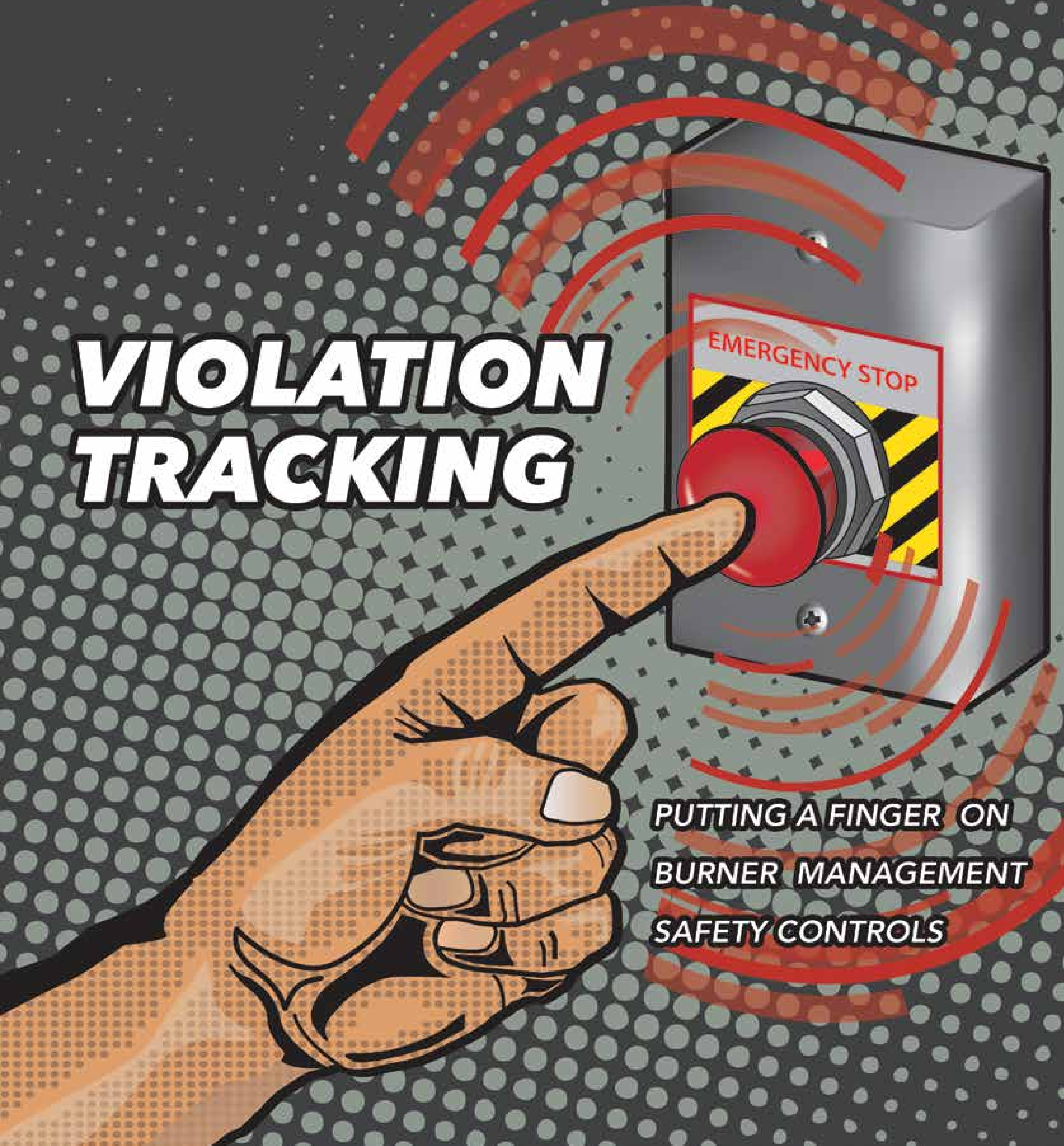
FALL 2015

BULLETIN

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

VIOLATION TRACKING



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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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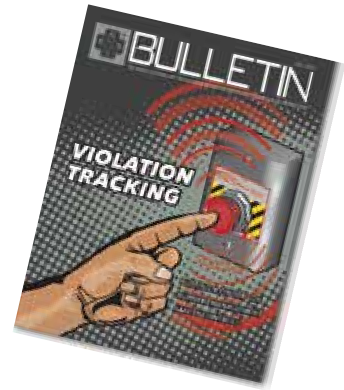

On the Cover:
Violation Tracking: A closer look at key violations for burner management systems.

COVER STORY

FEATURES

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SAFETY IN NUMBERS . . .

BY DAVID A. DOUIN, EXECUTIVE DIRECTOR

As we conclude this year's celebration of National Board's 95th Anniversary, it occurs to me that the pressure equipment profession has been blessed with a continuity few industries enjoy.

It all started back in 1867 with creation of the Hartford Steam Boiler Inspection and Insurance Company. Thirteen years later would see establishment of the American Society of Mechanical Engineers (now known as ASME) in 1880.

Just last year the industry celebrated 100 years of the *ASME Boiler and Pressure Vessel Code*. And now the National Board is within five years of its 100th anniversary in 2019.

These benchmarks prompted me to research some other anniversaries that have just recently been or will soon be achieved at the National Board. Seldom do we acknowledge other important milestones that play significant roles in what we accomplish every day on a professional basis.

For example, National Board registration was launched 94 years ago to provide important construction data to the pressure equipment industry. Those modest beginnings of only a handful of data reports back in 1921 compare today to a program that has achieved total registration of nearly 54 million boilers, pressure vessels, and nuclear vessels.

Another example: the *National Board Inspection Code* achieved its 70th anniversary this year. A review of the very first 20-page NBIC from 1945 stands in stark contrast to the three-volume nearly 800-page code released earlier this summer. (Perhaps a more important date is August 1987 when the NBIC was approved as an American National Standard.)

Although few would remember, the National Board pressure relief valve program began testing 80 years ago. Back in the early days, the program was conducted in a number of different facilities. Next year, the National Board Test Lab will celebrate 25 years in its current Worthington, Ohio, location. On May 27 of this year, the lab in Worthington completed its 40,000th pressure relief test.

Formed in 1915, the Boiler and Pressure Vessel Laws Society would continue its work for 83 years before disbanding in 1998. Today, however, the society vicariously lives on in the form of its flagstaff publication, the *Synopsis of Boiler and Pressure Vessel Laws, Rules, and Regulations.* In 1998, the National Board assumed responsibility for publishing the *Synopsis*, which is now available on the National Board website at no cost to North American pressure equipment professionals. Consistent with publication of the ASME Code in 1915, the *Synopsis* has also reached the century plateau.

Speaking of the Internet, I was surprised to discover that the National Board website will be 20 years old next year. That is significant for a number of different reasons, all of which positively impact the operations of the National Board.

Interestingly, the first National Board online web courses were launched 10 years ago in 2005. What began with a handful of courses of elementary design has grown to an impressive catalogue of more than 30 digital curricula with new programs being added regularly. (It doesn't seem like 18 years have passed since the construction of the National Board training center and creation of a world renowned campus learning center.)

Another program that has benefited from our website has been the ongoing registration of data reports. Electronic Document Transfer, or EDT, was developed in 1999 to allow two-way electronic exchanges of data reports online. Ease of use and the elimination of bothersome paperwork have made EDT indispensable in the growth of National Board registration.

Playing a critical role in the distribution and sharing of important technical information, the National Board website is accessed in more than 160 countries. Growth of the first site in 1996 from what was essentially an electronic billboard to the premiere web source it is today allows professionals to conveniently access a virtual library of technical documents (e.g., *Synopsis*), research data, and articles for free.

Many of the articles, both old and new, first appeared in our National Board technical journal.

When the *BULLETIN* was first published in 1943, it consisted of eight pages that by today's standards is called a pamphlet. But 72 years later, our colorfully illustrated, award-winning journal continues to be the industry's primary resource for all pressure equipment issues.

Lastly, let us not forget the annual ASME/National Board General Meeting. This next meeting in Orlando will be the 85th in a succession of gatherings that goes back to the 1920s.

Longevity is never the result of mediocrity. And for that we have much to be grateful for.

Time flies.

That's why it's best to have your feet firmly planted on the ground. ✤

2015 Registrations

The National Board's *Certificate of Authorization to Register* ensures a third-party inspection process, providing for uniform acceptance of pressure-retaining equipment by member jurisdictions. This important safety process is documented via submission of data reports by the manufacturer to the National Board. These are the only reports for items carrying the National Board registration number. Once registered, each report is maintained in a permanent file by manufacturer name and National Board number.

The list below identifies boiler, pressure vessel, and nuclear vessel registrations by size for the past five fiscal years. The National Board fiscal year is from July 1 to June 30.

The total number of registrations on file with the National Board at the end of the 2015 reporting period was 53,713,894. ✤

SIZE		FY 2015	FY 2014	FY 2013	FY 2012	FY 2011
BOILERS						
square feet of heating surface						
≤ 55	(A)	239,711	221,374	190,799	163,189	154,964
> 55 and ≤ 200	(B)	33,937	30,601	27,903	28,591	28,823
> 200 and ≤ 2,000	(C)	9,303	9,535	9,015	8,281	8,362
> 2,000 and ≤ 5,000	(D)	637	606	477	607	557
> 5,000	(E)	1,125	863	516	475	572
TOTAL		**284,713**	**262,979**	**228,710**	**201,143**	**193,278**
PRESSURE VESSELS						
in square feet						
≤ 10	(A)	1,151,114	916,056	911,754	927,192	788,752
> 10 and ≤ 36	(B)	276,324	266,031	207,702	207,621	202,902
> 36 and ≤ 60	(C)	75,250	59,416	43,805	44,401	40,017
> 60 and ≤ 100	(D)	19,668	19,323	17,261	16,162	12,924
> 100	(E)	28,037	25,950	24,098	21,189	16,784
TOTAL		**1,550,393**	**1,286,776**	**1,204,620**	**1,216,565**	**1,061,379**
NUCLEAR VESSELS						
in square feet						
≤ 10	(A)	158	345	476	443	482
> 10 and ≤ 36	(B)	64	133	181	79	51
> 36 and ≤ 60	(C)	28	33	21	9	14
> 60 and ≤ 100	(D)	24	3	8	6	18
> 100	(E)	76	156	143	169	94
TOTAL		**350**	**670**	**829**	**706**	**659**
TOTAL ATTACHMENTS*		105,993	108,465	96,557	103,175	92,158
GRAND TOTAL		1,941,449	1,658,890	1,530,716	1,521,589	1,347,474

*An attachment is any type of additional information submitted with the primary data report.

For more information on the Authorization to Register Program, access the National Board website at nationalboard.org

National Board NB-18: A Refresher on Its Resources and How to Use It

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

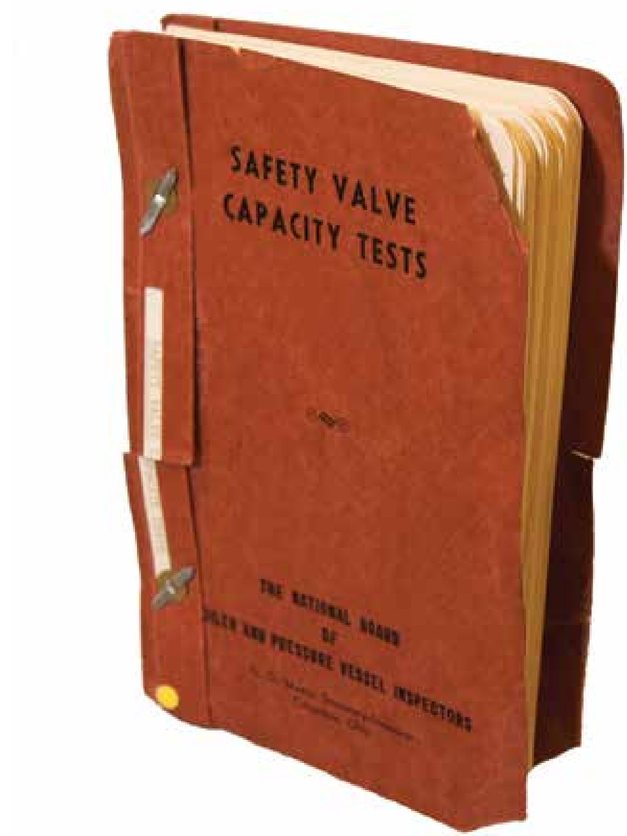
In 1939, the National Board published a book titled Safety Valve Capacity Tests. *This book was originally created as a resource for boiler inspectors to be able to ensure that the pressure relief valve(s) installed on a boiler would meet or exceed the steaming capacity of that boiler. It would later become known as* Pressure Relief Device Certification, *with the National Board identification number NB-18. This article provides a brief overview of the history of NB-18, what the document contains, and how to use the information contained within it.*

History

NB-18 began as a pocket-sized bound book that was published annually and available for purchase. By the mid-1970s, it evolved to a bound 8½-by-11-inch book with a red cover. From that, the industry term "red book" was coined.

NB-18 is still referred to as "the red book" by some who have been around long enough to remember when the hardbound version was still published. By the mid-1980s, it was published in loose-leaf binder format, while maintaining the red cover and annual publication frequency. Due to the nature of the valve industry and the growth in the number of certificate holders, changes to NB-18 were made almost on a daily basis (and still are), making an annual publication out-of-date before it was even available for purchase. This necessitated a migration to an entirely electronic format.

In 2000, the last hardbound copy of NB-18 was published. Since then, NB-18 has been available only on the National Board's website under the "Pressure Relief Devices" dropdown menu. The two main benefits of this entirely electronic format are that the most current version is always available (updates are done weekly) and there is no charge for the publication. Weekly updates are especially important when new products or configurations are introduced to market.

