work in 1941 by taking up a stack of citizen allegations about wasteful spending on training camps. The committee exposed many abuses and then went on to document fraud and carelessness in the defense program at large. At first, the committee hearings were a great embarrassment to the Roosevelt Administration, but later, FDR embraced the idea – so much so, that he asked Harry Truman to be his running mate in 1944.

Interviewed after V-J Day, Truman Committee participants listed the top factors behind their success. One was bipartisanship: no report went out unless it was unanimous. Another was the tireless pursuit of loose ends: if a citizen wrote to Truman that a bureau was being outrageously overcharged by a company, both bureau and company got letters summarizing the allegation. What's more, staff watched the calendar and knew when to look for responses. Silence was taken as an invitation to turn up the heat. Some allegations proved groundless, but others blossomed into well-publicized hearings and scathing reports. The committee's work saved billions for the effort and, by shining a harsh light on shoddy work, saved many lives.

Out of the Truman Committee's hard-won wartime experience, we can identify three broad types of follow-up work, all still relevant today:

- Red-Flag Follow-Up: For Truman, cases often began with complaints from citizens or workers. In the boiler world, follow-up could be triggered by signs that someone has been taking shortcuts in maintenance or logs. At the extreme end of this continuum, there's the follow-up triggered by a workplace fatality, when multiple agencies get involved.
- "Gap-Filling" Follow-Up: This means pursuing something that's missing. During the heyday of the Truman Committee, a tickler file helped identify when responses to inquiry letters were overdue. In today's safety field, regulators might need to reopen a file to see whether a draft emergency-response plan was

ever finalized, whether inspections are timely, or whether employees are keeping their training up-to-date. Simple, low-tech tickler files are as useful as ever, and they don't even need electricity to work. A set of 43 folders (31 to represent the days in a month, plus 12 folders for the months in a year) will bring good results if checked daily.

- Anti-Backsliding Follow-Up: Wrong-doers often made impassioned promises to change their ways, but investigators from the Truman Committee paid them a surprise visit months or even a year later.

In the case of the *Cassini*-Huygens, the landing-probe mission was saved due to persistent "Gap-Filling" follow-up.

In October 1997, NASA and the European Space Agency (ESA) launched a rocket toward Saturn. The mission involved two vehicles traveling in tandem: a science-gathering orbiter (*Cassini*) that would stay in space, and a robot landing probe (Huygens) that eventually would separate and land on Titan. Scientists knew little about Titan's surface due to the thick methane clouds, so every byte of information from the probe would be precious. The probe was so small (a flattened cone about 2.7 meters wide) that it couldn't send its strings of digital data directly to Earth; it could only communicate in orbit with *Cassini*, which had the power to relay the info to Earth. So for the probe to succeed, the radio link to *Cassini* had to operate perfectly during a scant three-hour window: the probe's approach to Titan, its drop by parachute, and however many minutes the probe's battery lasted on the surface.

Feeling confident they had covered all risk of radio glitches, the European team in charge of the probe mission turned down an "end-to-end" test of the radio system before launch – that is, decided not to test the radio link under realistic conditions. ("End-to-end" optical testing wasn't done before the launch of the Hubble Space Telescope either. Guess what happened when astronomers tried to use the primary mirror?)

Fast-forward to a year later: all seemed well on the long journey to Saturn, but that was no consolation to Claudio Sollazzo, a ground operations manager at the ESA's control center in Darmstadt, Germany. Because *Cassini* would be moving through space three miles per second faster than the probe, Sollazzo worried that the radio link was vulnerable to Doppler shift, even though this and other threats had been reviewed by three panels.

For an example of Doppler in action, think of a driver sitting in a car at the gates of a grade crossing, listening to a locomotive's air horn. As the train approaches, its air horn rises in pitch, but the tone drops after it passes.

Doppler also shifts the frequency of light and radio waves, and Sollazzo asked Swedish radio engineer Boris Smeds to figure out how to send a simulated, Doppler-shifted signal from Earth to *Cassini*'s probe-communications receiver and listen for what came back. Would *Cassini* be able to understand and return the signal?

Smeds decided to go above and beyond the original plan, which would only have simulated a Doppler change in radio frequency. Smeds insisted on a more realistic test. For one thing, he embedded a simulated data stream at the design rate of 8,192 bits per second. Managers refused: it was a waste of time. But Smeds came back with strong support from Sollazzo and the probe's project leader. He convinced managers that the frequency of the radio carrier wave was not the only thing to worry about, and won permission to carry out a two-day, full-up radio check at the Deep Space Network station in California's Mojave Desert. In order to cover the full range of troublesome variables that Smeds wanted to test (changes in power level and frequency while sending data), he had to set up his equipment in a concrete basement under one of the Goldstone antennas.

The first day's experiment showed some kind of reception problem, but it was sporadic. All that night Smeds puzzled over what it meant. Having only a few more hours of antenna time to solve the mystery, Smeds compressed his test plans and tried again the next day. Soon the problem was clear: Doppler shift was messing with the data bit rate as well as the carrier frequency. This threw off a critical timing pulse embedded in the stream of bits, so *Cassini* couldn't keep a good lock on the data.

Result: most of the probe's priceless data would be worthless static. Could controllers load a new computer program from Earth? No, because the problematic code was locked in "firmware," which couldn't be updated remotely.

Fortunately, because Smeds & Co. had pushed for an investigation very early in the *Cassini* voyage, there was ample time to study all options and arrive at an elegant solution, which attacked the Doppler dilemma directly. Recall the railroad-crossing analogy: to drivers who are idling at the gate, the Doppler effect is dramatic since the train is (almost) coming right at them. But to a driver on the highway a half-mile from the crossing, the Doppler effect is much less. It's not just due to the greater distance: he's offset from the tracks, so the train is moving mostly sideways (from his point of view) rather than coming directly at him.

And that's what the *Cassini*-Huygens team in Europe and America did, given the benefit of Smeds' timely warning: they shifted trajectory and timing so that from the probe's point of view, during the critical hours, *Cassini* was further away and also moving sideways. This kept the digital stream's bit rate within the receiver's range. Doppler had been tamed.

The timely fix brought Earth hundreds of photos about the strange shores of a methane lake on far-off Titan, along with mounds of data. The probe also sent us Earthlings a timeless reminder that there's no substitute for persistent people who follow up . . . rather than give up.

The 83rd General Meeting
BELLEVUE, WASHINGTON - 2014
Highlights

The theme was *Safety: Quality through Commitment*, and vibrant Bellevue, Washington, served as the backdrop to the 83rd National Board / ASME General Meeting May 12-16. Legendary entertainer Bob Newhart lit up the stage on Monday morning with his trademark humor and personable anecdotes that have endeared him to audiences for generations. A full line-up of technical presentations rounded out the day. Featured speakers included ASME's Madiha Kotb, Douglas Smiley of Zurich Services Corporation, Melissa Wadkinson of The Fulton Companies, Earl Harlow of Sabic Innovative Plastics, noted author and commentator James R. Chiles, and safety and motivational speaker Nick Morris.

Guests of this year's meeting experienced several of Seattle's must-see attractions. Monday's outing included Seattle's International District, historic Pioneer Square, the Ballard Locks, and a visit to famous Pike Place Market. On Tuesday, guests toured Boehm's Candy Kitchen and the authentic Swiss Chalet and Alpine Chapel. Next was a stroll through the enchanting Chihuly Garden and Glass exhibition at the Seattle Center. Final stop of the day was Chateau Ste. Michelle Winery for a private tour, lunch, and wine tasting.

Wednesday's group outing was an exciting tour of the world-famous Boeing plant in Everett. Guests explored the vast facility, witnessed airplanes being assembled, and visited its many interactive exhibits. The tour continued at the Museum of Flight, where lunch was served and guests took in the sights. The week's events culminated in a historic Wednesday evening banquet, where National Board and ASME joined to commemorate the 100-year anniversary of the *ASME Boiler and Pressure Vessel Code*. During this special occasion, Cirque Dreams performed fantastical feats and ASME leaders shared inspirational remarks in celebration of the centennial event.

David Douin, National Board Receive ASME Awards

From left to right: Kenneth Balkey, David Douin, and Madiha Kotb.

Kenneth Balkey of the American Society of Mechanical Engineers (ASME) presented National Board Executive Director David Douin with the ASME Dedicated Service Award (DSA) during the Wednesday evening banquet. The DSA honors "unusual dedicated voluntary service to the Society marked by outstanding performance, demonstrated effective leadership, prolonged and committed service, devotion, enthusiasm, and faithfulness."

Mr. Douin also accepted the 2014 ASME President's Award and the ASME Founder's Award on behalf of The National Board of Boiler and Pressure Vessel Inspectors. The President's Award is granted to those who have demonstrated significant contributions to the engineering profession. The Founder's Award recognizes a century of commitment to public safety. ✤

Board of Trustees Election Results

National Board members cast their votes at the 83rd General Meeting to fill five open seats on the Board of Trustees: chairman, second vice chairman, and three member at large positions. John Burpee (Maine) was elected the new chairman. Michael Burns (Florida) was elected second vice chairman. Benjamin Anthony (Rhode Island), Milton Washington (New Jersey), and Christopher Cantrell (Nebraska) were elected members at large. ✤

Galanes Receives of 2014 Safety Medal Award

David Douin presents George Galanes with the Safety Medal.

