PRESSURE POINTS

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ASME CODE NEWS

by Thomas P. Pastor, Director, HSB Codes and Standards

Questions and Answers

Q My company is constructing an HRSG in which the feedwater line between the steam drum and the economizer contains no valves. Paragraph 122.1.3 of B31.1 requires the design pressure for this line to exceed the MAWP of the boiler by either 25% or 225 psi, whichever is less. Must this line be hydrostatically tested to 1.5 times its design pressure, and if so does this mean that stop valves must be installed for this purpose?

A If there are no intervening valves between the economizer and drum then it is not necessary to isolate the feedwater piping for testing. The hydrotest pressure is based on the MAWP of the boiler outlet. The feedwater piping has a 25% enhancement to compensate for the potential shock of a feed pump pressure surge. It is merely an additional design element. Sometimes PP manufacturers will shop test the piping at 1.5 x MAWP of the piping. But it is not required if the piping will be field tested with the boiler hydro.

Q I have a question regarding reinforcement calculations in Section VIII, Div. 1. UG-36(b)(1) states that reinforced openings in cylindrical shells are not limited to size; however when the finished opening in vessels 60" ID or smaller exceeds one-half the vessel ID or 20 in., the supplemental calculations of 1-7 shall be satisfied in addition to UG-36 through UG-43. Must all the calculations of 1-7 be satisfied, and what do you do when the large opening is in a head instead of the cylinder?

A You are correct in stating that Section VIII, Division 1 does not set any upper limits on the size of openings. However, when the opening exceeds a certain size relative to the vessel diameter, it does require additional calculations (1-7), which are above and beyond those required by UG-36 through UG-43.

Appendix 1-7 calculations are required for openings in cylindrical shells when:

Vessel ID	**finished opening**
≤ 60″	greater than vessel ID/2 or 20″
> 60″	greater than vessel ID/3 or 40″

Appendix 1-7 contains three paragraphs:

1-7(a) These calculations are always required when the opening exceeds the limits stated above. These calculations are sometimes referred to as *compact reinforcement* in that they require a larger percentage of the required reinforcement to be placed closer to the opening.

1-7(b) These calculations are only required when all the following conditions are met:

a) vessel diameter is greater than 60 in.;
b) nozzle diameter exceeds 40 in. ID and also exceeds $3.4\sqrt{Rt}$;
c) $R_n/R \leq 0.7$;

The 1-7(b) calculations are not applicable for nozzle to vessel ratios [R_n/R] exceeding 0.7 or when the nozzle is not radially oriented; for these cases, reference is made to U-2(g), or 1-7(c).

1-7(c) This paragraph contains suggested good practice when placing a **LARGE** opening in a vessel. Although the rules are non-mandatory in nature, a vessel Manufacturer should take heed of this advice if he has no past experience with such construction.

Finally, the 1-7 rules only apply to large openings in cylindrical shells. For large openings in formed heads, UG-36(b)(2) suggests several alternatives involving a cone or reducer section. See Fig. UG-36 for further details.

Section VIII, Division 1 Joint Efficiency Rules and 'RT' Marking (Part 2 of 4)

by Tom Pastor, Director, HSB Codes and Standards

Last issue we published the first installment of a series of articles on Section VIII-1 joint efficiency rules, focusing on 'RT-1' vessels. This issue, we'll explore what level of radiography is required to achieve an 'RT-2' rating, and what this means relative to a fully radiographed vessel. *[**Note:** To thoroughly understand the following material, you need to be familiar with the definitions of joint category and type; this material was covered in our last issue, which can be found at HSB's Web site: www.hsb.com/presspts.htm]*

'RT-2' Vesssels

Unlike an 'RT-1' vessel in which all butt welds are required to be fully radiographed, radiographic examination in an 'RT-2' vessel focuses on those joints most critical to the design of the vessel. An 'RT-2' vessel provides the best balance in terms of risk and design economy. Let's see why that is!

UG-116(e)(2) defines 'RT-2' as: *when a complete vessel satisfies the requirements of UW-11(a)(5) and when the spot radiography requirements of UW-11(a)(5)(b) have been applied.*

It is important to note that absent of any service or thickness mandated examination, current Section VIII-1 rules permit a Manufacturer to examine welds on a joint-by-joint basis. This feature is uniquely applied for 'RT-2' vessels.

Referring to UW-11(a)(5), this paragraph requires that all Category A and D butt welds in vessel sections and heads must be fully radiographed when designed with a joint efficiency from column (a) of Table UW-12 [column (a) is associated with full radiography]. Two additional conditions must be satisfied:

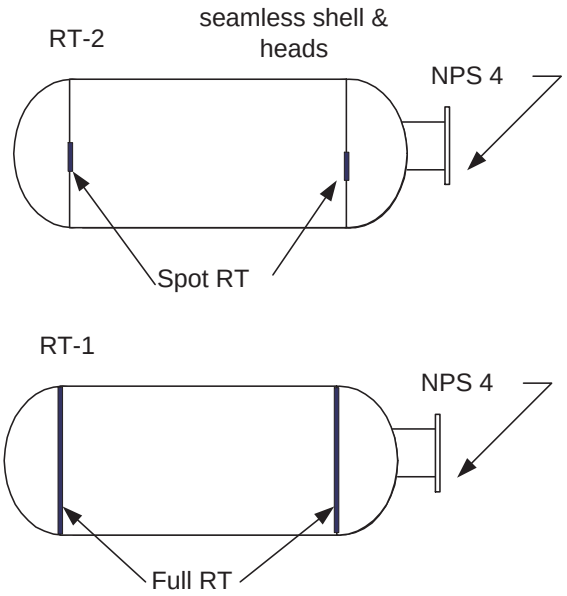
1. UW-11(a)(5)(a) – all Category A and B welds connecting the vessel sections or heads shall be Type No. (1) or (2) of Table UW-12.