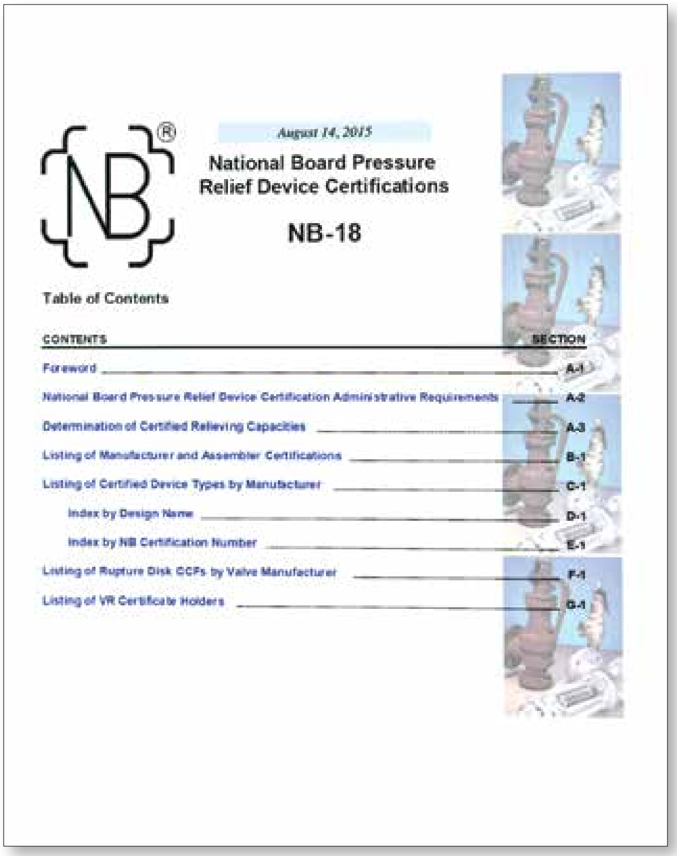


Content and Users

NB-18 presents the administrative requirements of the National Board pressure relief device certification program. It lists those device designs that are certified and the manufacturers and assemblers authorized to apply the National Board **NB** symbol to certified device types. NB-18 also contains a list of organizations which have received a National Board *Certificate of Authorization* for use of the **VR** symbol stamp in accordance with NB-514 and The *National Board Inspection Code* (NB-23). Additionally, NB-18 provides formulas and methods to calculate rated capacity based on the application for which the device is installed.

NB-18 has a wide variety of users. **VR** Certificate Holders seem to be the primary users and refer to NB-18 to look up the capacity and set pressure range of valves that they are repairing. End users of pressure relief devices also refer to NB-18 as a way to check capacity and set pressure range. Manufacturers and assemblers use it as a quick reference to identify the products that they (or their competitors) have currently certified. Inspectors may also use it if the installed pressure relief device's certification is called into question.

Key pages found in NB-18



August 14, 2015

National Board Pressure Relief Device Certifications

NB-18

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Table of Contents with hot links from downloaded NB-18

LISTING OF CERTIFIED DEVICE TYPES

Table of Contents

This publication includes certification tables for each design type presently certified. These tables are listed in alphabetical order according to the manufacturer. The following is an example and brief description of the listings and certification tables.

Certification Number 15567 H Series (Restricted Lift version of Cert # 15006)

Safety Valve

Flow Capacity, K

Steam

Steam

Pop

Adjustable

1 The National Board capacity certification number given solely to this valve type.
2 The design series or catalog number is the commercial designation specified by the manufacturer.
3 The Classification of the pressure relief device type as defined in ASME PTC 25.
4 This indicates the requirements of the Construction Code used during the initial certification testing. Also listed, the National Board accepted testing laboratory where the testing was performed. In some cases, the device may be certified for additional Code Section as noted in the tables.
5 There are several methods of establishing a certified value used to determine capacity.
6 The quantitative value and applicable unit used to determine device relieving capacity.
7 Special provisions of rules, such as Code Cases, and special applications that apply to the device.
8 The test medium listed is the medium that was used during the initial testing. Either air, gas, steam or water could be indicated as the test medium.
9 The certified mediums are the mediums for which the device may be used in service.
10 Set pressure is the value of increasing inlet static pressure at which a pressure relief device displays an operational characteristic. These characteristics are defined in ASME PTC-25.
11 Blowdown is the difference between actual popping pressure of a pressure relief valve and actual reseating pressure expressed as a percentage of set pressure or in pressure units. This indicates whether the valve has a fixed or adjustable blowdown construction.
12 The NPS (DN) and outlet size or range of sizes of a pressure relief device.
13 For pressure relief valves, flow area is the measured minimum flow area through the valve. For non-reclosing pressure relief devices (e.g. rupture disk devices), flow area is the minimum net flow area to be marked on the device.
14 The orifice diameter is the minimum diameter of the nozzle.
15 The minimum lift is the lift that the valve is expected to have to meet its rated capacity.
16 This column indicates the minimum and maximum set pressures valid for the size, Code Section and medium.
17 This column lists the medium of the certified capacity and is associated with the minimum and maximum set pressures in column 16.
18 This column lists the Code Section associated with the minimum and maximum set pressures in column 16.

Guide for using the information for certified device types found in C-1

How to use NB-18

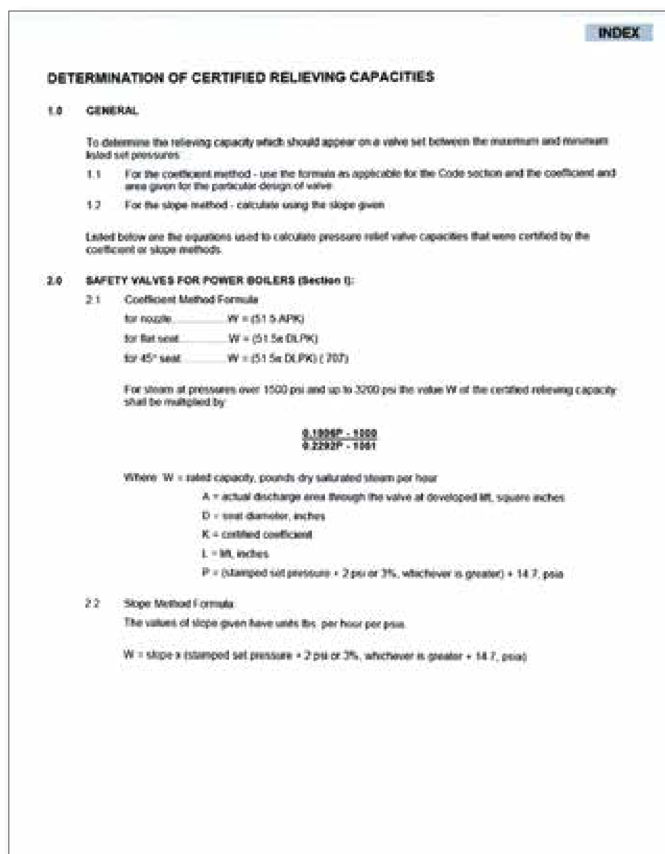
To use NB-18, download it and then navigate from the Table of Contents by clicking the hyperlinks (blue text). The file size is under 5 MB and takes less than 10 seconds to download on a high-speed connection. The downloaded file is a zip folder (compressed file) which must be extracted in order for the hyperlinks to work properly. Once extracted, click on the pdf file named "NB18ToC" to open the Table of Contents with hyperlinks.

Living Document

For over 75 years, *National Board Pressure Relief Device Certification*, NB-18, has been a valuable industry resource. The companies listed in its pages completed the rigorous testing and accreditation process each manufacturer or assembler must perform to ensure that their product has been designed, constructed, tested, and marked in accordance with specified codes recognized by the National Board and ASME.

This "red book,"now known as NB-18 – a free online resource that is updated weekly – will continue to signify quality, uniformity, and most of all, safety, in the pressure relief industry for years to come.

For more information about NB-18, visit the National Board website. ✽



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DETERMINATION OF CERTIFIED RELIEVING CAPACITIES

1.0 GENERAL

To determine the relieving capacity which should appear on a valve set between the maximum and minimum listed set pressures:

1.1 For the coefficient method - use the formula as applicable for the Code section and the coefficient and area given for the particular design of valve.

1.2 For the slope method - calculate using the slope given.

Listed below are the equations used to calculate pressure relief valve capacities that were certified by the coefficient or slope methods.

2.0 SAFETY VALVES FOR POWER BOILERS (Section I):

2.1 Coefficient Method Formula

for nozzle .... W = (51.5 APK)

for flat seat .... W = (51.5π DLPK)

for 45° seat .... W = (51.5π DLPK) (.707)

For steam at pressures over 1500 psi and up to 3200 psi the value W of the certified relieving capacity shall be multiplied by:

$$\frac{0.1906P - 1000}{0.2292P - 1061}$$

Where: W = rated capacity, pounds dry saturated steam per hour

A = actual discharge area through the valve at developed lift, square inches

D = seat diameter, inches

K = certified coefficient

L = lift, inches

P = (stamped set pressure + 2 psi or 3%, whichever is greater) + 14.7, psia

2.2 Slope Method Formula

The values of slope given have units lbs. per hour per psia.

W = slope x (stamped set pressure + 2 psi or 3%, whichever is greater + 14.7, psia)

Sample Capacity Calculations Found in A-3

DOT Specification Cargo Tanks

BY DAVID W. FORD, HAZARDOUS MATERIALS PROGRAM MANAGER, USDOT/FMCSA/SOUTHERN SERVICE CENTER

The United States Department of Transportation (USDOT) has two agencies responsible for the transportation of hazardous materials (HM) by highway. The Pipeline and Hazardous Materials Safety Administration (PHMSA) is the agency with jurisdiction over the transportation of hazardous materials in the United States (US) by all modes, and writes and enforces the Federal Hazardous Materials Regulations (FHMR, 49 CFR). As such, USDOT / PHMSA is "the jurisdiction" under the ASME *Boiler and Pressure Vessel Code* (ASME Code) and the *National Board Inspection Code* (NBIC) for the transportation of hazardous materials in cargo tanks.

The second agency within USDOT with HM responsibilities is the Federal Motor Carrier Safety Administration (FMCSA), which is responsible for enforcing FHMR for highway transportation. In addition to safety investigator staff, FMCSA has hazardous materials program managers and hazardous materials specialists who investigate HM shippers; motor carriers; and facilities that test, inspect, repair, and manufacture DOT specification cargo tanks and cargo tanks constructed under a special permit.

The FHMR applies to all transportation in commerce. The transportation of hazardous materials by persons not in commerce, such as for personal use, is not regulated by FHMR. In addition, FHMR regulates storage that is incidental to transportation. The FHMR includes requirements related to classification, communication standards, employee training and security plans. It also includes requirements related to the standards for the construction, maintenance, and qualification of packages, including cargo tanks and cargo tank motor vehicles.

Under FHMR, a cargo tank is a bulk package (capacity in excess of 119 gallons, or 450 liters) and includes all appurtenances, reinforcements, fittings, and closures. A cargo tank motor vehicle is a motor vehicle with one or more cargo tanks that are permanently attached or form an integral part of the motor vehicle.

The FHMR specifies what type of package a given hazardous material may be transported in, from glass jars to cylinders to cargo tanks. For cargo tanks, either a DOT specification cargo tank is required, or, in some circumstances, a non-specification cargo tank or a special permit cargo tank may be authorized. A DOT specification cargo tank (e.g., MC306, DOT406, MC331) must bear a specification plate that identifies the specification it was built to, and must be maintained to that specification regardless of the product it may transport (including water).

A non-specification cargo tank is a cargo tank that does not meet any DOT specification and may be built of any material suitable for the HM to be transported. Diesel fuel is a common hazardous material that is authorized to be transported in a non-specification cargo tank.

The original cargo tank specifications are referred to as the MC300 series; the most common one still in service is the MC306, used mostly for petroleum products. While the MC300 series specification is slowly phasing out of service, there are still some old cargo tanks in service, including a 1958 MC300 cargo tank that is still transporting gasoline in Alabama today. For high-pressure cargo tanks, it is not uncommon to see a MC330 from the 1950s.

Table 1: Various DOT/MC Specification Cargo Tanks

Specification	MAWP	Product Category
MC306	No less than 3 psig	Petroleum
DOT406	2.65 – 4 psig	Petroleum
MC307	No less than 25 psig	Chemical/corrosive
DOT407	No less than 25 psig	Chemical/corrosive
MC312	Not less than pressure used for unloading	Chemical/corrosive

Table 2: MAWP Requiring an ASME Certification Mark for DOT/MC Specification Cargo Tanks

Specification	MAWP Requiring ASME Certification Mark
MC306	N/A
DOT406	N/A
MC307	More than 50 psig
DOT407	More than 35 psig
MC312	Unloaded by pressure in excess of 15 psig
DOT412	More than 15 psig
MC330	All
MC331	All
MC338	All

In 1995, PHMSA issued a final rule that prohibits the manufacture of MC300 series cargo tanks after September 1, 1995, except the MC331 (used for compressed gases, such as propane) and the MC338 (cryogenic liquids), and established the DOT400 cargo tank specification series (see 49 CFR Section 180.405 for more details). The DOT400 series specifications are a great improvement over the MC300 series, based on incident and enforcement experience, and have much more specific language regarding how the cargo tank is to be manufactured.

From an NBIC and ASME perspective, DOT specification cargo tank pressures are very low. However, placing these cargo tanks full of hazardous materials on the public highway presents some unique risks. Therefore, the FHMR requires the use of the ASME Code in the construction of and the NBIC in the maintenance of these cargo tanks. This article explains how the ASME Code and the NBIC interact with the FHMR. Table 1 breaks out the various specifications commonly seen today and identifies their general product category and the pressures at which they operate.

While petroleum products such as gasoline, diesel, and liquefied petroleum gas are by far the most common hazardous materials transported in cargo tanks, they are also used for toxic gases, cryogenic liquids, self-reactive materials, organic peroxides, oxidizers, and even explosives.