George W. Galanes was presented with the 2014 National Board Safety Medal award during the Monday morning Opening Session. Mr. Galanes has been employed in the power generation industry for over 30 years and is an active member on several National Board and ASME committees. ✤

Honorary Members Chosen

Steven Donovan, former National Board member (1997 to 2012) representing the Northwest Territories, Canada; and Randy Pucek, former National Board member (1989 to 2012) representing Milwaukee, Wisconsin, were elected honorary members at the October 2013 Members' Meeting and presented with commemorative plaques at the 83rd General Meeting. ✤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Grasp just how you got here.


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12
Excellence

Boiler Math: Low Water + No Training = ?

BY JOHN HOH, SENIOR STAFF ENGINEER

There can be several answers to this equation. Most of them are unacceptable in our quest for safety. The best answer is to eliminate both factors. This is a true story that illustrates the frustrations many inservice inspectors have experienced during their careers.

On a very cold January day in the Midwestern United States, a jurisdictional boiler inspector was completing some external operating inspections at a school district. While there, he learned the county courthouse a few blocks away was having a new boiler installed. A new boiler installed in the middle of January – not the ideal time to have that done. This called for a slight change to his day's schedule.

The courthouse was constructed around 1940 so it suffered from an inadequate electrical system for modern needs such as computers, copiers, etc. The electrical demand at that moment was beyond critical because every office and hallway had multiple space heaters hooked up to a "spider web" of extension cords and multi-outlet power strips. Still, every person in the courthouse was wearing heavy coats, gloves, hats – anything to stave off the cold. The inspector asked about the new boiler and was directed to the stairs leading to the basement. A few bystanders hearing the word "boiler" gave the inspector a hopeful look, as if he alone could bring heat to their icebox.

The basement was not the lowest level in the building. There was a sub-basement, really just a large concrete pit, which was the boiler room. Here was a new cast iron steam heating boiler, fully assembled with all the safety appurtenances installed, but the wiring and piping were incomplete. The installer was nowhere to be seen. After a few minutes, the inspector heard a voice coming down the stairs: "It's a beauty, ain't it?" The inspector discovered the elderly gentleman walking down the stairs was the courthouse custodian and boiler operator. The inspector asked how long they had been without a boiler and was told almost three weeks. Now he knew why everyone looked so miserable.

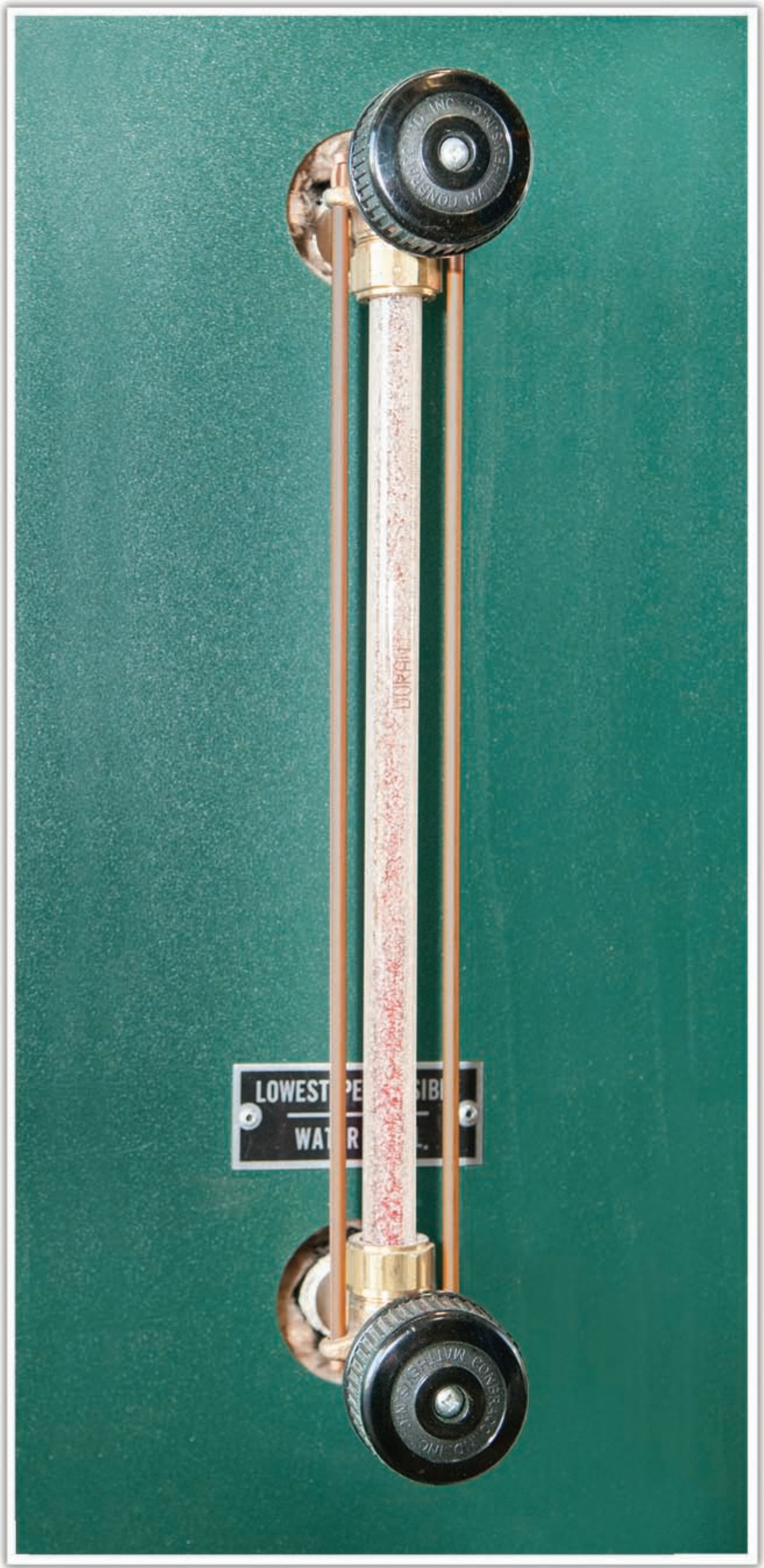
The inspector asked about the old boiler and what caused it to be replaced in the coldest part of the year. He learned it was the original boiler from around 1940 – a large, cast iron sectional type – and its failure was due to "too many hot fires built in it over the years." Focusing on that last answer, the inspector asked more about its operating history. It had originally been fired with coal, converted to an oil burner, and then a gas burner. When asked about the actual failure, the elderly gentleman said it cracked in several locations but didn't come apart. He said it sounded like a cannon going off with a loud "boom." The inspector asked him where he was at the time, and the man said he was standing right next to it. The inspector asked why he was standing next to the boiler when it just happened to fail. The response: "Well, I was making my rounds and came down to check on the boiler. It was making funny sounds and when I looked at the gage glass, there was no water in it. I knew I had to get water in that boiler quick, so I opened the feedwater bypass valve. I must have been too late because that's when the boiler went *boom*."

The inspector's heart skipped a few beats and he told the man the sounds he heard was the boiler overheating, and when he failed to see water in the gage glass, there was no way for him to know if it was just below the lower glass fitting or several inches down. Opening the bypass valve and dumping cold water into the overheated boiler was what caused the failure. The old guy was in denial so the inspector told him, "You are lucky to be alive. Cast iron is brittle and breaks rather than bending. It is a miracle that boiler did not explode, sending pieces everywhere, and they would have found you dead in this pit!"

It was a harsh way to deliver the message, but the inspector had to make the operator understand the consequences of his actions. Yes, he was alive and there was no structural damage to the courthouse. But, he had destroyed the boiler and as a result, the county commissioners were paying for a new one (it was not insured) and all the people in the courthouse were freezing. Luckily, the over-taxed electrical system survived without starting a fire. Since the county had already lost three courthouse buildings to fire since its founding in the 1840s, another structural fire as an indirect result of the boiler failure would have made this sad story even worse. After talking with the man a little more, the inspector could see the message was getting through. This was a positive outcome.

Of course, too many hot fires did not destroy the old boiler as the man had speculated. What seemed like a good idea to the operator in that single moment is what caused the failure. The man thought he was saving the boiler, but he was not properly trained in the basics of boiler operation. Why the water level dropped and why the low-water fuel cutoff didn't activate – we will never know. Had the operator been properly trained, it is quite possible he could have recognized the water level problem before it became critical, and he would have been testing the low-water fuel cutoff periodically to ensure it would operate when needed. Additionally, proper training would have ensured the operator would know to manually shut down the boiler when the water level dropped below the gage glass.

You're asking, what about inspections? An inspection of the old boiler would have been performed if it had been in the jurisdiction's records, but it had never been reported. Inspections can prevent a lot of problems, but one inspection every one or two years cannot prevent every problem. The operator is there every day. Safety requires the operator and inspector working together to prevent incidents like this. Maybe that's the new equation we should use: Inspections + Operator Training = Safety.



From the Tap to the Test Line:

Photography By Brandon Sofsky

On July 20, 2011, National Board staff broke ground at the National Board Testing Laboratory to begin an extensive expansion and systems upgrade project, which included a nearly 3,000-square-foot add-on for the installation of a brand new air testing system; doubling the air storage volume and increasing maximum pressure with the addition of six higher-pressure storage bottles; converting from air compressors to a liquid nitrogen storage and vaporizing system; and digitally automating every steam, air, and water testing console. But progress didn't stop there.

The Technology of Steam

By Wendy White, *BULLETIN* Editor

Two years later, on July 1, 2013, the test lab began the final phase of the project: the demolition and rebuilding of its boiler/steam generator room with a focus on enhancing efficiency. Every part of the system was scrutinized for improvement, and a brand new steam-making process was custom designed for the needs of the lab. The room was gutted from wall to wall, and all water, condensate, and steam piping removed and replaced.

Open Valve, Get Steam

The lab performs an average of 40-50 steam tests a month at its facility in Columbus, Ohio. When a pressure relief device (PRD) is steam tested, lab technicians mount the valve on the test line. An operator flips a switch, which opens a control valve on a header. Steam is released from a holding tank (located out-of-sight in the steam generating room) and flows through a pipe that passes through the wall and connects to the steam test line out in the test room.

Seems simple enough – open valve; get steam; perform tests. But the conversion of city tap water to quality, dry, saturated steam optimal for testing PRDs from around the world is a lesson in engineering.

The first step in that process: water treatment.

Softeners and Chemicals (1)

"Water treatment is the single most overlooked item I have seen at almost every steam-generating facility I've visited," states Lab Manager Brandan Ashbrook.

"It is usually left to a maintenance budget with disregard to the effects untreated water can have on the capital budget due to major re-tubing and repair projects," he says. "We need quality water with the least amount of minerals in it. Fewer minerals in the water means less scale build-up in the boiler system."

The journey from tap water to steam begins with water softeners. The lab installed a dual water softening system to ensure a continuous supply of treated water for steam production.

"When the main softener calls to regenerate, our system switches to the secondary softener. This way we never run the boilers with hard or mineralized water while a softener is regenerating," Ashbrook explains.

After water is processed through the softener unit, it is fed into two different feedwater vessels – the cool-down and deaerator vessels – and treated with additional chemicals for demineralization (chemicals enable pH control and oxygen control). The deaerator vessel stores water to feed the boilers. The cool-down vessel stores water used for cold lay-up. The water in both tanks is treated with different levels of chemicals based on the temperature and use of the water. The deaerator vessel is dosed with chemicals for running above 220°F, and the cool-down vessel is dosed for layup and running under 200°F.

2

Floor space is at a premium in the steam room, so the feedwater vessels are stacked to save space.

Chemical Stations 2

The chemicals are stored in bulk drums. Color-coded chemical lines run from the drums to the feedwater vessels. Water is injected with chemicals through a controller device, which monitors chemical consumption and controls the injection pump via a website.

"Through this website, our chemical provider can adjust the dosage needed and re-order drums when the liquid level becomes low. This monitoring system dispatches our drums as needed to maintain chemical levels on hand. We also perform in-house water sampling and upload our findings so the system is as accurate as we can make it," notes Ashbrook.

The Feedwater System 3

"Operating and running our feedwater system is simple, but the arrangement of pumps and bypasses is nothing short of a NASA project," Ashbrook remarks.

A dual-piped water feed (one pipe from the deaerator, one from the cool-down vessel) was installed to each of the three boilers to make the switch from one feedwater vessel to the other possible. The boiler PLC (programmable logic controller – a digital computer used to automate machine operations) opens the needed supply valve to send water to the boiler feed pump per the desired mode. The deaerator draws steam off of the header to preheat the supply water to the boiler.

"We can get the deaerated water up to temperature in just a few minutes because it is a well-insulated vessel that holds heat from the day before," he explains.

The temperature of the supply water to the boilers during run cycles is around 220°F. When the boilers are shut down, the system switches over to the cool-down feedwater, which is heated to around 160°F for cold lay-up. Once the water is softened, demineralized, and stored in the feedwater system, it is ready for use in the boilers.

Boilers/Steam Generators 4

The National Board worked with Vapor Power International to design the most technology-driven Modulatic® boilers available. (The Modulatic® is a once-through water-tube boiler with a positive displacement pump to provide a constant flow of feedwater.)

"Vapor Power knew we wanted to create the best steam with the capability to monitor every aspect of it. They developed a system that replaced our two 300-horsepower steam generators with three 220-horsepower steam hot water boilers, all 900-psi units," says Ashbrook.

The lab installed a PLC on each boiler. Another PLC monitors the deaerator and cool-down pumps, and also controls multiple boiler sequencing. As two or three boilers are brought online, the controller links the program as one and all three boilers run at the same burner rate. A monitor was also mounted at the steam test console in the testing room so operators can change the desired steam pressure and monitor the boiler room from the testing area.

"We batch run our steam here, so we never know day-to-day how many boilers we'll need until we open up the day's work. The majority of valves we test require one or two boilers, but if we're testing higher capacity valves, we may need a three-boiler output," Ashbrook reports.

"All steam valves should flow more than the stamped capacity and most are tested at 110 percent. So a stamped 10,000-pph Section VIII valve might flow 11,000 to 13,000 pph. With this output we would run two boilers to keep up with the valve," he explains.

When higher-capacity valves were tested with the previous system, it consumed far more energy for the amount of steam needed.

"The new boilers are more efficient because we don't need to run a large boiler for a small output. The 220s are tuned to keep a more consistent heat value across the pressure range, not just at full output. The new motor control, using variable frequency drives (VFD) and servos, allows the PLC to speed up or slow down the feed pump or combustion air blower to create the correct flow desired at any given point," notes Ashbrook.

Steam Piping 5

Steam exits the boilers en route to the steam header system, which hangs from steel supports. The new steam piping was built in sections off- and on-site and assembled at the lab.

"We replaced the previous piping with a newly designed stacked header system," explains Ashbrook. "We wanted to make sure we could capture any condensate or carry-over from the steam generators and control the speed of the steam running through the system. The construction of this piping system was very time consuming, as every joint was welded using the GTAW process, with 100 percent radiography and hydro-tested as well."

Steam Accumulator 6

The steam then makes its way through the steam header system and into the steam accumulator. Here, a supply of steam is stored and awaits demand to the steam test line. It also stores up capacity as needed. The steam accumulator was the only item repaired and re-used from the old steam system.

"We began repair work to the existing steam accumulator in-house in early July 2013. Once we removed the welded flanges and opened it up, we diagnosed some deeper corrosion and ultimately had to replace the lower section of the vessel," says Ashbrook.

The accumulator was removed from the lab and trucked off-site to be refurbished. When it was completed and re-installed, staff were able to finish the steam header installation and insulating projects.

"Steam quality is based on pressure and temperature. Our system – from the feedwater vessels to the piping – is highly insulated to maintain temperature for quality steam," he reports.

Steam Test Line 7

With an abundance of dry, saturated steam now stored in the accumulator, testing can begin. Out in the test room, the pressure relief device that is to be tested is mounted on the test line. An operator flips the switch to open a control valve on the header. Steam is released from the accumulator into the test line, passes through the PRD, and is then discharged into one of two steam condensers, where it is converted back to water. The water is pumped out and weighed for the capacity test. This process is the most accurate way to measure steam capacity.

The lab uses two steam condensers: tests under 1,000 pounds/hour go into a small condenser; tests over 1,000 pounds/hour go into a larger tank. Both condensers were replaced during the upgrade.

"The old units were showing their age," reflects Ashbrook. "The large condenser was a Navy surplus unit when it was purchased in the 1970s for the old lab that was located at Picway Generating Station."

In addition to the new condensers, the condenser pumps were replaced and new level indicators were added to the condensate wells.

"A float inside the device flips a magnetic indicator from yellow to black as the water level changes. This is great in low-light areas," he says, referring to the dimly lit steam pit located beneath the test line where the condensers are housed.

"We've added a remote camera to these indicators so we can view water levels and record the testing condensate levels from the operator position above. This increases our efficiency because we do not need an additional operator in the pit to pump off the condensate."

End Results

Now outfitted with the latest in equipment and controls/communication technology, the new steam system not only satisfies the lab's immediate needs, but also has the capability to address future challenges in both testing and research work. The new technology also gives staff the ability to control and monitor all aspects of steam generation, including temperatures and flow rates, which ensure quality steam for quality testing.

Completing this project required the commitment and expertise of many people, as Pressure Relief Department Director Joseph Ball acknowledges: "The lab manager, lab engineers, and technicians have worked hard and put in many late nights to manage and complete a lot of difficult work. The outcome of this project helps ensure the laboratory's continued status as a worldwide leader in the testing of pressure relief devices."

Results from the past few years' upgrade and expansion project at the test lab are showing in the lab's overall accuracy. ASME PTC 25 states that a lab needs to achieve an accuracy of +/- 2% of overall flow measurements with +/- 0.5% for individual elements. The lab is around 1% overall, with +/- 0.15% for most individual elements.

"This could not have been achieved without the continued support of Executive Director David Douin and the Board of Trustees," conveys Ashbrook. "Their commitment to the efficiency and modernization of the lab facility is a commitment to safety and quality for years to come."