All DOT400 series cargo tanks must be constructed according to the ASME Code, Section VIII, Division I. This means that ASME Code, Section VIII, must be followed during construction, except that the recordkeeping requirements of the ASME Code are not required for those cargo tanks not required to have the ASME certification mark. This is one of the many improvements of the DOT400 series cargo tanks' specifications over those of the MC300 series.

Certain cargo tanks (*see Table 2*) exceeding a specific pressure, and all MC330/331 and MC338 cargo tanks, must be constructed ***and certified*** to ASME Code, Section VIII, meaning that ASME Code, Section VIII, must be completely followed during construction except where the FHMR provides exceptions, and the cargo tanks must bear the ASME certification mark on the manufacturer's data plate. (In the HMR, the ASME data plate is referred to as the nameplate.)

In addition to the DOT specification plate (and, when required, the ASME data plate), the manufacturer must issue a Certificate of Compliance for the specification cargo tank that identifies the specification to which it was manufactured. When the ASME data plate is required, the ASME U-1A form also must be issued. The Certificate of Compliance, and other related drawings and paperwork, must be signed by a person meeting the definition of a Design Certifying Engineer (DCE) [See 49 CFR 171.8].

REPAIRS

The DOT does not only regulate the manufacture of specification cargo tanks; it also regulates the repair, testing, and inspection of these cargo tanks. The FHMR require that all repairs, modifications, stretching, and rebarreling of DOT/MC specification cargo tanks comply not only with the DOT specification of the cargo tank being repaired, but also comply with ASME Code, Section VIII, Division 1, and the NBIC.

Repair, as defined in the FHMR, means any welding to the cargo tank wall (essentially the shell and heads; see 49 CFR Section 180.403). It does not include welding on appurtenances, pads, or any suspension or support component. Any repair – as defined by the FHMR – requires the facility to hold either an ASME **U** Stamp or a National

*A weld repair by a non-**R** Stamp facility. Note the poor quality of the weld, including the excess weld material left on the surface. Also note the heat ring around the entire weld – this is from the same person later welding a lap patch on the inside of the cargo tank, because the original weld repair was leaking*

Board **R** stamp. ***This is applicable to any DOT specification cargo tank, not just those that bear the ASME certification mark.***

If the DOT specification cargo tank bears the ASME certification mark, it must be repaired by a facility that holds a valid National Board **R** Stamp. If the DOT specification cargo tank does not bear the ASME certification mark, it must be repaired by a facility that holds a valid National Board **R** Stamp or an ASME **U** Stamp.

Further, if the DOT specification cargo tank does not bear the ASME certification mark, the repair may be performed without an authorized inspector certification, completion of the R-1 form, or stamping with the **R** Stamp. All other provisions of the ASME Code and NBIC, such as the use of qualified welders and the use of the procedures in the facility's quality control manual, apply (see 49 CFR 180.413).

As welding equipment is commonly available, it is very easy for cargo tank owners to have an illegal repair done on their DOT specification cargo tanks. This represents a serious hazard to the traveling public, since the persons performing these repairs are not following the FHMR or the NBIC. Pictured above is the underside of a DOT specification cargo tank that was repaired by a person who did not hold an **R** Stamp. The cargo tank owner was required to have the entire repair removed and replaced by a facility holding an **R** Stamp and following proper procedures. FMCSA actively investigates facilities that perform repairs without holding an **R** Stamp.

The lap patch, or lap weld, is an easily-identified repair that indicates it was performed by a non-**R** Stamp shop. While this has always been an improper repair on DOT specification cargo tanks bearing the ASME certification mark, it is illegal on all DOT specification cargo tanks if performed after October 1, 2003. Any lap weld performed after that date must be removed and repaired properly by a National Board **R** Stamp holder or **U** Stamp facility.

One area of concern that must be noted is that the HMR has adopted the 1998 Edition of the ASME Code and the 1992 Edition of the NBIC. Since these are the official versions adopted by the HMR, they are the only legal Editions that may be used on DOT specification cargo tanks. DOT is fully aware that this is a compliance issue, since all manufacturers and repair facilities use the most current Edition of either standard.

After any repair that involves welding on the cargo tank wall, a pressure test (see 49 CFR Section 180.407(g)) must be performed and documented. After any repair involving piping, a leakage test (see 49 CFR Section 180.407(h)) must be performed and documented. After any replacement or repair of pressure

An internal lap weld on a DOT specification cargo tank

relief devices, piping, or internal valves, a leakage test must be performed and documented (see 49 CFR Section 180.413). A National Board **R** Stamp is not required for welding on piping.

With the advent of the DOT400 specification series, modifications, stretching, and rebarreling have dropped off considerably, but sometimes are still performed. Any change to the structural integrity of the cargo tank must be certified in writing by a DCE. The modification must meet the corresponding DOT400 specification (e.g., for a MC306 it must meet DOT406), or the current specification for MC331 or MC338 cargo tanks, and must meet the ASME Code and NBIC, as appropriate. In addition, a supplemental specification plate must be applied to the cargo tank motor vehicle, a supplemental Certificate of Compliance must be issued, and a registered inspector must certify the work (see 49 CFR Section 180.413(d)).

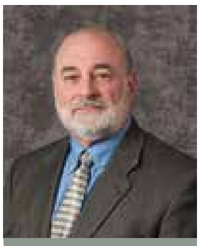
Mounting of an existing cargo tank onto another chassis is a common practice, especially with propane bobtail trucks. If no welding is done on the cargo tank wall, and there is no change in the method of attachment or in the rear end protection device, this work may be performed by a registered inspector. If welding on the cargo tank wall is performed, a National Board **R** Stamp holder is required. If there is a change in the method of attachment or a new rear end protection device is installed, it must be certified by a design-certifying engineer.

While this is not a complete discussion of the testing and inspections regulations, it is important to note that all persons performing tests and inspections on DOT specification cargo tanks must meet the definition of a registered inspector, must have a valid cargo tank facility number from USDOT/FMCSA, and must meet the training requirements of Part 172 Subpart H.

USDOT/PHMSA and FMCSA are committed to the safe transportation of hazardous materials in cargo tanks, and appreciate the commitment by ASME and NBIC participants in this endeavor. ✽

Inspecting Beyond the Obvious – It's Worth the Extra Effort

BY JOHN HOH, SENIOR STAFF ENGINEER



The two stories related here are true. The first incident caused only property damage; the second is much more tragic. This article could have been titled "Inspecting with Your Eyes Open," but that did not quite capture the message, as all inspectors keep their eyes open. But are inspectors truly observing the *entire picture* when they are on location to perform inspections? There may be subtle clues which could point to a much greater problem if the inspector looks a little closer. These stories illustrate how inspecting beyond the obvious could save a life.

I grew up in Illinois surrounded by farms. When I was about 10 years old, my father and I visited a neighbor who had a large grain and dairy farm less than a mile from our home. It was early in the morning and we found the neighbor walking around the outside of one of his barns. We quickly noticed the area of interest – a gaping hole approximately 4 feet by 10 feet in the metal siding. The neighbor said his family heard a loud "boom" during the night and thought it was a jet breaking the sound barrier (this was back when it was fairly common to hear the "sonic booms"). That morning, when he walked out to the barn and opened the door, he noticed sunlight on the floor where it would normally be dark. Looking to the side wall, he now had a large hole where his air compressor used to reside.

To a young boy, the hole in the side of the barn and the mangled remains of the receiver tank were impressive, but what I remember most was the flight path of the electric motor. It traveled in an upward arc, hitting a few purlins between the rafter trusses and lodged itself in the opposite wall. The roof purlins were 25 to 30 feet from the floor and the opposite wall was 60 feet away. To put this in perspective, this was the 1960s, when electric motors were not as compact as they are today. I would estimate the motor weighed close to 100 pounds.

What caused this scene? The air receiver was not a factory-built air tank; it was a repurposed water heater tank. Many farmers are known for making do with whatever is available to get the job done, and some get very creative with their solutions. Since this incident occurred long before I became an inspector, I'm speculating the neighbor may have relied on the pressure switch to prevent an over-pressure condition rather than installing a safety relief valve. I do remember the neighbor saying they found the pressure switch was stuck in the "on" position. I also believe the compressor was never shut off at the end of the work day, so who knows how many times it cycled during the night due to small leaks in the fittings. You might be asking if any welding had been performed on this tank, and although I don't know for sure, my guess is there probably was.

On the night of the explosion, the compressor kicked on, the pressure switch probably got stuck, and the tank ruptured. Now, <u>if</u> a safety relief valve was installed, <u>if</u> the set pressure was correct, and <u>if</u> it was in operational condition, I would suspect either internal corrosion of the tank or possibly improper welding was the cause of the rupture. Even though this neighbor has long since passed away, I don't want to condemn him for his creativity. After all, the water heater tank was probably rated for 125 psi; it did operate for several years; and a tank is a tank, right?

Unfortunately, this is the mindset of some people who are not in our industry, and their misguided attempts to construct, repair, alter, and use pressure equipment has resulted in accidents. Some have paid a heavy price and others are still operating on luck. This incident could have been much worse if it had happened during the day when the farmer was working in this area of his barn. He was lucky and he learned a valuable lesson. While this incident happened on a farm where inspectors would not normally visit, creativity knows no bounds; this could easily have been an industrial location. If you found a water heater or maybe a propane tank being used as an air receiver, but it was small enough to be considered exempt from jurisdictional regulations, what would you do?

Before joining National Board staff, I was the chief boiler inspector in Missouri for a few years. One evening while listening to the local news broadcast, I learned of an explosion and a fatality at a factory producing die-cast metal parts. The explosion was caused by what was described as a pressurized container.

I contacted the factory manager the next morning and learned it was not a pressure vessel, but he asked that I stop by a few days after OSHA and all the other investigators had finished their work. When I visited the factory, the manager was very open to questions about the tragic event and took me out on the factory floor to the site of the incident.

He explained that a liquid mold-release agent was sprayed onto the die surfaces when the machine was opened between each run of parts. This was performed manually by the machine operator using a spray wand much like you would see on a garden sprayer.

The mold-release agent was drawn from a steel 55-gallon drum. The drum head was affixed to the drum with a lever-lock ring closure. The spray wand hose was fastened to a dip tube and threaded fitting, which screwed into one of the bung holes in the drum head. The machine operator was killed when the drum head came loose from the drum and flew like a disc, hitting the operator at the base of the skull and almost decapitating him.

What happened? Rather than using a pump to suction the mold release agent from the steel drum, the factory was introducing compressed air into the drum to force the liquid through the spray wand. There was an air pressure regulator and pressure gage installed on the air line feeding into the drum. The factory manager said they never used more than 5 psi. I asked if the air pressure regulator was somehow designed to prevent more than 5 psi being introduced into the drum. He said no, and during the investigation they found the regulator was adjusted to maximum output. I asked what pressure the factory used in its compressed air distribution piping.

A walk to the compressor room revealed the compressed air lines were regulated to 110 – 115 psi. The manager and the investigators believed the operator was experiencing problems with the spray wand plugging up and rather than determining why, the operator adjusted the regulator to force the liquid out at a higher pressure. The flat drum head deformed under the higher pressure and caused the lever-lock ring to release suddenly, allowing the drum head to explosively leave the drum. The investigators did not find any evidence the drum head hit any part of the machine or any other structure before hitting the operator at full force. The drum head could have potentially traveled up or any direction around the perimeter of the drum, but it flew directly at the operator.

If closed head or open head drums (such as the one described here) are designed to Department of Transportation (DOT) or United Nations (UN) standards, they are required to withstand a small amount of pressure, but they are not designed as a pressure vessel.

As inspectors, we are focused on the equipment covered by jurisdictional regulations and referenced standards. How many pressurized 55-gallon drums have we walked past and ignored because they are not supposed to be pressure vessels? These could possibly be found in many types of industries and fluid transfer systems. If inspectors find this type of situation, they should point out that drums are not designed as pressure vessels and an alternative and safer method should be implemented.

Inspecting beyond the obvious could mean the inspector makes recommendations on conditions not addressed or exempted by jurisdictional regulations, but it could save a life.

One life saved is worth the extra effort. ♣

NBIC Historical Boiler Subgroup Meeting

The *National Board Inspection Code* (NBIC) Historical Boiler Subgroup met at the National Board campus in Columbus, Ohio, on July 13.

The main objective of the NBIC Historic Boiler Subgroup is to develop code requirements for the inspection, repair, and alteration of historical steam boilers of riveted and/or welded construction not falling under the scope of NBIC Supplement 1 for locomotive boilers. Types of historical boilers include steam tractors, traction engines, hobby steam boilers, potable steam boilers, and other such boilers that are being preserved, restored, and maintained for demonstration, viewing, educational, and historical purposes.

Minnesota Chief Inspector Joel Amato was elected chairman in January with the announcement of former chairman Robert Reetz's retirement. "Bob left some pretty big shoes to fill and set high standards for the group," Amato says. "As the name of the group implies, there is a lot of history and experience among the committee members. Their professionalism and expertise is exemplary, and I'm grateful to be working with such experienced people. With their guidance, I know we will maintain those standards and make good decisions that will provide a functional code to ensure the safety of historic boilers for many years to come. As always, our first priority is boiler safety."

Many historical boilers are still used for exhibition purposes across the jurisdictions and the work of the Historical Boiler Subgroup plays an important role in providing reliable rules and regulations for the continued safe operation of these antique boilers. ✤

Here, an 1899 Minneapolis Threshing Machine Company 22-horsepower, single-tandem compound engine is shown running a sawmill at the Western Minnesota Steam Threshers Reunion in Rollag, Minnesota. The engine is owned by Jeff Knutson of Fargo, North Dakota.