Hybrid Laser-GMAW Welding

BULLETIN Interview with Paul Denney

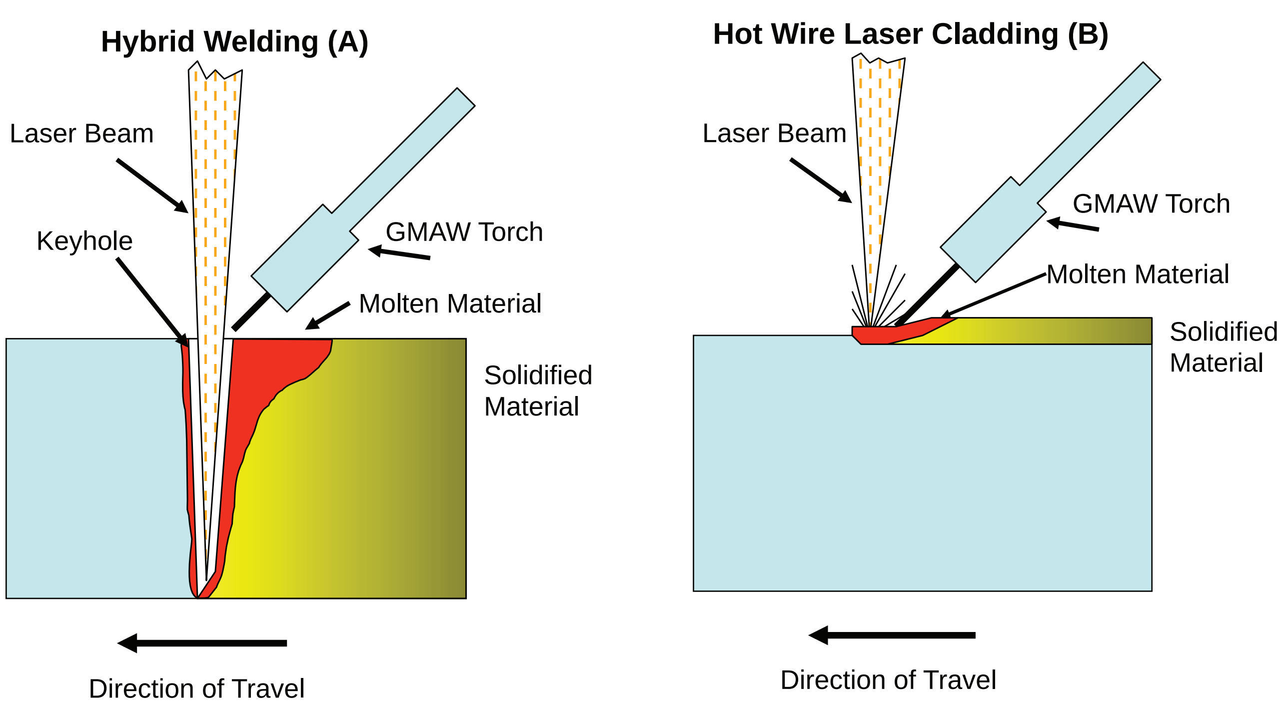
Hybrid laser-gas metal arc welding (GMAW) is one of the newest welding processes to be included in the 2013 Edition of the *ASME Boiler and Pressure Vessel Code*, Section IX, QW-220. The process combines high-power density/high-penetration laser welding with low-cost/high-deposition rate GMAW.

At present, this technology is not widely used in the boiler and pressure vessel industry. But as the process is implemented over time, it may be used in a variety of applications in the future. The *BULLETIN* interviewed Paul Denney, Senior Laser Applications Engineer, Automation Division, at Lincoln Electric in Cleveland, Ohio, to acquaint inspectors with the process and its advantages and limitations. Mr. Denney has over 30 years' experience in laser materials processing, is a co-inventor sharing 26 patents, and has addressed many international technology conferences.

Mr. Denney explains that most hybrid laser-GMAW systems combine a laser focus head (optics) with a GMAW welding torch, plus the bracketry that holds these two elements in such a way that the molten metal from the GMAW process forms a weld pool and the laser beam is located in that puddle. The most widely publicized use of hybrid lasers has been in shipyards, especially in Europe, where hybrid laser systems are used for making long structural welds. The US Navy has accepted the hybrid process for some applications, such as the fabrication of certain stiffeners and some lightweight panels for ship construction. Besides shipyards, the welding of structural components, such as beams and poles, is the most common use for hybrid.

"The best applications are those where there are long welds and a square butt joint," Denney says. "This is where the advantages of the high speed and deep penetration of the process shine."

Following are more insights from Mr. Denney regarding this process.



Two presentations of laser "hybrid" processing: A) laser with GMAW in a "laser leading" configuration, and B) diagram of the hybrid laser arc weld (HLAW) cladding process which uses a GMAW power supply to heat the wire as it enters the laser-produced clad pool. Images throughout courtesy of Lincoln Electric.

***BULLETIN*: What is the background of hybrid laser-GMAW?**

Denney: In the 1990s, there was extensive interest in combining lasers with GMAW processing for butt welds in material greater than 0.125 inches thick. Some of the early work took place at Aachen University in Germany. The combination of lasers with GMAW became widely investigated for many applications, such as ship structures, structural components, heavy manufacturing, and pipeline welding. Probably the first really successful use of hybrid welding was accomplished in Germany by Frank Roland at Meyer Werft shipyard, a builder of cruise ships and freighters. The company converted from an arc welding process to hybrid welding with 20-kilowatt (kW) CO_2 lasers. Decks and bulkheads with stiffeners were joined successfully. The hybrid welding system was installed parallel to the development of new specifications for the shipbuilding industry to allow for hybrid welding. Since 2000, there have been a number of other companies that have investigated and installed hybrid laser systems, especially as new, high-power solid state lasers (Yb fiber and Yb disk) have increased in power and decreased in cost. To meet these needs, a number of companies have offered hybrid "systems," which range from welding torches and power supplies to complete cells that offer the laser, motion system, controls, and the integrated "optics-torch" system.

Hybrid Laser Arc Weld (HLAW) processing showing the combination of GMAW with laser welding.

***BULLETIN*: Describe the equipment.**

Denney: The size and weight of a hybrid system depends on the size of optics used, the torch, the bracket to hold them together, as well as the cabling. A typical system operating at 10 kW weighs about 20 pounds and would fit in a cylinder approximately two feet in length and ten inches in diameter. Simply put, the laser beam provides the penetration (and the speed) while the GMAW process provides the filler material to take care of gaps, mismatch, and chemistry. The orientation and position of the laser beam to the torch depends often on the laser spot size, laser power, joint configuration, and application.

***BULLETIN*: You said the hybrid process is successfully used in shipyards. What other application or industry could be next?**

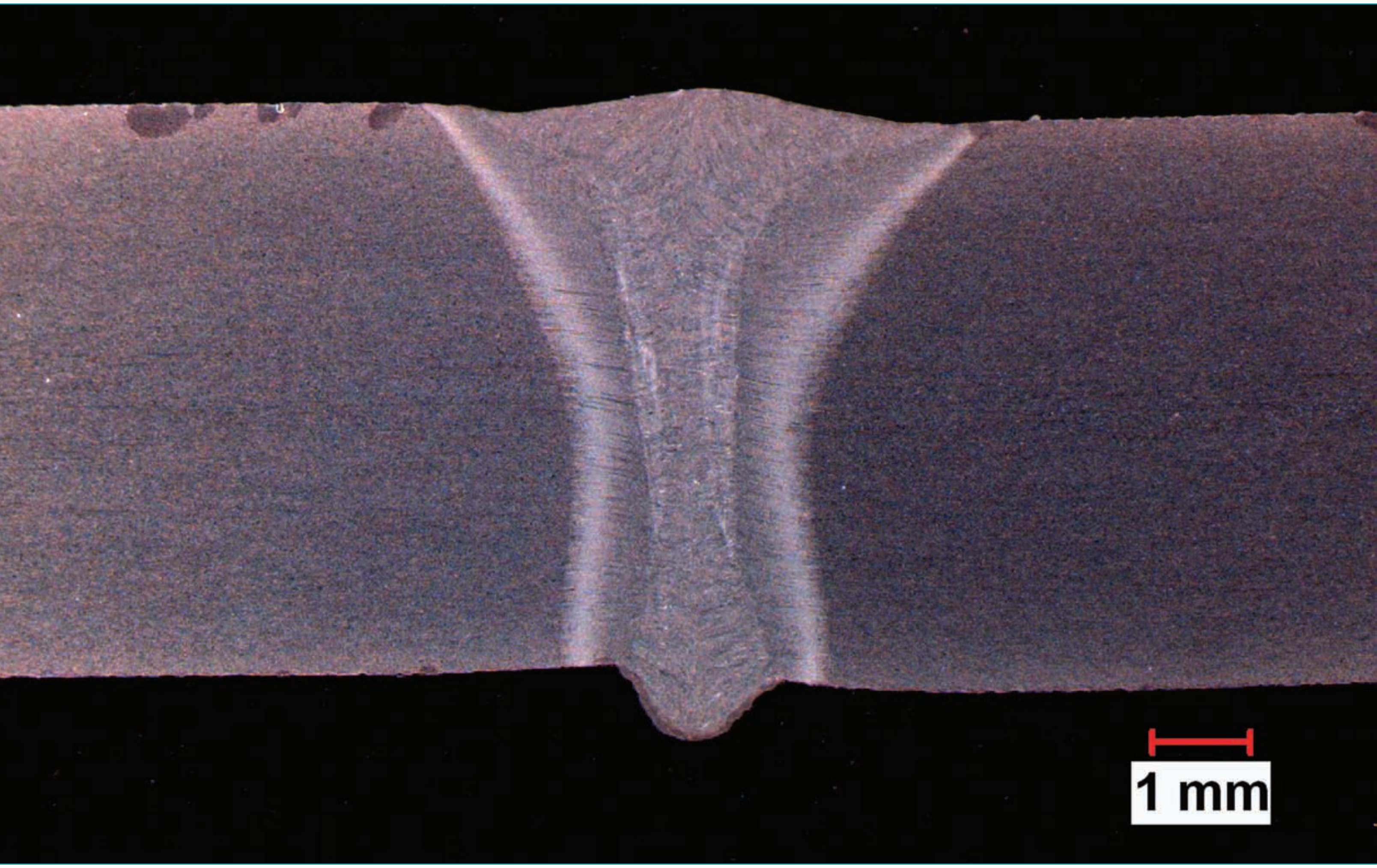
Denney: Pipe-to-pipe welds may be a big application for the hybrid process, especially for shop welding (not field welding) where the parts can be rotated. The advantage here would be the travel speed and the elimination or reduction of beveling. The US Navy did demonstrations showing that piping could be fabricated using hybrid processing. Manifolds and other components may be welded if designed to take advantage of the hybrid process.

BULLETIN: **What should boiler and pressure vessel manufacturers and inspectors know about hybrid laser-GMAW welding at this point in time?**

Denney: The welds will be narrower than inspectors normally see and the defects may be harder to detect. Missed joints, where the weld does not melt both sides of a joint, can be very difficult to detect unless radiographed. Also, porosity in the root of the weld can occur from contamination in the material or from instability of the laser keyhole in the process. In some cases there can be centerline cracking or hot metal tearing along the centerline, which will depend on the chemistry of the weld metal, filler material, welding parameters, and joint geometry. Visible defects may include "humping" of the weld bead on the top of the bead or unacceptable back bead profiles. These defects can often be addressed by changing the welding speeds or selecting a different weld mode if a solid state power supply is being used. The different weld mode will alter how the droplets are transferred to the weld pool and how they interact with the laser beam. For the boiler industry specifically, the hybrid process has been considered for years in the fabrication of "water walls" or boiler components where GMAW or sub-arc processes are presently used to form gas-tight membranes between adjoining tubes. Because there is a high "density" of welds in these parts and because of the location of the welds, there is considerable distortion in these parts when arc welded. Because of the deep penetration and lower heat input of the hybrid process, panels welded should have less distortion and can be made more quickly.

BULLETIN: **Hybrid laser-GMAW welding was added to the 2013 Edition of the ASME code. How do you envision these standards developing in the coming years?**

Denney: I think many companies would like to consider using the hybrid processing but because there were no specifications in this area, they were reluctant to investigate a process that will be expensive to qualify. With the



Cross section of HLAW in a square butt joint; 10 kW laser power; 140 ipm; 0.25" steel plate.

ASME code and the American Welding Society (AWS) starting to develop a specification for hybrid processing, there will be guidance on the critical parameters and how best to develop welding procedures that can be qualified for their specific application.

***BULLETIN*: What other manufacturers could benefit from this process and might incorporate it in the future?**

Denney: Manufacturers that already fabricate with arc processes or possibly don't fabricate because of the amount of distortion may consider the hybrid process. Because of the amount of material deposited, the joint configuration, and the low heat input, the hybrid process usually has less distortion than most other welding processes. Therefore, using the hybrid process may decrease or eliminate some secondary processes, such as straightening, that are normally needed for other welding applications. Also, because of the higher welding speeds of the hybrid process and the low distortion, it may be more economical to fabricate some structures versus other methods. This is why the process is being used on some structural parts; the cost to roll specific shapes, especially for certain grades of steels, is quite high. This "lower cost to fabricate" may also be applied to some structures that are now made from castings.

***BULLETIN*: What are the advantages of hybrid laser-GMAW welding over conventional welding processes? Disadvantages?**

Denney: Advantages are deep penetration welds at very high speeds with low heat input and expense of joint preparation. The disadvantages are the added safety issues, the cost of laser equipment, the tighter tolerances required, the difference in preferred joint geometry over arc processes, and the fact that it is a new technology that is not fully understood or trusted.

***BULLETIN*: Regarding the technology parameters, what are its capabilities?**

Denney: There are many variables that influence the capabilities, including the optics used, the anticipated gap/fit-up issues, and the laser power available. The shipyards were welding up to 0.50-inch plates with machined edges in a single pass as an example of thickness, but that was with laser power greater than 10 kW. We have been able to make square butt joints in sheared-edge 0.120-inch plate (more joint variations) at over 140 inches per minute with less than 5 kW of delivered laser power.

***BULLETIN*: What are some limitations of the technology?**

Denney: One limitation is penetration. This is a function of the laser power and power density. By increasing the power density (smaller laser beam spot for a given power) weld penetration can be deeper, but part alignment becomes more critical. There may also be more defects because of the relationship of the size of the keyhole the laser makes to the amount of liquid material around it. So to go deeper, a larger spot is needed and therefore more laser power (higher cost). The typical maximum penetration that is achieved with lasers in the 15-kW range is about 0.75 inches in depth.

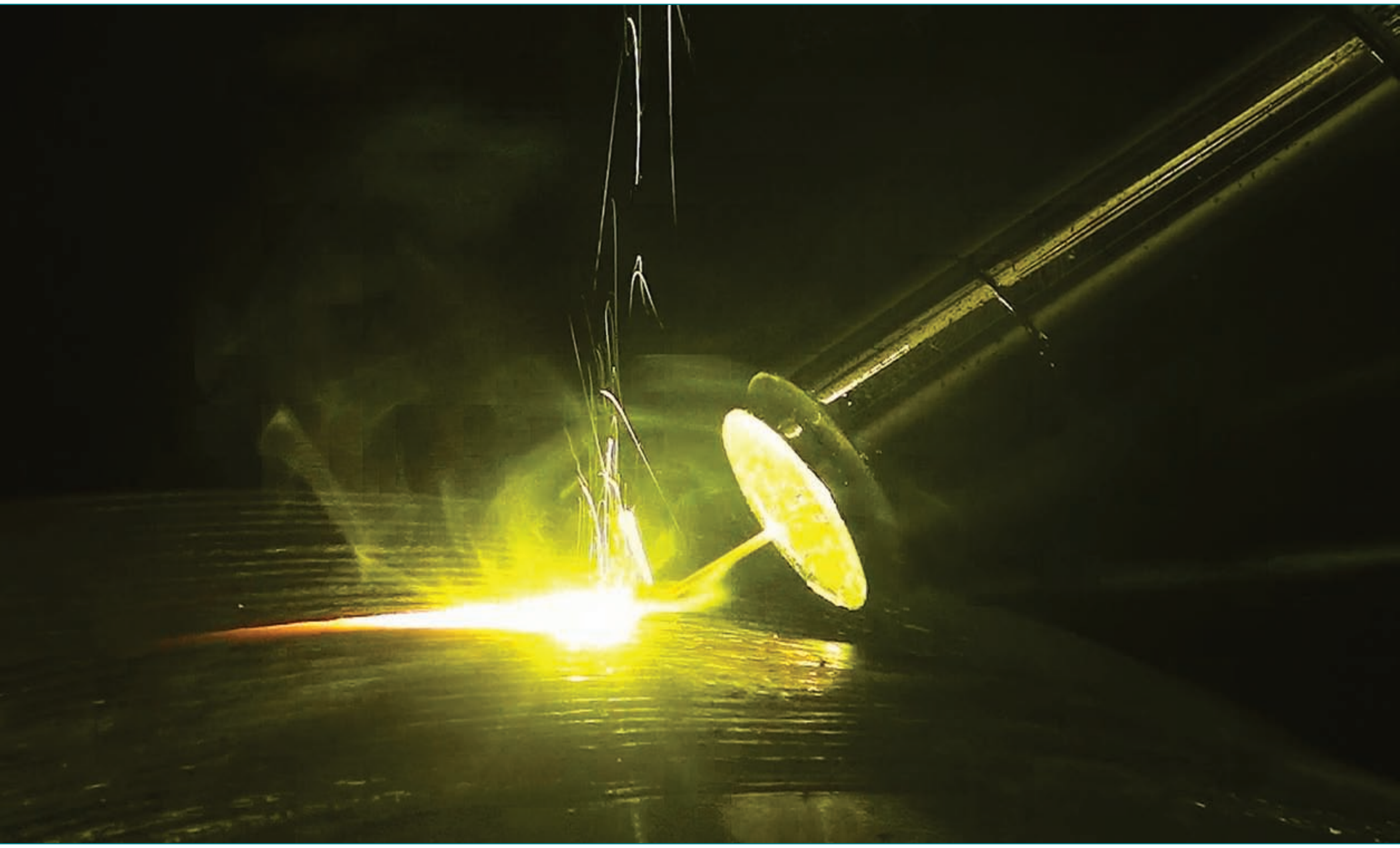
The second is hardness/heat-affected zone (HAZ) because laser hybrid is a lower heat input process; the cooling rate is much higher than arc processes. So, for some steel alloys there may be an issue of high hardness in the HAZ of the weld. Hardness in the weld metal can be addressed with proper filler material selection, but HAZ changes can be addressed only through pre-heating, material selection, and/or post processing.