From left to right: Ernest Brantley (visitor), Clayton Novak, Bonnie Peterson (visitor), Robert Underwood, Bob Ferrell, Mike Wahl, Joel Amato, Tom Dillon, Dennis Rupert, Frank Johnson, John Sharier (visitor), and Robert Bryce.

Restricted Lift Pressure Relief Valves

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

The restricted lift category of pressure relief valves (PRVs) provides unique benefits to users and, at the same time, presents challenges to valve manufacturers or assemblers and repair organizations. This article reviews the design features of restricted lift PRVs, outlines their benefits, and addresses issues the National Board (NB) has seen when they are certified or repaired.

Background

Most modern valve designs are "full lift" designs where the flow area is determined by the valve inlet bore diameter. For the valve bore diameter to control the flow, the valve lift must be equal to at least the valve bore diameter divided by four. When valve designs are originally developed, their manufacturers determine standard flow areas in set increments that are listed in their literature. These flow areas may be unique to their design or be based upon industry standards.

A widely used standard for PRV dimensions is API-526 (Flanged Steel Pressure Relief Valves). To comply, valves must meet listed inlet and outlet sizes, flow areas, and installation dimensions. Users benefit in that a valve built to this standard can be interchanged in their facility from one manufacturer to another. By including API-526 as part of a bid specification, the user will not need to adapt its system to a unique size or flow area. Numerous manufacturers have developed API-526-compliant designs because of users' widespread adoption of the standard.

API-526 includes standard orifice sizes, which are designated by a letter series. Originally developed for the petrochemical industry, these standard orifice sizes have been adopted by valve manufacturers and users in other industries, and "API" orifice valves are now available for many different services.

Restricted Lift PRVs

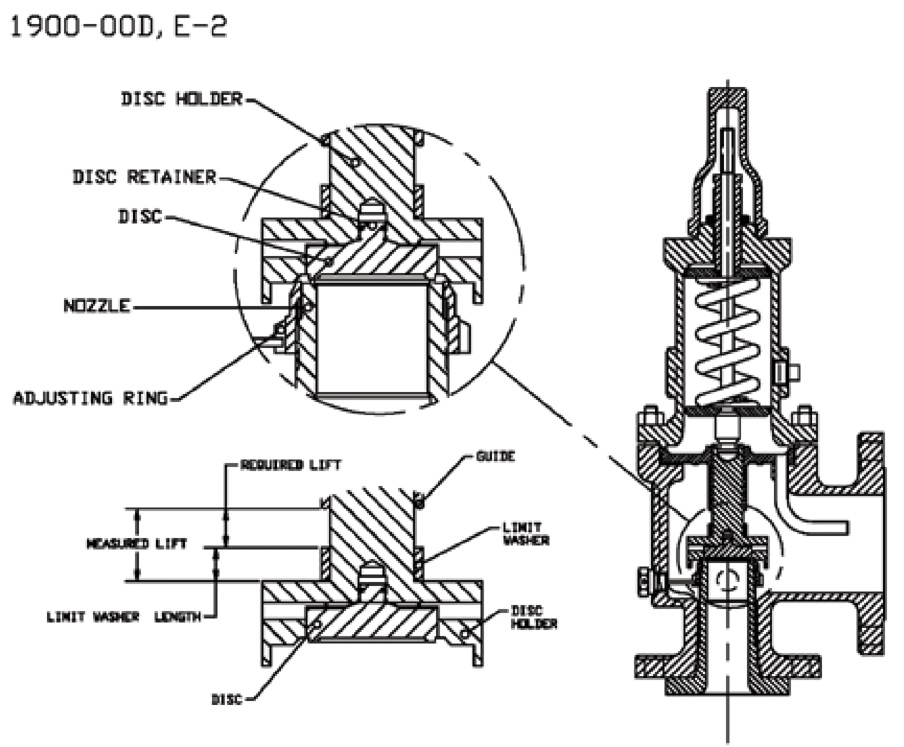
When users select a PRV, they estimate the capacity their system is capable of producing when subjected to an overpressure situation. Using the *ASME Boiler and Pressure Vessel Code* (ASME Code)-permitted overpressure and estimated capacity, calculations are done to determine the flow area necessary to allow the needed amount of fluid to be relieved. Often, the flow area required will not match a flow area available from the valve manufacturer, so the next-larger size is selected. Using that larger area, the relief capacity of the valve can be determined, and that capacity will be more than adequate to address the overpressure scenario.

At first it would seem that excess capacity from a PRV should not be a problem. Once there is enough flow, more should be better! However, pressure relief system design is a complex process, and having the ability to relieve the required amount of flow during the overpressure condition is just one part of that design. All of the flow through the PRV must be safely managed. In process plants, the discharge piping must be routed to a safe point of release or sent through a system (flare stack) to ensure released fluid is safe. In the case of a flare, the discharge is ignited and burned, turning the volatile fluids into combustion products such as carbon dioxide and water vapor. Flow into the flare system is based upon the size of the PRV, and the greater the valve flow, the larger the piping and flare system needs to be.

Inlet piping must be designed for pressure drop to the PRV, which is a function of the PRV flow rate. Discharge piping must be designed to ensure any back pressure built up during the overpressure condition will not affect the PRV capacity. A higher flow rate may mean larger inlet or discharge pipe sizes, or the need to install bellows-type valves, which can handle higher back pressure levels. Higher flow rates also result in higher discharge forces, which increase the size and/or number of pipe support needed. Noise emitted also increases. These issues can increase system complexity and cost.

Therefore, it benefits users to have PRVs with capacities as close as possible to the required value. A restricted lift PRV design accomplishes this. In these designs, the lift is restricted to a value that results in a rated capacity equal to the required amount.

For example, a user calculates he needs a flow area of 2.00 square inches to give the needed capacity. Using API-526, he must choose a valve with an area of 2.853 square inches, which is the orifice size that is closest to (but larger than) the required area. However, this results in the actual flow being 42.6% more than necessary. The solution is to restrict the lift to 70.1% of the full lift (2.853 sq. in x .701 = 2.00 sq. in.), and the capacity will then be exactly the required amount.



Dresser Inc. Type 1900 Restricted Lift Valve. Courtesy of Consolidated Valve, GE Oil & Gas

Certification

Provisions for restricted lift valve-type certification are included in ASME Code Sections I, III, and VIII, and begin with a pre-certified full lift design. Three different valve sizes are tested, each at three different lift values. The code specifies that the minimum lift in each size shall be no less than 30% of full lift or no less than 0.080 inches (2 mm) – whichever is greater. Each size is tested at the minimum lift and two higher intermediate lifts. To be successful, the valve must flow at a capacity equal to or greater than the full lift capacity multiplied by the percentage of lift restriction. After the initial tests, two production valves are witnessed being built at the manufacturer's facility and tested for function and restricted capacity. If successful, the design is considered certified, and the manufacturer may build a valve of that design at any amount of lift restriction that falls within the ASME Code-permitted limits. This certification allows manufacturers to tailor a valve to the exact specifications of the customer.

When the NB began to certify these designs, it recognized that establishing an accurate lift was a critical part of the valve manufacturing process. Most of the designs include either an adjustment or a part that functions as the lift restrictor. Because of tolerances on other parts, the restrictor is usually custom-fitted and matched to a specific valve. If the lift restrictor is left out of the valve, it can still meet ASME Code criteria for operation and will flow more than the capacity on the nameplate. Although this passes the test criteria, the valve is not what was actually specified!

Therefore, it became a NB procedure to measure the lift during all certification tests of restricted lift valves to check the quality assurance process and ensure the valve was assembled in accordance with the manufacturer's procedure. During some tests, we have found the lift restrictor was incorrectly manufactured or assembled, installed in the wrong valve, or left out altogether.

When a manufacturer or assembler is preparing a restricted lift valve, they must carefully follow their procedures, which usually involve assembling the valve without a spring, measuring the available lift, and then calculating the length of the lift restrictor. The valve is reassembled with the lift restrictor in place, and checked before final testing. The final lift should fall within the manufacturer's assembly tolerance, and adherence to the details of the procedure is critical to achieve an accurate lift.

Most procedures we have audited require valve bonnet bolts to be torqued to a specific value during the measurement procedure. If the bolts are only hand-tightened, the length of the lift restrictor will be greater than needed because the gasket "crush" will not have been accounted for. When the final assembly is done and the bonnet bolts are torqued to the specified value, the gasket deformation moves the top of the valve closer to the bottom, leaving less room for the lift restrictor and causing lower lift. Lift under specification is obviously not desirable, because the lift directly affects the valve capacity.

Conclusion

Restricted lift valve designs offer the PRV user many advantages when specifying pressure relief valves. Accurate determination of the restricted lift during valve manufacturing, or verification of the installed lift when a valve is being repaired, is critical to ensuring that the rated capacity the user is counting on will be available. Because that capacity has been matched precisely to their needs, the design of other elements in the relief system can be optimized.

Reference: *API-526, Flanged Steel Pressure Relief Valves, available from the American Petroleum Institute.*

The Spectrum of Effective Training

Inside and Outside the Classroom

BY JAMES R. CHILES

Employee safety training? That sounds like a dry topic. But it doesn't have to be.

For instance, take Survival Systems USA in Groton, Connecticut, which I visited last year while researching an article on helicopter crashes. I wasn't just visiting to take down some interviews. I joined temporary ranks with Army and federal-agency air crews. I suited up for the two-day course and jumped into its dunker pool to learn how to escape from a flooding, sinking, upside-down helicopter.

After being held upside down in the pool as our noses filled with water (so we'd learn to overcome any silly fear of drowning), we held our breath and felt our way across a dark and flooded copter cabin, groping across the seats and aisles to alternative escape hatches. Safety divers and instructors hovered close at hand during each exercise to critique our performance, to deal with any signs of panic, and to cut us loose if things got tangled. Then we learned how to use tiny pressurized air tanks to stretch our survival margin. I noticed instructors offered no time-out signals. When I asked about it, I was told that real crashes don't offer time-outs or the opportunity to use nose clips, so Survival Systems doesn't offer them either.

We jumped off a platform, as if from a hovering helicopter, and climbed aboard a raft during a simulated gale. Instructors reminded us frequently that survival in open-water crashes needs more than muscle memory and a memorized checklist. Survival also depends on advance planning and the ability to solve problems as they arise.

I passed, perhaps not with flying colors but certainly with slightly bruised fingers and well-chlorinated nasal passages. One of the most valuable lessons to me was the importance of pre-emergency situational awareness: as a passenger on the way out to an ocean rig, I should give close attention to the cabin layout before each flight. I should figure out where the exits are, how those doors or windows open, and what emergency gear would be available after ditching.

Helicopter escape training is expensive, but offshore-oil operators and military branches worldwide have decided it's justified due to the frequency and severity of helicopter crashes at sea. The urgency is being driven by offshore oil exploration, which depends greatly on helicopter transport.

While the offshore-helicopter training niche has gotten much attention, a scan through the investigative reports about workplace injuries and major disasters will show that training shortcomings are usually in the list of lessons learned; apparently, training needs elsewhere are not getting enough attention. According to a National Research Council (NRC) report on the fire and explosion at the Macondo well in the Gulf of Mexico, the crew on board the *Deepwater Horizon* wasn't ready to handle high-pressure, high-temperature kicks in the drilled formations, even though the hazards were well-known around the industry. The NRC recommended, "Drilling rig contractors should require realistic and effective training in operations and emergency situations for key personnel before assignment to any rig." *Realistic and effective.*

How does the subject of water hazards relate to work done on land by boiler and pressure vessel inspectors, and by those who own and operate such equipment? What counts as effective training, whether it happens inside or outside the classroom?

Let's begin with who's responsible for safety during an inspector's visit. Isn't it true that under the *National Board Inspection Code* (NBIC) Part 2, Section 1, paragraph 1.5.3, the equipment's owner or user has clear responsibility to prepare the location so it's safe for the intended use? And don't the owner's advance preparations generate a flurry of activity before the inspector drives up, occupying two days or more for a large industrial boiler? That's time to shut down the equipment, let it cool, do the lock-outs and tag-outs, open the hatches, ventilate and test the air, set up the confined-space entry, and knock off scale and corrosion. Won't all that preliminary activity make the inspector's subsequent visit safe?

Most of the time, but not *every* time. In any case, as a second reading of

Section 1 reminds us, inspectors are jointly responsible with the owners for a safe visit. Inspectors need training to prevent the known hazards, such as their own lock-out and tag-outs, and confined-space entry or fall protection. If they see a hazard to their well-being, inspectors have stop-work authority and can stop until it's fixed, and if necessary they can schedule a new date.

What hazards might those be? Say an inspector is scheduled to visit a large ammonia plant during its "turnaround" for heavy maintenance. Turnarounds are a 24/7 blitz of employees, contractors, and cranes. The savvy inspector knows to be extra careful at turnaround time, watching out for truck traffic and headache balls.

Seemingly routine visits can pose hazards too. There could be fall hazards such as corroded catwalks or slippery, sloping decks. An operator running a boom-lift for the inspector might have forgotten to put the outriggers down. If, prior to his confined-space entry, the inspector checks communications with the outside attendant and finds the link unreliable, that's something to fix right away.

According to Timothy C. Healey, safety director for the Hartford Steam Boiler Inspection and Insurance Company (HSB), toxic and asphyxiating atmospheres are among the most common hazards during confined-space entries. That's why HSB equips all its inspectors with personal atmospheric monitors: not as a substitute for the owner's advance preparations and testing, but as an extra layer of safety. While it may seem unlikely that such personal atmospheric alarms would ever trigger since the owner's employees or contractors will have been working in the boiler beforehand, it does happen. While a triggered personal alarm is "exceptionally rare," says Healey – maybe once or twice a year out of 10,000 confined-space visits – "we invariably get a note of thanks from the inspector in those cases," he says.

HSB's proven, traditional approach to inspector training provides a good transition into the broader subject of "the right training for the right need." Healey says that HSB relies chiefly on

Marines with 2nd Battalion, 5th Marine Regiment, prepare to board a Modular Amphibious Egress Trainer during a helicopter dunker exercise

Image courtesy of Defense Video & Imagery Distribution System.