Another limitation is access/orientation. The size of the hybrid head and the alignment of laser beam to wire make it difficult for limited access areas and some joint configurations. An example is making fillet welds for certain tube-to-tube sheets configurations. This application may be difficult because of the challenge of keeping the orientation of the torch and laser beam constant while travelling around a small-diameter tube at greater than 100 inches per minute. There may be other laser processes that would be better-suited for this application, such as autogenous laser welding.

Finally, large gaps can be an issue. While the hybrid process is sold on the concept that the GMAW part takes care of any gap issues, there are limitations. If the gap gets so large that GMAW can't bridge and/or provide enough fill, then the hybrid process will have to slow down. In some cases, by slowing down, it may be more economical to use high-deposition arc methods, such as Tandem GMAW, instead of hybrid.

***BULLETIN*: How does hybrid welding compare to other high-deposition rate processes, and how cost effective is it?**

Denney: The physical limitations are typically related to access. If the joint is a tight fit for the GTAW (gas tungsten arc welding) or GMAW torches, most likely the hybrid process won't fit either. Welding around small-diameter pipes in place (moving optics) is difficult and limits the process even though hybrid laser can be used out of position. As for cost, comparing GMAW equipment (torch, power supply, etc.) to hybrid laser equipment (laser, optics, torch, power supply, etc.), the difference is easily a factor of 10 to 50 times greater. However, when considering full systems costs (motion, fixturing, controls) the difference can drop significantly to be only double the cost of a traditional



Example of laser hot wire processing being used to apply a stainless steel clad layer on steel base material. Note there is no "arc" in the process.

arc process system. Another factor to consider is the production rate. For many applications, the hybrid process can more than double the production rate. There are also cost savings that may occur before and after the hybrid process versus arc that will lower the cost per part and make the hybrid process economical, including things like joint preparation and straightening. And there may be a performance improvement from the process that is more difficult to measure. So comparing the hybrid process to other technologies is not always an easy thing to do.

***BULLETIN*: Are you working on any other types of hybrid welding processes?**

Denney: We are working on a process that could be considered "hybrid" (it combines laser with an arc welding power supply) but instead of laser plus GMAW, it is laser plus hot wire so it is more similar to GTAW with filler material. Like in GTAW, which uses an electrode (and an arc) to create a weld pool and adds cold or hot filler wire, we use the laser (and photons) to create a weld pool and add hot wire. Also, to maximize the filler addition, we are using a solid state power supply that heats the wire as high as possible without arcing so only a minimal amount of heat from the laser is needed to finish melting the wire. This process does not have the deep penetration capability of normal hybrid but it also does not have negative arc characteristics, such as molten metal mixing or arc interference. We are looking at making welds and overlays like GTAW but at deposition rates that are more than four times greater. And because there is no arc, the process can be used in narrow joints that are less than a third of what is required by GTAW.

***BULLETIN*: Any final comments?**

Denney: Many companies are looking at competing in a global economy through automation, which lowers the amount of labor in a product. Many of these customers are moving to robotic/automated welding systems, which have become economical with advancements in robotics and electronics. Because lasers are an automated process to begin with, using hybrid welding should be seen as another step in automation and productivity for manufacturers. The hybrid process should not be looked at as an answer for all welding applications, but as a potential solution for specific applications.

Purposely Setting a Valve Higher than Nameplate Stamping: Acceptable or Not?

BY THOMAS P. BEIRNE, P.E., TECHNICAL MANAGER, PRESSURE RELIEF DEPARTMENT

Can a valve be purposely set higher than its nameplate stamped set pressure? This question has been posed to the pressure relief department a few times in the last year. The answer is not as simple as one would think.

Set pressure is determined by the maximum allowable working pressure (MAWP) of the equipment the valve is protecting. For the purpose of providing an example, let us assume we have an *ASME Boiler & Pressure Vessel Code*, Section VIII, pressure relief valve for which the nameplate stamped set pressure is 100 psi. The production set pressure tolerance in this case per UG-134(d)(1) is +/- 3%, making the allowable set pressure range 97 psi to 103 psi.

The question of setting a valve higher than the set pressure stamped on its nameplate poses itself most often when ASME/**NB** and/or **VR** certificate holders are asked by their customers to set a valve at the high end of the tolerance (in this case, 103 psi, to make sure the valve does not leak or go off early), but still stamp it at 100 psi. Typically, the user of the valve wants to operate their equipment as close to the MAWP as possible. By requesting a higher (but within tolerance) set pressure on the valve, it will improve their chances of the valve not leaking or going off as the pressure approaches MAWP.

Keep in mind that code requirements are minimum requirements.

Interestingly enough, the ASME code does not specifically prohibit the certificate holder from doing this as it does not mention how the +/- 3% tolerance gets used. It merely says the final set pressure shall not go outside +/- 3% of the stamped set pressure. However, tolerances are built into the code for a number of reasons, none of which is the willful intent of the certificate holder.

Some ASME/**NB** and/or **VR** certificate holders will actually specify tighter tolerances in their quality control programs so that even though there may be differences in measurement techniques and test gage tolerances, the code tolerances will still be met once the valve is shipped. Keep in mind that code requirements are minimum requirements. Going above and beyond the minimum is always encouraged.

So to answer the question: Is it acceptable to purposely set the valve higher than the nameplate set pressure? Technically, yes; however, it is not in the spirit of the code to do so. As a certificate holder, a company is making a commitment to the overall goal of public safety; therefore, the certificate holder should make every effort to set the valve as close to the nameplate set pressure as is feasible. ✤

MICHAEL BURNS

Chief Boiler Inspector, State of Florida

BULLETIN Photograph by Inga Finch Photography

To look at Michael Burns, one cannot be anything but impressed by his svelte, honed, 6-foot-2-inch, 190-pound physique. But that is now.

Back in 2009, the Florida Chief Boiler Inspector checked in at an unwieldy 260 pounds. And when he shed 100 pounds just a year and a half later, those acquainted with him were taken aback by what they feared was declining health.

Not so, Mike says with a smile. It was simply an adjustment that would permit him to transition to a newfound pastime: running, swimming, and biking (read triathlon).

Although perhaps hard to believe, he weighed in at a modest 139 pounds in high school and was considered too small to play varsity football.

Born on Long Island, New York, Mike enjoyed a childhood that focused on sports: biking, street hockey, little league baseball, swimming at Jones Beach, and stickball. All of these activities notwithstanding, the one thing he clearly remembers about growing up on Long Island was a lack of air conditioning. "The heat was stifling not only in the house but especially on the streets," he recalls.

Admitting he wasn't much on schooling ("At that time, I never saw how what they were teaching would be relevant to my future!"), Mike did like movies.

"Perhaps the most inspiring to me as a kid was PT-109, which depicted the actions of John F. Kennedy as a Navy officer in command of a motor torpedo boat."

Mike surmises the movie had an influence on him entering the Navy following high school graduation at the early age of 17. "I wanted to be a diver," he explains. "But the Navy was pushing me into a nuclear curriculum. Knowing that would involve more schooling than I wanted to experience, I opted for the boiler program. It seemed like there were boilers everywhere I looked!"

Following boot camp in 1984 at Great Lakes, the Navy flew him to San Diego en route to a meet-up with the

USS *Thomaston* in Japan. "In San Diego, I was considered transient personnel," he recollects with a nod. "After reporting on board the ship we steamed mainly to Asian ports of call, moving Marines to and fro. The boiler room...well...was unsurprisingly hot. The forced draft blower room hit 145°F some days."

Less than a year on the USS *Thomaston*, Mike found himself on the ship's decommissioning crew before being ordered to the guided missile cruiser USS *Horne*. And so the fireman's world tour took him to other more exotic ports of call in Hawaii, the Indian Ocean, Africa, and finally Alaska.

"I was out one evening at some port in Alaska on liberty with my boiler watch section when, after an entire day of partying, we all headed back to the USS *Horne* at about 11:30 p.m.," he explains. "It was then I experienced one of the scariest moments in my military career. We couldn't find the USS *Horne*! We all came to the conclusion the ship had sailed without us," he chuckles.

As it turned out, the sailors weren't left behind. Rather, the tide around the dock had dropped significantly, thus creating the illusion (perhaps fueled by extended revelry) the USS *Horne* was en route to its next port of call.

Preparing to leave the service, Mike decided to continue his military work in the reserves. But as he flew back to Long Island following his discharge in August 1986, he made a career decision: "I never wanted to see another boiler again. The heat and the boredom had taken its toll on me."

After six months of operating a forklift at a Long Island warehouse, the New York native had a change of heart and applied to Hartford Steam Boiler (HSB) to become a boiler inspector. "I began in February of 1987 and entered the company's boiler inspection school at Parsippany Plaza in New Jersey. The following month, I passed my commission examination in Albany, New York."

Mike's initial inspection assignments covered five New York City boroughs. "During a visit to the city, driving a brand new Plymouth Reliant K car, my hubcaps were stolen," he recalls with a laugh.

"Some of the work was in a bad part of town and involved inspection of government buildings along with some new construction," he adds. "But it was a great experience because I was exposed to a wide variety of older pressure equipment from boilers still stoked with coal to boilers put together with rivets."

During the mid-1990s, Mike was promoted to boiler inspection supervisor, but not before earning an Associate in Applied Sciences degree and Associate of Science degree at SUNY Farmingdale and a Bachelor's degree in Business Administration at Hofstra University. While taking a business administration course, he struck up a conversation with the woman who would become his wife: Janet. Married in 1995, the Burnes bought a house in Long Beach. (The Burnes have two daughters: 12-year-old Bonnie and 9-year-old Bernadette.)

Mike parted ways with HSB, and a business venture brought the Burnes to Colorado in 2002. Three years later, he received orders to return to active duty. "I ended up being sent to Kuwait to provide TSA-type services for returning soldiers," he relates with arms crossed. "During the day, temperatures would easily top 140°F. At night the temperatures generally hovered in the 110°F range. Thermometers were constantly breaking."

Mike's nine-month stint overseas resulted in a positive outcome for the New York native. "I was able to get my 20 years of service to become eligible for veterans' benefits," he relates with a grin.

In April of 2006, Mike rejoined HSB as an inspector in southern Florida. "In 2008, I received a call from the state informing me the position of state chief boiler inspector was open and asking if I would be interested. Somewhat reluctant to take the position, I agreed to have lunch with state officials in Tallahassee."

It must have been quite the lunch. Mike joined the state in August 2008 and hasn't looked back.

When speaking with Mike, one best be prepared to discuss two subjects: pressure equipment and/or running. And maybe dieting.

As to how he disposed of 100 pounds in a year and a half, Mike cites one specific reason: discipline. "I checked my calorie intake every day and I didn't exceed my limit." In terms of keeping off the weight, some of which did come back, he credits his devotion, nay, addiction, to running.

The Florida official typically runs about 40 miles per week, keeping track of heart rate, miles, pace, and elevation on a wristwatch-like mechanism he checks with the regularity of a text-addicted teenager. "Tallahassee's great network of trails and having the encouragement and support of the local running club's diverse membership [Gulf Winds Track Club] make running something special. I'm working towards qualifying for the 2016 Boston Marathon!"

Leadership abilities carried over from his military days have made the Florida official one of the National Board's most-experienced retired veterans and knowledgeable members. In addition to his 20-years' service with the Navy, Mike boasts 200 hours of fire inspection training and membership on a number of National Board and ASME committees. Recently elected National Board Board of Trustees Second Vice Chairman, he also serves on the organization's Technical Scholarship Selection Panel and the Examination Committee for Inspectors. Additionally, he sits on the ASME Conference Committee and the Boiler and Pressure Vessel Committee on Nondestructive Testing.

Asked to comment on how the life of a commissioned inspector has improved since joining the industry 27 years ago, Mike pauses to reflect and then sarcastically replies: "It's a good thing government and company vehicles no longer have hubcaps!"

Online Training Help Desk

Your Most Frequently Asked Questions

BY KIMBERLY MILLER, MANAGER OF TRAINING

Since 2010, the National Board has added 20 online courses to its menu of training. In 2013 alone, there were more than 2,000 online training enrollments. With such an increase, more and more questions about our learning management system (online training center) are asked by students. Here are the most frequently asked…

I've logged into the National Board website, but where do I enroll?

The National Board website and the online training center are two different sites with two different accounts. While users can do a lot of things on the National Board website, they cannot take online training from their website account. To enroll in online training, click "Launch Online Training Center" from the menu located under the Training tab on the homepage. A new screen will appear with a dialog box requesting a username and password. For first-time students, click the *Request a new account* link located under the password box. Once you create a student account you will be able to enroll in any of our online courses located under the Catalog.

Why is it recommended to use my email address as my username?

Easy – because you won't forget it! People creating a random username are far more likely to forget it than when they simply use their email address.

Can one person from our company do a group enrollment for our employees?

Although you can do group enrollments for classroom training, you cannot for online training. Here's the reason why: student transcripts. In order to provide a transcript showing all enrollments and course completions for a student, there must be an individual record maintained. To do this each student must have his or her own account which contains not just a username and password for entering the system, but name, employer, birth date, course enrollments, and completion information (i.e., completion status, date, scores, etc.).

The best way to manage this is to allow each employee to establish his or her own student account on our online training system. However, one person from a company could create an account for each employee, then – when logged into the system as the student – enroll them in the required training. The company employee designated to this task would then be responsible for providing each employee with his or her username and password information.

What should I do if I can't remember my username and/or password?

Click the *Forgot your password?* link located under the password box on the online training center login screen. Using this link will allow the system to send TWO emails. The first provides you with your username and alerts you to the fact that your account's password has been reset. This email is immediately followed by a second email containing the temporary password for your account. It is important to note the password is only valid for seven (7) days, so you will want to log into your account before it expires. You will be asked to update your temporary password to a password of your choice when you log in.

I couldn't remember my username so I decided to just create a second account, but now I can't see the previous training I have taken. Why?

Before answering "why," I first need to say, don't do this! The first thing you should do is utilize the *Forgot your password?* link. If you are still having an issue logging into the system, please use the *Contact Us* link in the top right corner of the online training center to either email or call the training department. As I mentioned earlier, all training enrollments are associated with the account from which they were purchased. The system has no way of knowing if one person has multiple accounts, even if you have used the same username to create them – it is no different than having multiple accounts on Amazon.com. And unfortunately, we have no way of merging multiple student accounts into one. If you have done this, you will now need to maintain multiple accounts in order to document your training.

Can I pay for online training with a check or wire transfer?

No. Individual online training may only be purchased using a credit card.

How do I get a receipt for my enrollment?

All payment transactions are immediately processed and a receipt is automatically sent to the email address associated with the student account. Since this receipt is generated by the system, it is sent from "CustomerSupport" with a subject line of "National Board Online Training Order # ...". If you do not find this email in your inbox please check your junk or spam folder, as some email systems may filter the email when "CustomerSupport" is not listed as a sender in your contacts. This is the only receipt sent for online training enrollments.

I'm on the last page of the course but the course status still says "In Progress." What should I do?

Nine out of ten times this happens because a page was not marked "completed" in the course. All pages must be viewed in order for the course to be marked as completed. *So, which page is it?* You will be able to find a page by opening the Table of Contents menu (click the TOC button at the bottom of the page), which lists each page in the course. If there is no check mark next to the page name then it is not completed. Simply return to the incomplete page – wait a minute for the page to register – then click the Next button. Once all pages have been "checked," you will see a check mark appear in the left hand menu next to the course name and your course status will change to "Completed." You will now be able to print your certificate.

My completed courses disappeared from MY ELECTIVE LEARNING. Where did they go and how do I print my certificate?

Once a student completes a training course and its status is "Completed," the course moves to the History tab found under MY ELECTIVE LEARNING or MY REQUIRED LEARNING. Courses listed under this tab may still be opened in a review mode, if necessary. This is also where the final certificates are maintained. To print a certificate, click the Radio button next to the course title then the Print Certificate button at the bottom of the list of courses. Certificates open in Adobe Acrobat Reader as a PDF file. You may then print or save the certificate to your computer.

Should I create a new account if I change jobs?

No. Maintain your records under one account. Simply log into your account and click the *Your Settings and Preference* link followed by *My Profile*. You will then be able to update your employer, email address, username, password, etc. All changes to your username and / or password will be effective the next time you log into the system.

What continuing education training am I required to take?

If you are unsure which course you need to take, reference the designators across the bottom of your commission card. For example, if you have an A_R, then you only need to enroll in the continuing education bundle for the A_R, B. If you have an A with no subscript R, then you only need to take the A, B bundle. All continuing education is under the BUNDLES tab in the CATALOG.

How long do I have to complete a course once I enroll?

We do not have expiration times on any of our online training so students may take as much time as needed to complete a course. However, keep in mind we do update the courseware with the publication of new codes. For example, at the end of 2013, we rolled out the 2013 NBIC courses. We then removed the 2011 courses from the catalog and began to monitor the completion status of any students enrolled in the removed courses. Once there are no students actively taking a course, it is archived and no longer available.

What happens if I click the Drop Course button?

Clicking the Drop Course button is the same as throwing away the course. If you drop a course you will lose all access to the training. No refund will be provided for dropping a course, nor will it be reinstated into your course list. Be very careful and thoughtful before deciding to drop a course.

For a complete list of both online and classroom training courses and seminars, please visit www.nationaloboard.org.