Image courtesy of Defense Video & Imagery Distribution System.

Underwater Egress Training Course on Camp Lejeune, N.C., May 15, 2012

classroom-like settings, rather than simulations or mock-ups, because the equipment being checked by the company's loss-control inspectors varies greatly in size and type. Therefore, mock-ups and other realism-stressing, methods couldn't cover the huge range of relevant subject matter. HSB's training venues are classroom-like settings, which can be as small as an office conference room or as big as a ballroom, depending on group size.

Critical to training quality at HSB are the veteran inspectors who lead the courses and the materials they work with, such as plenty of site photographs and vivid stories that drive home the lessons learned and close calls. New lessons from the field keep the courses up to date, and even long-time inspectors can pick up new insights in the refresher sessions.

"Our inspectors and equipment surveyors are a hardy lot and they're self-reliant, but the key that makes them successful is informed observation," says Healey. "We want them to apply those same skills to their own safety and health, so they can get back home at the end of the job." What Healey calls the hazard-awareness mindset is not only good for the employees, it's good for business because inspectors work best when they're not distracted by open safety concerns.

Looking over the full spectrum of safety-related training and what might be needed beyond the classroom, there's the fast-growing field of computer simulation. This could be well-suited for process control operators, for airline pilots learning to deal with turbulence and computer failures, and for industrial incident commanders – anyone who has to diagnose a fast-moving and complex situation, and then make the right decision. From what I hear, many control-room operators responsible for chemical-processing and peaking power plant operations could use more simulation time, in particular, focusing on what might go wrong during start-up time. According to the Chemical Safety Board, startups are when big and complex plants are most likely to experience anomalous conditions, AKA, the dreaded "upset."

It's not enough for operator newbies to wait until on-the-job training begins and just gaze over the shoulder of seasoned operators who are dealing with an upset; trainees need to hammer out their own analytic and decision-making skills under pressure. The best and safest place to throw emergencies at them is a simulated control room that fully models their plant's behavior as built – and as modified over time.

Beyond computer simulation, at the extreme end of the training realism-scale, are courses such as the helicopter underwater-escape schools I described at the outset. There are many such courses offered, such as buildings with live fire for firefighters and collapsed buildings for rescue personnel.

My point about realistic training is not that everybody needs the excitement. As Timothy Healey points out, mock-up settings may be too specific to be useful, or otherwise may not be worth the time, money, or risk to trainees. But realism is worth considering for certain foreseeable situations in which classrooms and computer simulations wouldn't be enough.

If inspection in a particular region makes it likely that inspectors will visit multi-story plants that process explosive materials, wouldn't it be a good idea to have them try out an escape tube sometime, so in the case of an alarm siren, they wouldn't hesitate to use that route? Or to try out an eye-wash station?

One thing a mock-up can do is ascertain whether a new inspector's hard-wired inclinations really fit the job he or she is to do. Let's say the state inspector's office is training a new class of boiler inspectors. After the initial rounds of classes on safety procedures, the instructor suspects that two students might have deep-seated fears about being wedged and trapped in small spaces (like me!). Wouldn't it make sense to check that possibility beforehand by sending those two to a hands-on, confined-space entry course, rather than just wait and see what happens during a difficult boiler entry in the real world, where panic reactions can turn little problems into big ones? Think of how quickly a flailing and desperate individual can foul rescue lines.

Finally, realism has the virtue of making a lasting impression of how important safety really is, and how "winging it" often falls short. During my travels I've seen, researched, or participated in many training regimens. The realistic ones come back to me most vividly. At Whiteman Air Force Base I watched armorers practice loading the B-2A Stealth bomber with a bunker-buster bomb. While the bomb was a dummy version filled with sand rather than high explosives, it weighed tons and a mistake in the training room certainly could have sent an airman to the hospital if not the morgue. I accompanied firefighters in Colorado learning how to cope with propane tank jet fires, and you can bet all of us listened carefully as the instructors told us how to avoid burning our hands off in the session to come.

During the Vietnam War, instructors at Army bases in Texas and Alabama forced every fledgling helicopter pilot to make dozens of power-off emergency landings, so as to be fully prepared if their Huey engines quit in combat. Called "full down auto-rotations," these drills saved many lives later, but also resulted in more than a few crashes during flight school. Was the risk worth it? The Army Aviation program certainly believed so.

Final thoughts: traditional classroom sessions taught in vivid fashion by a seasoned instructor will always have value and can be the bedrock of a fine safety program. But realistic training in a simulator cab or a mock-up is worth considering when:

- Events in the real world are likely to be confusing and fast-moving, leaving little room for error, and yet operators must diagnose and get things under control.
- Teamwork and clear communication are vital.
- Equipment is specialized and its use must be practiced under stress.

The look and feel of the real-world crisis – noise, water, temperature, smoke, heights, entrapment – will assault the senses and could trigger deep-seated fears in some participants. Realistic training might help uncover this inclination before a real emergency, at which point the trainee can choose to work the issue, or decide to seek other employment.

In July 2015, NASA announced that four astronauts had been selected to be the first to fly a new fleet of commercial spacecraft to the International Space Station. They'll do their test-pilot training at NASA facilities first made famous in Tom Wolfe's book about the original Mercury Seven astronauts, *The Right Stuff*.

Even as we watch this new frontier unfold overhead, let's not forget about the Right Stuff that's always needed right here on Earth: world-class training that prepares operators and inspectors to take their place on the machine frontier. ✤

A Review of ASME Code Section VIII, Division 1, Torispherical Head Calculations

BY TIM GARDNER, SENIOR STAFF ENGINEER

The inspector can encounter many types of heads when inspecting pressure vessels. Examples include hemispherical, ellipsoidal, flat, and torispherical heads to name a few. Most of the general public is familiar with hemispherical, ellipsoidal (three-dimensional version of an ellipse), and flat shapes; but the torispherical head is relatively unknown to those without an inspection or fabrication background. Even so, torispherical heads are among the most commonly chosen heads by manufacturers for use in the construction of pressure vessels.

There are two things that differentiate torispherical heads from other heads used in The American Society of Mechanical Engineers' *Boiler and Pressure Vessel Code* (ASME Code) Section VIII, Division 1, construction. The first is that the spherically dished, or torispherical, head is one of the most confusing when it comes to its geometry. The second involves performing calculations of thickness or allowable pressure. Knowing which equations to use depending on the dimensions, and how to deal with corrosion and its particular effects on the head geometry, is more difficult than one might think.

Let's examine the characteristics of this head and review the pressure or thickness calculations to alleviate the confusion for the inspector and ensure that this critical vessel component is given the proper scrutiny so that it meets or exceeds the requirements of ASME Code Section VIII, Division 1.

What is a Torispherical Head?

We first will look at the unique physical characteristics of the torispherical head. See Figure 1 below showing an ASME Code Section VIII, Division 1, torispherical head with defined dimensions:

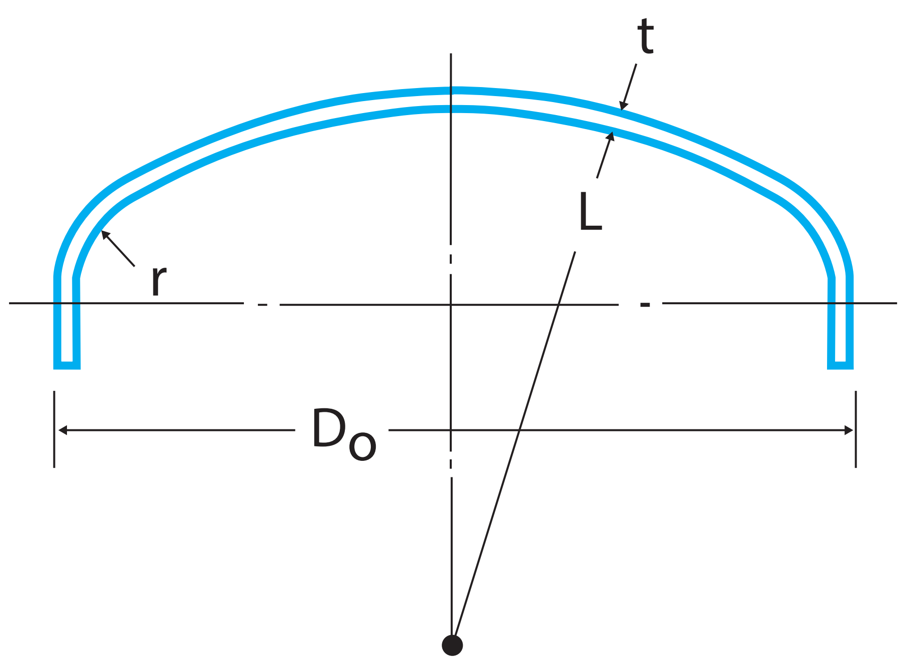


Figure 1: Torispherical Head Dimensioned per ASME Code Section VIII, Division 1

Where
D_o = outside diameter of the "flange" or head skirt
r= inside knuckle radius
L= the inside spherical radius (crown radius)
t= thickness of the head

In many cases **$L=D_o$**, and in no case will **L** be greater than **D_o**. This leads to a very common question an inspector may ask in regard to this type of head: How can the inside crown radius equal the outside diameter? To answer this we need to develop an understanding of just what a torispherical head is.

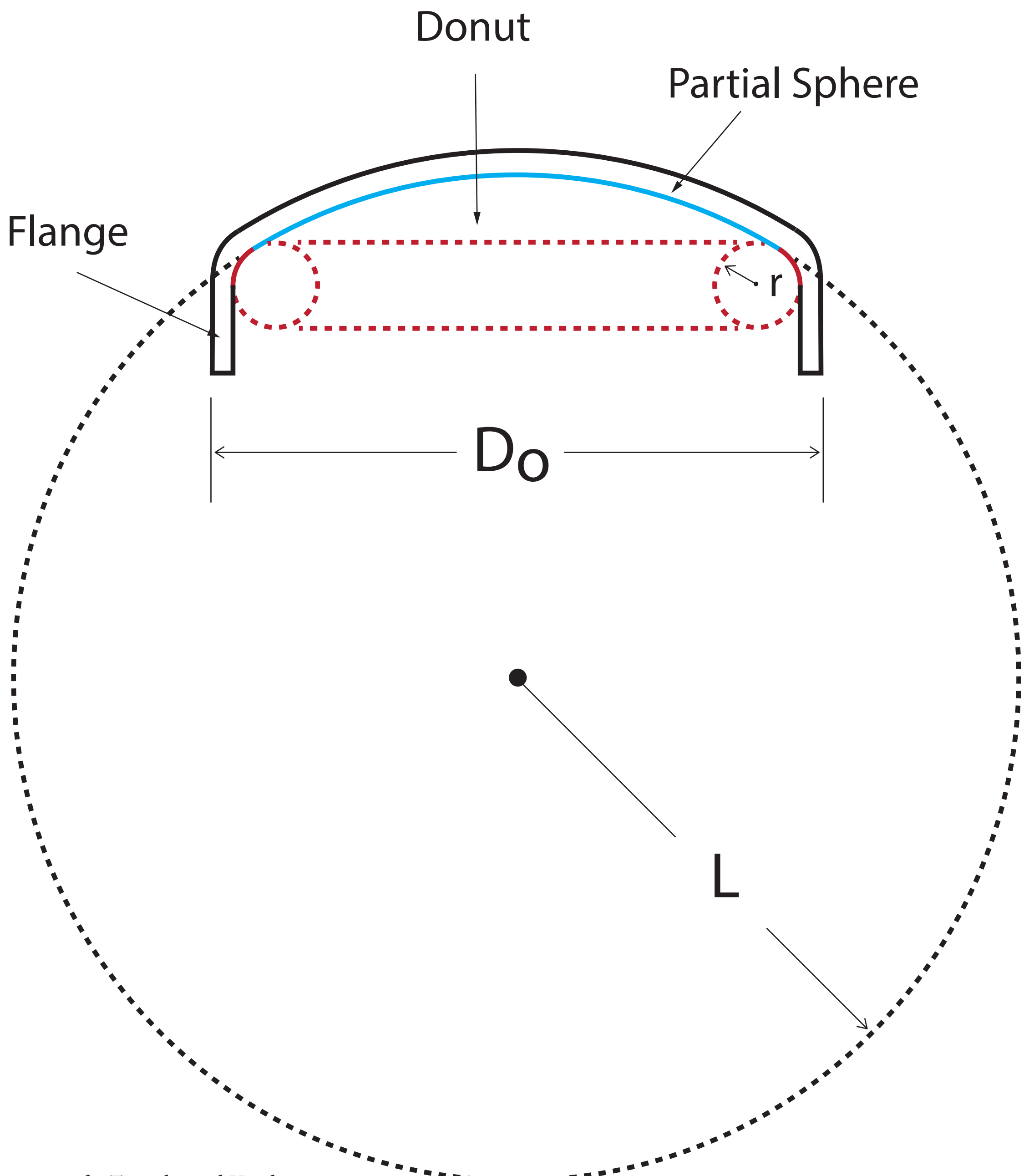


Figure 2: Geometry of a Torispherical Head

A torispherical shape results when a portion of a sphere intersects a torus. *Sphere* is the formal term to describe a ball shape and *torus* is a geometric term describing the shape of a donut. If you picture a small portion of a ball resting on a donut and only look at the outside surface, you have a pretty good idea of what a torispherical shape looks like. See Figure 2 to better understand how the curvature of the torispherical head is determined.

Next let's consider the cross-section of the shape. The construction of this head can be best thought of in terms of the circles as shown in Figure 2. The arc associated with the majority of the head is part of a circle (cross-section of a sphere) with a radius of **L**. The arc associated with the knuckle radius is part of a much smaller circle (cross-section of the torus or donut) with a radius of **r**. The flange dimensions are generally selected to suit the design of the vessel to which the head attaches, but will always be the outside diameter of the torus shape. So how does an inspector use this information to verify torispherical head calculations?