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• Clarification of Pressure Vessel Terminology, Vol. 68, No. 3, p. 10 (fall 2013) ✤

New National Board Members

Hawaii

Mr. Julius Dacanay has been accepted to National Board membership representing the state of Hawaii. Mr. Dacanay earned a bachelor of science degree in mechanical engineering from the Technological Institute of the Philippines. He was a mechanical engineer for A. de Vera Construction & Engineering in Manila, Philippines, from 1996 to 1997. From 1997 to 1999, he was a mechanical engineer with Pittsburgh-Des Moines, Inc. in Saudi Arabia. Mr. Dacanay became a Hawaii state boiler inspector in 2002, was promoted to manager of the Boiler & Elevator Inspection Branch in August 2013, and was appointed chief boiler inspector in November 2013. ✚

Julius Dacanay

Massachusetts

Mr. Henry R. Geryk Jr. has been accepted to National Board membership representing the Commonwealth of Massachusetts. He began his career as an operating engineer and then as the assistant to the chief engineer with Strathmore Paper Company in 1982, and then served as a district engineering inspector for the Commonwealth of Massachusetts Department of Public Safety in 1985 through the present. Mr. Geryk attended the Wentworth College of Technology in Boston and received an associate of science in mechanical power technology in 1980, and a bachelor of science in mechanical engineering technology in 1982. ✚

Henry R. Geryk Jr.

Michigan

Accepted to membership representing the state of Michigan is Mr. Mark S. Moore. Mr. Moore served the US Army, military police, from 1972 to 1975. Between 1980 and 1990, he was employed with multiple Florida contractors as a plumber/pipefitter and boiler installer. He was hired by the Florida Department of Corrections in 1990 as a plumber/boiler installer, and was a vocational instructor III/high-pressure boiler operator at Lowell Correctional facility from 1991-1998. He joined the state of Michigan as a boiler inspector in 2004 and earned his National Board commission in 2006. He was appointed assistant chief inspector in January 2011 and became chief in October 2013. ✚

Mark S. Moore

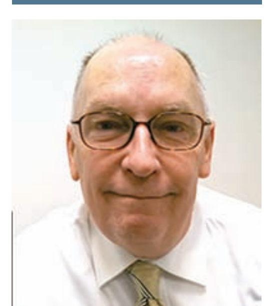
Missouri

Mr. Joe Brockman has been accepted a National Board member representing the state of Missouri. Mr. Brockman served the United States Navy from 1986 through 2006. He was employed as a boiler and pressure vessel inspector for the state of Missouri before becoming deputy chief in January 2014. ✚

Joe Brockman

Seattle

Representing the city of Seattle and accepted to membership is Mr. Larry Leet. Mr. Leet served four-year terms in both the US Army and the US Coast Guard beginning in 1969. His civilian career includes positions as an NDE examiner at multiple shops; boilermaker for Flohr Metal Fabricators; fabricator/welder with Weld and Design, Inc.; quality control manager for both Union Tank Works, Inc. and Morfab Company, Inc.; engineer, quality control management, for Coastline Fabricators; and engineer level II inspector for American States Insurance. In 1998, he became a pressure systems inspector for the city of Seattle before taking the position of chief in 2000. ✚



Larry Leet

Call for 2015 Safety Medal Nominees

The National Board of Boiler and Pressure Vessel Inspectors is seeking nominations for the 2015 Safety Medal award. This award, the highest honor bestowed by the National Board, will be presented at the 84th General Meeting in Colorado Springs, Colorado, April 27-May 1, 2015.

To be considered for the Safety Medal, letters of recommendation must be submitted by three individuals who are acquainted with the candidate and can attest to his or her safety contributions within the boiler and pressure vessel industry. At least two of the letters must be from National Board members. Each letter of recommendation should include:

- The name, title, employer, and business address of the candidate.
- A listing of specific candidate contributions or achievements relative to the award.
- A brief biography of the candidate that includes positions held, National Board involvement, and participation in industry activities, including any honors and awards known to the individual making the nomination. (Note: In order to be considered, the candidate must have served on a National Board committee or a nationally recognized standards committee, have participated in National Board activities for not less than 15 years, and been recognized as a contributor to professional organizations related to the boiler and pressure vessel industry.)

The name, title, employer, and business address of the individual submitting the nomination should also be included. For complete information visit the National Board website. Letters of recommendation are due by December 31, 2014, and should be addressed to:

Mr. David Douin, Executive Director
The National Board of Boiler and Pressure Vessel Inspectors
1055 Crupper Avenue
Columbus, Ohio 43229.

Correction

The article *NBIC Part 1, Section 3-Controls: Hot Water Supply Boilers Versus Potable Water Heaters*, published in the 2014 winter *BULLETIN* had an incorrect item on page 18. Please note the following: Table 1: "ASME Construction Code Requirements;" third column, "Code #2 (HLW Stamp) Potable Water Heaters;" nine rows down, should read: "Two temperature controls, one operating and one limit set at no higher than 210°F," rather than "One required with maximum setting 210°F."

Daniel Burns Remembered

Former National Board member Daniel Burns died on March 4, 2014. He was 60 years old. Mr. Burns was a member of the National Board from 1998 to 2006 representing the state of Nebraska. He served in the US Navy from 1972 to 1988 as a senior chief boiler technician aboard the USS *Gray*, USS *Saratoga*, USS *America*, and USS *Coral Sea*. After his military service, Mr. Burns was a contract worker at various nuclear, chemical, and refinery plants. He was also employed with Hartford Steam Boiler as an authorized inspector. He joined the state of Nebraska as its boiler inspection program manager in 1998.


Daniel Burns

Code Interpretations

The *National Board Inspection Code* (NBIC) and the American Society of Mechanical Engineers' *Boiler and Pressure Vessel Code* (ASME B&PVC) each issue responses to technical questions submitted by their respective user communities. Interpretations clarify the meaning or intent of existing rules. Section 10 of the NBIC contains an index of all approved interpretations at the time of publishing. A comprehensive index of NBIC interpretations is available at nationalboard.org under the NBIC tab.

The ASME B&PVC contains an index of all approved interpretations at the time of publishing, along with the written interpretations for a given date range, at the end of each Section. All written interpretations are also published online at: http://cstools.asme.org/interpretations.cfm.

Following is a selection of interpretation questions currently posted on the respective websites. To see the corresponding answers and the complete collection of questions, refer to the websites listed above.

2013 NBIC Interpretations

- **Interpretation 13-01,** Subject: Part 3, 5.7.5, Edition: 2011
  Question: When temperature limits are not required to be placed on the original manufacturer's nameplate in accordance with the original code of construction, may the temperature field for Figures 5. 7. 5 b) and 5.7.5 c) be indicated as N/A?
- **Interpretation 13-02,** Subject: Part 3, 1.8.5 q), Edition: 2013
  Question: If audit personnel are qualified in accordance with the requirements of ANSI/ASME N45.2.23, Qualification of Quality Assurance Program Audit Personnel for Nuclear Power Plants, may they perform the audits specified in 1.8.5.1 q)?

ASME B&PVC Interpretations posted January 2014

SectionVIII-1

- **Interpretation: VIII-1-13-08**, Subject: UG-32, Formed Heads; UG-34; and UHA-44 (2004 Edition), Date Issued: February 6, 2013
  Question (1): Does ASME Section VIII, Division 1 (2004 Edition, 2005 Addenda), UG-32(a), footnote 18 allow Mandatory Appendix 1, 1-4 to be applied to formed heads with proportions where *r* is less than 6% of the skirt outside diameter and less than 3 times the head thickness, but with *L*/*r* less than 162/3 (i.e., heads of other proportions)?
  Question (2): Per UG-32(j), does the term *head thickness* refer to the required thickness calculated per UG-32(e) or (f), as applicable?
  Question (3): Does U-2(g) allow the design and acceptance of a formed head that is not of the type defined by UG-32?

Section IX

- **Interpretation: IX-13-13,** Subject: QW-423.1, Date Issued: June 10, 2013
  Question: In accordance with QW-423.1, may P-No. 1 base materials be substituted for P-No. 8 base materials when following a P-No. 8 to P-No. 8 WPS for the purpose of a welder qualification, when variable QW-403.18 applies?
- **Interpretation: IX-13-10,** Subject: QW-201, Date Issued: March 21, 2013
  Question: Company A owns Companies B and C. May Company B use WPSs qualified by Company C in accordance with the requirements of Section IX without requalification, provided Company C describes the process that they follow in their Quality Control System/Quality Assurance Program for the operational control of procedure qualification?

Section I

- **Interpretation: I-13-07**, Subject: PW-43.1.2 (2010 Edition), Date Issued: March 19, 2013
  Question: When determining the allowable load per unit length of attachment on a tube bend, is the following the intent of PW-43.1.2:
  (a) that the allowable unit load in tension determined by using the outside diameter of the tube be increased by the tension unit load for a tube having an outside diameter equivalent to the outside diameter of the bend and having a wall thickness the same as that of the tube bend
  (b) that the allowable unit load in compression determined by using the outside diameter of the tube be increased by the compressive unit load for a tube having an outside diameter equivalent to the outside diameter of the bend and having a wall thickness the same as that of the tube bend?
- **Interpretation: I-13-09,** Subject: PW-39; Table PW-39-3; Figure PW-16.1, Illustration (z); Postweld Heat Treatment Requirements (2010 Edition) Date Issued: March 19, 2013
  Question (1): Are the tube to header welds illustrated by Figure PW-16.1, illustration (z) considered circumferential butt welds?
  Question (2): Do the postweld heat treatment exemptions for circumferential butt welds noted in Table PW-39-3 apply to the welds illustrated by Figure PW-16.1, illustration (z)?


NBBI
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Get all the details at nationalboard.org under the General Meeting tab.

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