What is a UG-32(e) Torispherical Head and How is it Calculated?

Probably the most common of the torispherical heads encountered by inspectors is the Section VIII, UG-32(e) head. This class of torispherical heads has special dimensional relationships defined in the UG-32(e) paragraph as follows:

- $\mathbf{t_s/L} \geq 0.002$, where $\mathbf{t_s}$ is the minimum specified thickness after forming
- The inside knuckle radius is 6% of the inside crown radius or **r**=0.06**L**
- The inside crown radius equals the outside diameter of the skirt or $\mathbf{L=D_o}$

Calculations for the torispherical head, sometimes called a flanged and dished (F&D) head, when made according to ASME Section VIII, Division 1, UG-32(e), are relatively straightforward. To calculate the required thickness or allowable pressure of a UG-32(e) head, the following formulas are used:

(1) $\mathbf{t} = 0.885\mathbf{PL}/(\mathbf{SE}\text{-}0.1\mathbf{P})$ $\mathbf{P} = \mathbf{SEt}/(0.885\mathbf{L} + 0.1\mathbf{t})$

Where **L** and **t** are as defined on p. 20
P= Internal design pressure
S= Maximum allowable stress in tension
E= Lowest efficiency for any joint in the head

Determining the required thickness, **t,** or the allowable pressure, **P,** is a matter of inserting the **S**, **E**, **L**, and **P** or **t** values as appropriate. For a new vessel that will not be subject to corrosion, a thickness can be specified at or thicker than the calculated required value. But what about vessels where corrosion is expected and a corrosion factor has been applied?

How is Corrosion Handled when Making Torispherical Head Calculations?

Corrosion occurs in some vessels due to the properties of the liquid or gas being contained. The vessel designer takes this into account by adding a corrosion allowance to the thickness of the shell, heads, and other components exposed to the substance. The corrosion allowance is documented on the vessel data report and is included as part of the thickness listed for the heads. Typically, the corrosion is assumed to be uniform for the head. Let's look at what happens to a torispherical head as it corrodes.

The inside crown radius and the knuckle radius both are changed as the material is corroded away. They are increased by the amount of corrosion. If ⅛″ of material is corroded away, these two radii are increased by ⅛″ each. What **does not change** is the **outside** diameter of the flange or $\mathbf{D_o}$. So in the UG-32(e) head case, **L** is no longer equal to $\mathbf{D_o}$. If it exceeds $\mathbf{D_o}$ then it violates the rule in UG-32(j) stating that **L** cannot be larger than $\mathbf{D_o}$. This means that if a torispherical head that was purchased with no allowance for corrosion is found with less than the expected thickness needed to ensure **L** is less than $\mathbf{D_o}$, it would no longer meet ASME Code Section VIII, Division 1 requirement.

In addition, the knuckle radius is no longer 6% of the crown radius. In most cases it would be close to 6%, but mathematically it would be greater since the corrosion allowance would be added to both the top and bottom (numerator and denominator) of the fraction **r/L**.

A torispherical head with geometry based on UG-32(e) still can be used for an application involving corrosion, but the corroded state would need to satisfy the UG-32(e) geometry. One would use the fully corroded values for calculating the thickness needed for the given pressure and then add an amount of thickness equivalent to the corrosion allowance to the required calculated thickness of the head to determine the minimum specified thickness.

For example, the required fully corroded thickness of a UG-32(e) torispherical head for a given internal pressure is calculated to be ⅞″. If the vessel manufacturer wishes to include a ⅛″ corrosion allowance, it would add ⅛″ thickness to all internal surfaces of the head. When purchasing or manufacturing the head, a thickness dimension of 1″ reflecting the extra thickness would be specified. In many cases the vessel designer will prepare a template of the new head contours for use by the receiving department.

The knuckle radius that results from adding the extra thickness for corrosion will be smaller than 6% of the corrosion-adjusted spherical radius and would, therefore, normally violate UG-32(j). Recall that UG-32(j) requires that the knuckle radius be greater or equal to $.06\mathbf{D}_o$ and in no case no less than three times the head thickness. This is not an issue since the dimensional symbols in the equations for calculating thickness or pressure are all based on values in the corroded state as stated in UG-16(e). The extra thickness need not be addressed in any code equations or rules. On the other hand, if a larger knuckle radius is used to avoid violating UG-32(j), then the head will corrode to a shape that does not satisfy the geometry of UG-32(e). So what about torispherical heads that do not conform to the geometry of UG-32(e)?

How are Calculations Performed for Torispherical Heads Not Conforming to UG-32(e)?

There are other torispherical heads that are not designed to the UG-32(e) configuration. Other torispherical heads that inspectors may encounter include the 80-10 torispherical head and the high crown type. For 80-10 heads, the dish radius is 80% of the outside diameter or $\mathbf{L}=0.8\mathbf{D}_o$ and the knuckle radius is 10% of the diameter. For the high crown torispherical head, the crown radius is 85% of the outside diameter. For these and other non-standard heads, the formula in ASME Code Section VIII, Division 1, Appendix 1-4, would need to be used to check for adequate thickness or allowable pressure. The Appendix 1-4 equations are stated in (2) below:

(2) $\mathbf{t} = \mathbf{PLM}/(2\mathbf{SE}-0.2\mathbf{P})$ or $\mathbf{P} = 2\mathbf{SEt}/(\mathbf{LM}+0.2\mathbf{t})$ where $\mathbf{M} = \{3 + \mathbf{SQRT}(\mathbf{L}/\mathbf{r})\}/4$

The **M** value varies from 1 to 1.77. The 1.77 represents the case where **r/L** is 0.06, which is the limiting value per UG-32(j). The equation for thickness in (2) reduces to the equation for thickness in (1) for the case where $\mathbf{r}= 0.06\mathbf{L}$. A torispherical head with a knuckle radius of $0.06\mathbf{L}$ results in the greatest required thickness for a given spherical or crown radius.

As with the UG-32(e) calculation, the dimensional symbols are based on the fully corroded condition. The corrosion factor is handled the same way with the Appendix 1-4 designed heads as with UG-32(e) designed heads. Once the head thickness is calculated, the corrosion factor is added to the calculated thickness.

The limits on the knuckle radius and the dish radius in UG-32(j) are applicable for these and any other ASME torispherical heads.

Conclusion

It is important that an inspector properly verify the design of torispherical heads. The inspector should also review receiving records for the head to ensure that the proper head was received and was confirmed to have been made to the specified dimensions and shape. When manufacturers and inspectors understand how the standard ASME Code Section VIII, Division 1, UG-32(e), and other types of torispherical heads are designed, dimensioned, and calculated, they can ensure that the heads are in compliance. This will result in a pressure vessel head that will perform as expected and ensure the pressure integrity of the vessel during its service life. ♣

Improving Safety Through Violation Tracking

Device Type: Safety Controls for Burner Management Systems

BY CHUCK WITHERS,
ASSISTANT EXECUTIVE DIRECTOR – TECHNICAL

A closer look at the major violations found on specific safety devices as reported to the National Board by participating member jurisdictions

Each year The National Board of Boiler and Pressure Vessel Inspectors compiles violation statistics as reported by its member jurisdictions. From January 1, 2014, to December 31, 2014, there were a total of 663,987 inspections based on 117 reports submitted by 30 member jurisdictions (about half of the National Board member jurisdictions reporting); therefore, we can conservatively double the amount of inspections performed and easily increase the number of violations reported.

The previous two articles in this continuing series focused on key violations for safety relief devices (fall 2013 issue) and low-water cutoffs / flow-sensing devices (fall 2014 issue). This article focuses on three key violations inspectors noted when inspecting safety controls for burner management systems installed on high-pressure / high-temperature boilers, low-pressure steam boilers, hot water heating and supply boilers, and potable water heaters.

The top three burner management violations addressed in this article are **electrical power disconnects missing or not functioning**, **emergency shutdown switches missing or not functioning,** and **improper installation of fuel train assemblies**. These three violations totaled 7,286 out of 8,587 reported violations or 85% of all burner management violations reported.

Violation Tracking Statistics for Burner Management Period:
1-1-2014 to 12-31-2014

Device Type: Burner Management	Electrical Power Disconnects – Missing/ Not Functioning	Improper Installation of Fuel Train Assemblies	Emergency Shutdown Switches – Missing/Not Functioning
High-Pressure/High-Temperature Boilers (S)(M)(E)	81	185	207
Low-Pressure Steam Boilers (H)	308	187	549
Hot Water Heating and Supply Boilers (H)	1,886	849	2,147

(Chart does not include all categories of violations for burner management.)

Causes of Burner Management Violations

Why are there so many violations related to burner management? Answering this question can be extremely difficult because several variables must be considered; chief among them is the fact that each jurisdiction regulates its requirements for burner management differently, based on varying editions of adopted standards. These disparities can cause confusion regarding proper procedure for emergency shutdown switches, power disconnects, and fuel train installations. Some common types of burner management violations are summarized below, but again, many variables contribute to these violations.

- An electrical power disconnect may be tied to more equipment than just the boiler.
- A power disconnect may not be installed at the boiler.
- A power disconnect may be wired incorrectly so that only high voltage (480 v, 240 v) is disconnected but not the primary control (120 v).
- A power disconnect is not connected if and when new equipment is installed.
- A lack of understanding of jurisdictional requirements and applicable standards leads to poor training, which can cause improper installation, repair, replacement, and/or maintenance of equipment.
- Many types of pressure equipment with new technologies are being developed, which means various manufacturers' recommendations should be followed as well.

Today, these and other causes of violations exist, creating numerous variables that must be considered. For this reason, The National Board of Boiler and Pressure Vessel Inspectors; jurisdictions; and insurance and inspection agencies, along with their inspectors, contractors, installers, and owner/users; continually need to find ways to improve their training and knowledge of pressure equipment. Not only is proper installation important; but testing of installed safety devices should be performed when adding, repairing, or replacing equipment and at regular inspection and maintenance intervals.

With a basic understanding of where violations are coming from, let us review some code requirements from the American Society of Mechanical Engineers (ASME) and the *National Board Inspection Code* associated with burner management. Understanding these codes will help to minimize violations.

Electrical Power Disconnects and Emergency Shutdown Switches

First, it is recommended that inspectors educate users regarding the differences between electrical power disconnects and emergency shutdown switches. These two required safety features are often confused, but, in fact, are separate safety features used for different purposes. It is easy to see why properly installed safety controls are important when we fully understand why these controls are necessary.

Electrical Power Disconnects

To begin, ASME CSD-1 (Controls and Safety Devices for Automatically Fired Boilers) states: "a disconnecting means capable of being locked in the open position shall be installed at an accessible location at the boiler so that the boiler can be disconnected from all sources of potential." This code requirement states two important elements: the electrical power disconnect shall be installed at the boiler and shall have the capability to be locked in the open position.

An electrical power disconnect located at the boiler cuts power at the unit for purposes of maintenance, testing, repair, or inspection. Its capability to be locked in the open position adds extra assurance that the unit will not operate during an inspection. So one can see the importance of having this safety feature installed at the boiler for visual verification, and having the capability to be locked in the open position so no one can operate the boiler until work is completed and it is safe to turn on the power. Of course, it doesn't do any good if this safety feature is installed but fails to function as required. Therefore, jurisdictional inspectors should not only verify the installation of this disconnect, but should also verify its functionality when performing in-service inspections. This will ensure proper wiring of the safety control in accordance with the manufacturer's recommendations.

Emergency Shutdown Switches

Most violations associated with emergency shutdown switches are due to not being installed as required or failing to function properly. The following standards are but a few that specify the same basic requirement for emergency shutdown switches. ASME CSD-1, NBIC Part 1, NFPA 85, and ASME Section IV all state directly or indirectly that "a manually-operated remote shutdown switch or circuit breaker shall be located **just outside the boiler room door** and marked for easy identification." Along with this main requirement, there are a number of additional directions provided for safe and effective installation that need to be considered, such as:

- Consideration should be given to type and location of the switch to safeguard against tampering.
- When the boiler room door is located on the exterior of a building, the switch should be located just inside the door.
- If there is more than one door, there should be a switch located at each door.
- Activation shall immediately shut off the fuel or energy supply.

Additionally, NBIC Part 1, Section 2; some building or mechanical codes; and manufacturers' recommendations may provide more guidance for installation of manually-operated remote shutdown switches for boiler rooms exceeding a 500-square-foot floor area or containing one or more boilers with a combined fuel capacity of 1,000,000 Btu/hr or more.

Why do we need emergency shutdown switches in addition to disconnect switches at the boiler? The answer is *protection of personnel.* In an emergency situation, operators or maintenance staff working in the boiler room can readily trip the switch on the way out, or someone on the outside (knowing there is a problem) can shut the boiler down without entering the space.

Oftentimes, especially when multiple boilers and/or water heaters are installed in the same room, the inspector is confronted with the question, "How many emergency shutoffs do I need for my boiler room?" This question can only be answered satisfactorily by contacting the jurisdiction where the units are installed since each jurisdiction, based on the specific edition of standards adopted, will enforce this requirement in various ways.

A Prime Example

Here is an excellent example of proper installation of emergency shutdown switches and power disconnects. Recently, all of the steam generators were replaced at the National Board Testing Laboratory, where safety relief devices are tested for capacity certification. This extensive project entailed a complete rework of the boiler room, including adding all new piping, pumps, valves, and controls. As a past chief boiler inspector concerned with quality and safety, I decided to verify each of the three steam generators were equipped with emergency shutdown switches and power disconnects as required by ASME CSD-1. I observed the following safety controls were installed as I toured the boiler room with our chief boiler operator.

A quick disconnect power switch was installed on each boiler panel to cut off the power to the associated control panel and stop the pumps and open or close valves in order to protect the steam generator by relieving residual pressure. (Figure 1)

Along with each steam generator being equipped with a quick disconnect power switch, the main electrical power disconnect for each of the steam generators was installed in an electrical panel adjacent to the steam generators to disconnect the main electric power for each boiler. (Figure 2)

Next, I turned my attention to the emergency shutdown switches. The facility is equipped with 19 emergency stop buttons located at every exit throughout the laboratory, boiler room, and maintenance room. When these buttons are pushed, a loud buzzer and strobe light are activated to indicate both the shutdown of the steam generators and the isolation of systems and storage tanks to prevent over-pressurization. (Figures 3 and 4)

Each power disconnect switch and emergency shutdown switch was verified to function properly at the time of installation and will be checked at a specified frequency in the future. Needless to say, upon completion of my tour, I was pleased to know that the installation of our steam generators and pressure equipment met an approved safety standard (ASME CSD-1) that will serve to protect our personnel and equipment under normal operating, maintenance, repair, and emergency conditions.

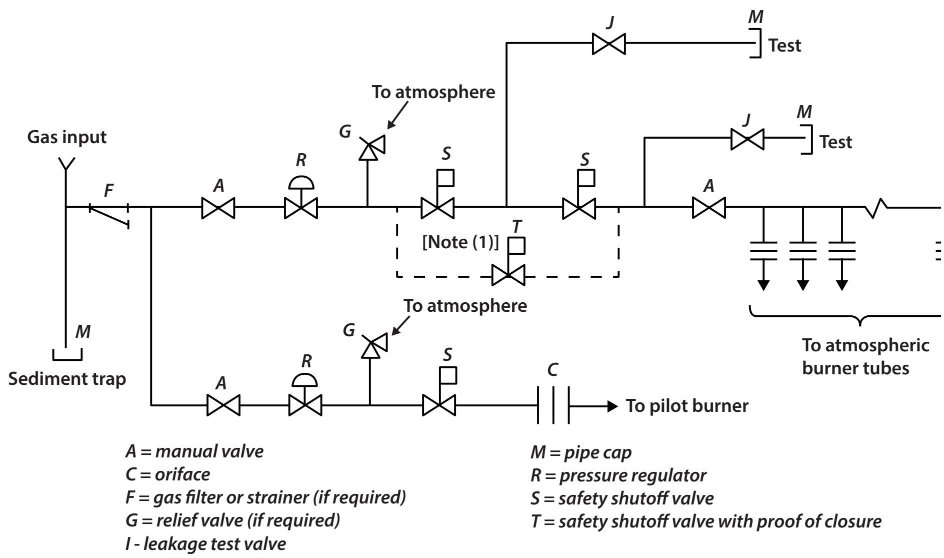
Improper Installation of Fuel Train Assemblies

Last year, inspectors reported over 1,650 violations for improper installation of fuel train assemblies. This number is far too high when we think of consequences of a furnace explosion that may easily occur due to safety controls not functioning properly. Many fuel train violations include missing safety components such as valves, drains, vents, and test connections, and even using improper materials that do not meet required standards.

If one is familiar with ASME CSD-1 and NFPA 85 standards and those of organizations such as Underwriters Laboratories (UL), Factory Mutual (FM), and Industrial Risk Insurers (IRI) – all of which specify various requirements for fuel train assemblies – it is obvious that there are many opportunities for improper installation of fuel trains, which are needed to ensure safe lighting and operation of a boiler. Figure 5 is a simple diagram of a typical gas fuel train assembly from ASME CSD-1, Appendix B. As the diagram shows, there are many requirements that must be met for proper installation.

5

Fig. B-1 Typical Atmospheric Gas Fuel Train [Greater Than 400,000 Btu/HR (117 228 W) and Less Than or Equal to 2,500,000 Btu/hr (732 678 W)



An additional important requirement for a fuel train specified in ASME CSD-1, Part CF, requires that burner assemblies having inputs in excess of 400,000 Btu/hr shall bear a label and/or be listed by a nationally recognized testing agency (that is accepted by the jurisdictional authority) as complying with one of the following:

- Standard for commercial industrial gas-fired heating equipment, UL 795.
- American National Standard for gas-fired low-pressure steam and hot water boilers, ANSI Z21.13.
- Standard for gas-fired pool heaters, ANSI Z21.56.

However, within ASME CSD-1, the size of the boiler and the type of fuel fired will determine what standards or provisions are required for compliance with CSD-1. If the jurisdiction mandates ASME CSD-1 (presently, 43 National Board member jurisdictions do), we should understand the differences among standards. For instance, ANSI Z 21.13 is a performance-based standard and CSD-1 is a design-based standard. In other words, Z 21.13 allows for a wide range of ignition and timing sequences for burner controls based on performance testing under normal and abnormal operating conditions.

As a design-based standard, CSD-1 requires the installing contractor to test the operation of the control systems prior to their release to the owner/user since timing sequences are generally shorter and no certification of the boiler unit is required. Regardless of these differences, manufacturers, installers, and inspectors should understand **when** and **what** requirements need to be met to comply with ASME CSD-1 since this standard is required by more and more jurisdictions.

In summary, there are many contributing factors associated with burner management violations. Violations often occur when those involved with installation and inspection activities are not familiar with the varying standards and regulations related to burner management. Confusion regarding which regulations are mandated from jurisdiction to jurisdiction can also contribute to violations.

While it can be difficult for owners, installers, contractors, inspectors, and manufacturers to keep up with the many variables and code revisions, all parties can help minimize violations and improve safety by working as a team to share information and seek out answers regarding specific jurisdictional regulations.

Training of both new and seasoned personnel also plays an important role in minimizing violations. The National Board continues to revise and expand classroom and online training courses to teach safety standards for construction, installation, inspection, and repairs of pressure equipment to anyone interested in learning. Specifically, the National Board online course "2012 CSD-1: Controls and Safety Devices for Automatically Fired Boilers" is a self-guided course that provides a general overview of ASME CSD-1, and includes the electrical requirements for controls, safety devices, and burners. For more information on this and other classroom and online courses, visit nationalboard.org. *LET US NOT LEARN FROM OUR MISTAKES BUT RATHER MINIMIZE OUR MISTAKES BY LEARNING!* ♣

BULLETIN photo by Smith Productions

TONY ODA

Washington Chief Boiler and Pressure Vessel Inspector

Tony Oda likes to keep things uncomplicated.

"One dog, one wife, and one daughter," he proclaims with a grin.

It's a philosophy that dominates his life right down to his responsibilities as Washington chief boiler and pressure vessel inspector. "I tell all inspectors: 'you inspect it, you own it.'"

By his own admission, Tony is a stickler when it comes to "doing our jobs to the best of our abilities," especially since it involves public safety. One of the main focus points is the accuracy of his department's work, particularly its database. "That's why our number one job is to verify nameplates." He explains that without verification of maximum working pressure (MWP), there is no assurance a vessel is safe.

"We have the skill and capability to prevent accidents," Tony emphasizes. "And that is why just one preventable incident is unacceptable!" The state official's passion has not gone unnoticed by his supervisors who have given their chief inspector the latitude and support "to make our program the best it can be."

Tony admits his values and beliefs are the culmination of a variety of experiences that began while growing up in Hawaii.

"I was born in Kauai," he admits with pride. "I lived there until I was seven and then we moved to Oahu."

Tony was one of four Oda children raised by his machinist father and bookkeeper mother.

It's not difficult to envision the idyllic life Tony enjoyed during his childhood. "Back then you surfed just about every day and there was no end to the baseball season," he smiles. The state official says that despite living in paradise, he worked at various full and part-time jobs since he was 15 years old.

Following high school graduation in 1971, the Kauai native attended college for 2 ½ years but left when he could find no professional interest to pursue.

The National Board member recalls that as he approached his latter teen years, he had no inkling as to what he wanted to do for a living. For reasons unclear to him now, Tony at one time thought banking would be a good profession.

The age of 21 was a kind of milestone for the Washington inspector. Not only did he start a new job as an assistant manager at a consumer finance company ("my attempt to perhaps follow a banking career"), he traveled with friends to the mainland for the very first time. And what was the first mainland city he visited? Las Vegas.

Tony spent a year with the consumer finance company before souring on the financing business.

Answering a newspaper advertisement, the state inspector took an aptitude test along with 130 other applicants for the position of refinery operator at Chevron. Despite feeling underqualified without a college degree, Tony was only among four applicants offered positions.

"The reason I did so well on the test," he explains, "was my familiarity with mechanical devices and aptitude which I picked up from my machinist dad." Tony's admiration for his father becomes apparent when he discusses his earlier years. "My dad instilled in me three core attributes: working hard, avoiding cutting corners, and always being on time. I was blessed to inherit his work ethic."

Starting his new job at Chevron, the Washington official still had no desire to enter the machinist industry. "My attraction was a paycheck double of what I made at my previous job!"

Tony said it was during his training that he suddenly realized he enjoyed the operator job. "The only negative was the shift work," he adds.

The mid-1980s marked another milestone for Tony. "I had known Miri since high school," he smiles. "After she earned her college degree, we attempted to conduct a long distance relationship. She was working for a U.S. senator at the time in Washington D.C. and the chance of us ever getting together – between letters and long distance telephone calls – was remote."

That is, until Miri returned to work in the senator's Hawaii office in 1984. Romance again blossomed and in 1986, Miri and Tony became Mr. and Mrs. Oda.

In 1989, the couple visited Seattle on vacation and found the area to their liking. While Tony enjoyed his responsibilities at Chevron, the Odas were becoming frustrated with the shift work and the effect it was having on their personal lives. "We actually made a plan during our vacation to relocate to Seattle," Tony confides. "We also set a target date: 1992."

In January of 1992, the Odas put their plan into action. "By the middle of that year, I had quit my job at Chevron and Miri and I established our new residence in Mukilteo, Washington," the state official explains.

"Miri completed graduate school and I began looking for my first job on the mainland," he continues. "I first tried the state to see if any inspector positions were open. It was on my second attempt that I spoke to then-Washington chief Dick Barkdoll. We did a five-minute telephone interview and suddenly I am working for the state!"

Starting on July 1, 1992, Tony was immediately sent to National Board "A" school, where he earned his "A" endorsement, followed shortly by National Board "B" school, and ASME and National Board team leader certifications two years later. "Once I started with the state, I decided I never wanted to leave!" he says. Timing was on his side, as within three years, he was very busy as an inservice inspector, shop inspector, and review team leader.

In 2001, the Odas moved to Tumwater just outside the state capitol of Olympia where Tony served as a state technical specialist in the boiler and pressure vessel department. And while he had no designs on becoming chief inspector, he nonetheless was promoted to the position in 2011.

Today, the Washington State boiler and pressure vessel program is comprised of 11 field inspectors, an inspector supervisor, a technical specialist, and four office staff. Of the 114,000 pieces of pressure equipment in the state, Tony's department oversees 28,000 units.

The Washington National Board member is proud of the relationships he has forged with companies and organizations under his jurisdiction. "Key to working with these groups is solid communications," he explains.

Tony says he enjoys answering any and all questions with the only exception being one he has been asked a thousand times:

"Why would anyone purposely choose to leave Hawaii?"

Formación Online Ahora Disponible en Español

(Online Training Now Available in Spanish)

BY KIMBERLY MILLER, MANAGER OF TRAINING

The National Board is pleased to announce the addition of four Spanish language courses to our menu of online training: ASME Code Reading Primer; *National Board Inspection Code* Part 1, Installation; *National Board Inspection Code* Part 2, Inspection; and *National Board Inspection Code* Part 3, Repairs and Alterations.

These four courses have been translated into Spanish through the National Board's partnership with EnginZone, a training organization headquartered in Lima, Peru. With offices in both Peru and Chile, EnginZone is an approved provider of technical training on behalf of fellow technical organizations ASME, ASTM, and NFPA.

Although these new Spanish courses are completely hosted on the EnginZone platform, they have the same look and feel as their English language counterparts offered from the National Board online training center. The technical information provided within each course is exactly the same as the English versions, and a certificate will be provided to each student upon course completion.

Although these new Spanish courses are completely hosted on the EnginZone platform, they have the same look and feel as their English language counterparts offered from the National Board online training center.

One addition to the Spanish language *National Board Inspection Code* (NBIC) courses is the ability for students to view the related NBIC pages referenced within each course in Spanish as linked documents from each course. This new feature was integrated into the Spanish courses to provide continuity to the training; allowing students to move seamlessly between the training and code pages/paragraphs referenced, staying in one language. Thanks to this feature, students enrolled in the Spanish language NBIC courses will not be required to make a secondary purchase of the related code books as all the necessary information is provided to them.

Keep in mind, the ASME Code Reading Primer course does reference ASME Sections I; IV; VIII, Division 1; and B31.1, which are not included with the Spanish language version.

Those interested in taking one of these new Spanish language online courses should contact EnginZone to enroll, either via email at online@enginzone.org or by calling (51) (1) 205.5515 (toll charges apply). All enrollments, issuance of completion certificates, and technical support are managed through the EnginZone offices and not the National Board Training Department.

Tuition for each online course is $150.00 USD.

For more information about EnginZone, please visit their website at www.enginzone.com. You can also link to EnginZone from the National Board website under the "Training" tab.

Note: *These new courses reference 2013 Editions of the NBIC and ASME Boiler and Pressure Vessel Code Sections and the 2010 Edition of ASME B31.1.*

Classroom Training Courses and Seminars

The 2016 training calendar is coming soon. Check the National Board website for up-to-date availability.

Remaining 2015 Classroom Training Courses and Seminars

All classroom training is held at the National Board Training Centers in Columbus, Ohio, unless otherwise noted. Class size is limited and availability subject to change.

COMMISSION/ENDORSEMENT COURSES

(C) AUTHORIZED NUCLEAR INSPECTOR (CONCRETE) COURSE
TUITION: $1,495, 2.5 CEUS ISSUED
DECEMBER 7-11, 2015

EnginZone

Online Training Courses Listed by Category

Visit www.nationalboard.org for complete listing of online courses

General Knowledge Courses/$99 per course

- ASME Code Reading Primer
- ASME Nuclear Code Reading Primer
- ASME Nuclear Inservice Code Reading Primer
- Basic Mathematics: Operations and Formulas

New Construction Inspection Course/$150 per course NEW!

- Fabrication: General and Welded **NEW!**

Inservice Inspection Courses/$150 per course

- 2012 CSD-1: Controls and Safety Devices for Automatically Fired Boilers
- 2013 Edition National Board Inspection Code, Part 1, Installation
- 2013 Edition National Board Inspection Code, Part 2, Inspection
- 2013 Edition National Board Inspection Code, Part 3, Repairs and Alterations
- 2015 Edition National Board Inspection Code, Part 3, Repairs and Alterations **NEW!**

CONTINUING EDUCATION COURSES/ $100 PER BUNDLE

IMPORTANT NOTE: Inspectors that completed their last continuing education courses in 2013 are required to complete the new 2015-16 courses prior to December 31, 2015 for renewal.

2015-2016 NEW CONSTRUCTION BUNDLE (A, B, A$_R$*) NOW AVAILABLE!

- Calibration: ASME Code Requirements
- Efficiency Determination: Part 1
- Efficiency Determination: Part 2

*The A$_R$ Endorsed Inspector must complete the New Construction training as well as the NBIC Part 3 training course to meet the continuing education requirements. A "New Construction with Repairs" bundle is available on the online training center.

2015-2016 INSERVICE BUNDLE (IS, O) NOW AVAILABLE!

- Operation and Installation of Pressure Relief Devices
- Inspection Techniques for Potable Water Heaters

2015-2016 INSERVICE BUNDLE (N, NS) COMING SOON!

- Inspector Duties: Design Documents
- Material Organizations and Suppliers (NCA-3800)

2015-2016 INSERVICE BUNDLE (I, NS$_I$) TBA

2015-2016 INSERVICE BUNDLE (C, NSc) TBA

CERTIFIED INDIVIDUAL COURSES/$150 PER COURSE

CERTIFIED INDIVIDUAL COURSES/$150 PER COURSE

- Cast Aluminum Boilers
- Cast Iron Boilers
- Electric Boilers
- Reinforced Thermoset Plastic Corrosion-Resistant Equipment
- Unfired Miniature Pressure Vessels
- Pressure Relief Devices

Member Retirements


Rodney Handy

Kentucky Senior Boiler Inspector Rodney Handy retired from his post effective June 12, 2015. Mr. Handy became a National Board member in August 2003. Prior to that, he served in the US Navy from 1979 to 1985, and spent much of that time aboard the USS *King*. His civilian career began in Detroit working as an inspector for an insurance company before he accepted a job at the University of Kentucky running the school's chillers. In November of 1985, he was employed with the commonwealth of Kentucky as a boiler inspector. He became a senior inspector with the commonwealth in 1994, and then assumed the role of chief in 2003.


Chris Fulton

Former Alaska Chief Chris Fulton retired on August 31, 2015. Mr. Fulton served in the US Army from 1969 to 1971 as an NDE Specialist in the United States and Germany. His civilian career began as an employee with Cam Industries in 1972. He transitioned to the Puget Sound Naval Shipyard in 1974, and then he worked in boiler operations at the Bangor Naval Base from 1978 to 1981. Between 1981 and 2007, he was employed by Royal Insurance, Kemper Insurance, and Factory Mutual Insurance. He also worked for the states of Alaska and Nevada. He joined the state of Alaska in 2007, when he became the chief boiler inspector.

James Parsell Remembered


James Parsell

James Parsell, former Utah safety director and National Board Board of Trustees member, passed away on July 7, 2015. He was 84 years old. Mr. Parsell served in the US Navy during the Korean conflict. In 1971 he began working for Hartford Steam Boiler Insurance Company doing inspection and miscellaneous work. Mr. Parsell joined the state of Utah in 1977 as an inservice boiler inspector. He assumed the role of Utah safety director and became a National Board member in 1987. He served as board chairman of the National Board from 1993-1996. Mr. Parsell retired from the state of Utah in 1997 and was named an honorary member in 1998.

ASME Names Michael Merker Associate Executive Director


Michael Merker

The American Society of Mechanical Engineers (ASME) has appointed Michael Merker as associate executive director of Standards & Certification. Based in ASME's headquarters in New York City, Merker will administer the Society's engineering codes and standards activity and associated training, conformity assessment, and certification programs. ASME Standards & Certification involves more than 5,200 volunteers operating within 700 committees. During his career at ASME, Merker has held varying positions of increasing responsibility and played a major role in expanding conformity assessment programs to more than 70 countries around the world. Merker also has contributed significantly to the development and growth of the Society's digital publishing activity. Merker will remain a member of the ASME Executive Leadership Team, reporting to Thomas Loughlin.

New Members

Mark Jordan

Mark Jordan represents the commonwealth of Kentucky. Mr. Jordan was employed as the general manager for Queen Anne's Railroad from 1992 to 1997. He was general manager for Big South Fork Scenic Railway from 1997 to 2004. In 2005, he became employed with the commonwealth of Kentucky as a boiler inspector until assuming his current role of chief. ♣

Dan Sankovic

Dan Sankovic represents the province of Manitoba. Mr. Sankovic was employed as a computer numerical control (CNC) machinist and then millwright with various companies between 1995 and 2006. In 2006, he joined with the Government of Manitoba as a power engineer until assuming his current role of boiler inspector. ♣

Advisory Board Update

At the August Board of Trustees meeting, Barry Berquist, president of Samuel Pressure Vessel Group, was appointed to the National Board Advisory Committee representing pressure vessel manufacturers. Peter Molvie was re-appointed to the committee representing boiler manufacturers.

Additionally, former Advisory Committee member Michael Pischke, who represented pressure vessel manufacturers, was presented with a plaque by Chairman John Burpee and Executive Director David Douin in appreciation for his service. Mr. Pischke served from 2009 to 2015. ♣

Mr. Burpee (left) and Mr. Douin (right) present Mr. Pischke with plaque

NBBI TECHNICAL SCHOLARSHIP

Two $12,000 Scholarship Awards Available for Eligible Applicants

The 2016 National Board Technical Scholarship application period is now open. Deadline for submission is February 28, 2016. The program offers up to two $12,000 scholarships to students who meet eligibility requirements and who are pursuing a bachelor's degree in a qualified engineering curriculum or related studies. Applicants must also be enrolled, full-time, in an accredited four-year college or university in the U.S. or Canada with a cumulative college GPA of 3.0 or higher on a 4.0 scale.

The scholarship is available to the children, step-children, grandchildren or great-grandchildren of past or present National Board Commissioned Inspectors (living or deceased) and to past or present National Board employees (living or deceased).

The selection committee reviews all applications and notifies the chosen recipients by the last business day of March. Complete scholarship requirements and application form can be accessed at www.nationalboard.org by clicking the "Tech Scholarship" button on the left-hand side of the homepage. Questions and further information may be obtained from the Scholarship Administrator Connie Homer at 614.431.3206, or by email at chomer@nationalboard.org. ♣

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 interpretations is published online at: http://www.nationalboard.org/Index.aspx?pageID=4&ID=22.

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 review the complete collection of questions, refer to the websites listed above.

NBIC Interpretation

- **Interpretation:** 13-05, Subject: Part 1, 3.8.2.3, (Edition: 2013)
  Question: Is it permissible to place the operating temperature control on a storage tank located in a hot water supply system?
  Reply: Yes.

ASME B&PVC Interpretations posted January 2015

Section VIII-1

- **Interpretation: VIII-1-13-17,** Subject: Figures UG-118 and UG-119(a), Nameplate (2013 Edition), Date Issued: June 27, 2014
  Question: May the manufacturer's serial number be shown at the top of the nameplate and be in compliance with Figures UG-118 and UG-119(a)?
  Reply: Yes.

Section IX

- **Interpretation: IX-13-29** Subject: QW-304, Volumetric Examination of Welder or Welding Operator Performance Qualification Tests for Unassigned Base Metals, Date Issued: May 29, 2014
  Question: A welder performance qualification is performed using two coupons of the same unassigned base metal with the manual GTAW process. The unassigned base metal is a similar composition (same UNS number) as a P-No. 61 base metal. May the completed test coupon be examined by a volumetric NDE method?
  Reply: No.

Section I

- **Interpretation: 1-13-25**, Subject: Feedwater from a Common Source, PG-61 and Figure PG-58.3.1(a) (2013 Edition), Date Issued: June 3, 2014
  Question: When two boilers firing gaseous and/or liquid fuel are:
  a. each provided with a means for shutting off the heat input to the boiler before the water level reaches the lowest permissible level in the boilers as required by PG-61.2
  b. both fed from a common source of feedwater complying with PG-61.1
  c. both valved as shown in Figure PG-58.3.1(a) for "two or more boilers fed from a common source"

  Does Section I define the number of feedwater pumps to be supplied?
  Reply (1): No.

Section IV

- **Interpretation:** IV-13-13, Subject: HG-307.5, Electric Immersion Heating Element Support Plates, Date Issued: January 30, 2014
  Question: Is it the intent of HG-307.5 to preclude the use of a miscellaneous pressure part per HF-203 as a manufacturer's standard pressure part?
  Reply: No.
  Question (2): Is it the intent of HG-307.5 to preclude the use of pressure parts manufactured by a Section VIII, Division 1, "U" Certificate Holder when the element support plate is designed per the rules of Section VIII, Division 1, Mandatory Appendix 41, and documented with a U-2 Partial Data Report?
  Reply (2): No.

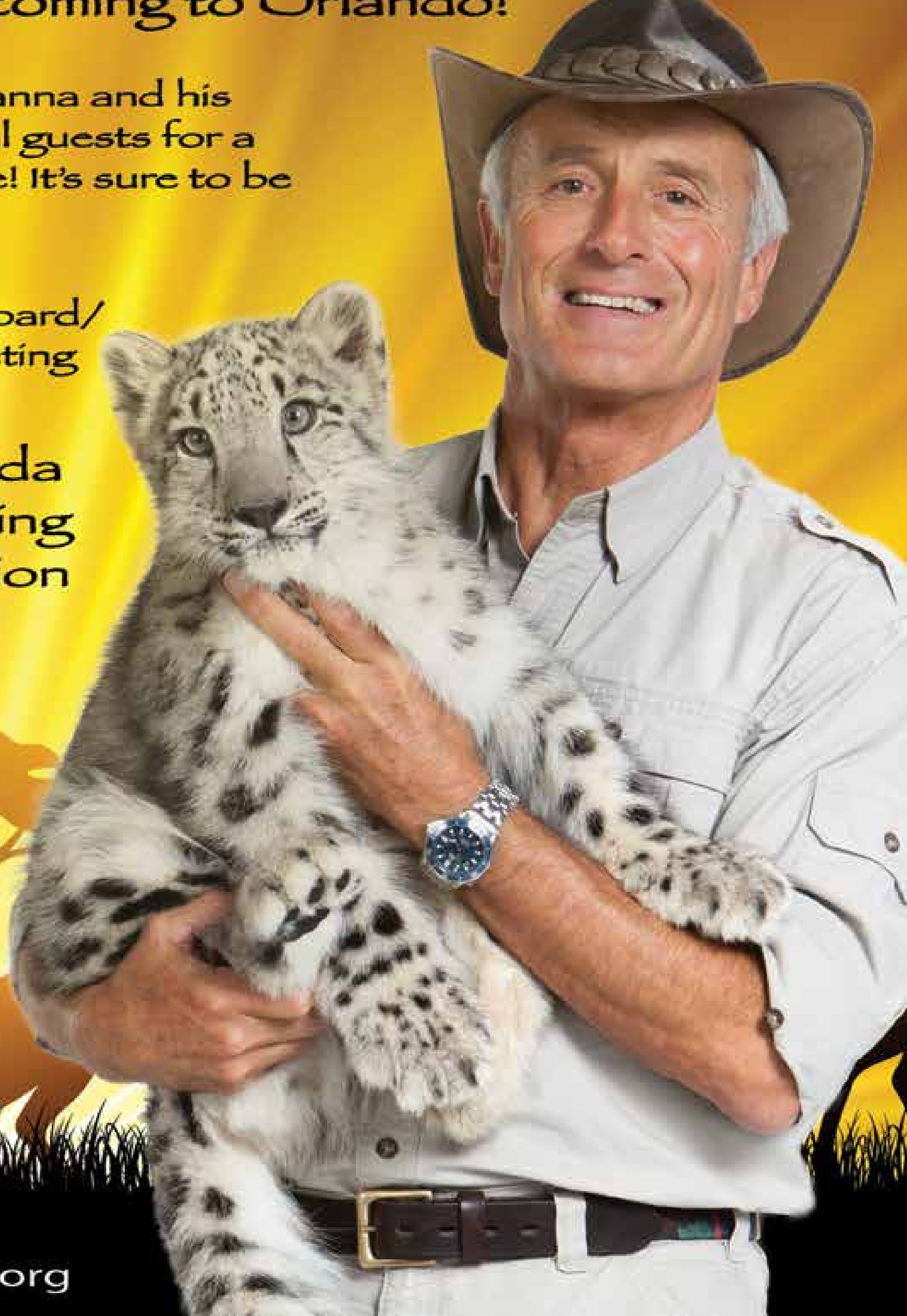
JACK HANNA

No Lion – America's Favorite Zookeeper is coming to Orlando!

Join Jungle Jack Hanna and his menagerie of special guests for a walk on the wild side! It's sure to be a roarin' good time!

The 85th NationalBoard/ ASME General Meeting

Orlando, Florida
Monday Morning
Opening Session
May 9, 2016



Watch for details at
www.nationalboard.org

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