2. UW-11(a)(5)(b) – all Category B or C butt welds which intersect the Category A butt welds in vessels sections or heads or connect seamless vessel sections or heads shall, as a minimum, meet the requirements for spot radiography in accordance with UW-52.

Simplifying the above rules, in an 'RT-2' vessel, only the Category A welds in shells and heads are fully radiographed and the intersecting Category B or C welds are spot radiographed. But the vessel sections and heads are designed using the joint efficiency associated with full radiography.

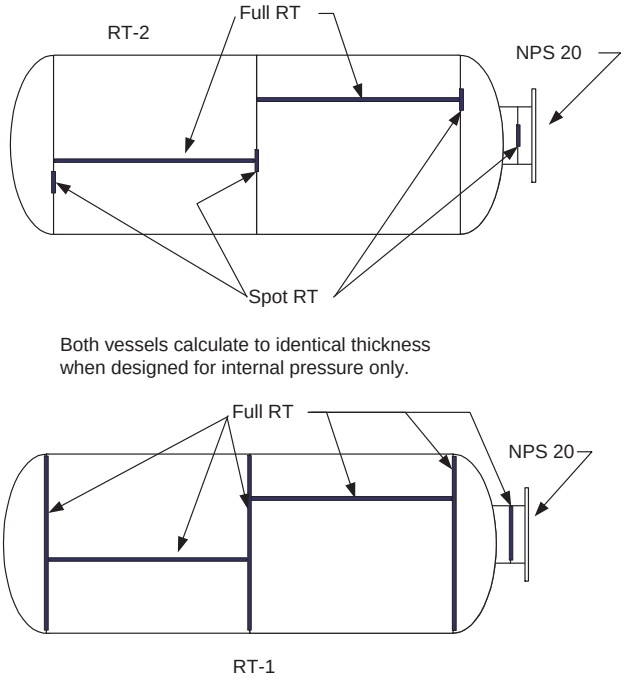
Let's look at a couple of examples.

In this first example involving a seamless shell with two seamless heads, the 'RT-2' vessel only requires spot RT on the two Category B seams. However, if one welder welds these two seams and they are equal to or less than 50', then only one spot RT will be required [see UW-52(b)(1)].



The two vessels are identical in thickness since in both cases a joint efficiency equal to 1.0 will be used in the shell hoop stress calculation and the head calculations. The shell axial stress calculations do not control the design even though the joint efficiency *E* is equal to 0.7 [assume Type 1 joints for the girth seams].

In a complex vessel, the savings due to reduced radiography based on 'RT-2' vs. 'RT-1' can be more dramatic. As in the first example, the number of spot RTs can be reduced depending on the number of weld increments [see UW-52(b)(1)] in the vessel.



Some additional facts about UW-11(a)(5)(b)

1. To stamp a vessel 'RT-2', the rules stated above must be applied to the entire vessel.
2. The spot x-ray taken to satisfy UW-11(a)(5)(b) is not at all related to spot RTs required by UW-11(b).
3. The spot x-ray taken per UW-11(a)(5)(b) is sometimes referred to as the "quality shot." Looking back at the first vessel fabricated from seamless components, the stresses acting on the Category B welds do not control the design for an internal pressure only load case. The spot RT taken of these seams is a statistical "quality check" of the ability of the welder to deposit sound weld metal.

Next issue we'll examine the rules for a complete spot RT'ed vessel – 'RT-3'.

LOOKING AHEAD TO THE 2001 EDITION

One of the many advantages of participating on ASME boiler and pressure vessel committees is knowing well in advance what revisions will be published in future addenda and editions. Starting with this issue, we will begin to highlight Code revisions of interest that will appear in the 2001 Edition next summer.

Section I – PW-9.3, Incorporation of Code Case 2210

Current Section I rules (PW-9) require that the centerlines of components making up a longitudinal weld seam must coincide. Thus when a thickened tubesheet is welded into a drum, the centerlines must line up resulting in 3:1 weld tapers on the ID and OD as shown in Fig. PW-9.1.

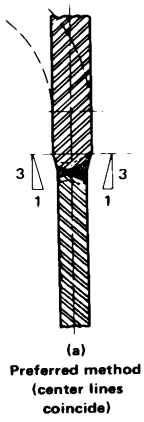


Fig. PW-9.1. 1

Boiler manufacturers would prefer the ID of the drums to be flush, therefore requiring the tubesheets-to-shell joints to be offset. The provisions of Code Case 2210, which was written to provide an option for an offset joint as shown in Fig. 1, are now being incorporated into Section I.

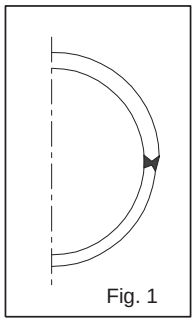


Fig. 1

Two additional conditions must be satisfied to use this offset joint:

1. ratio of thicker/thinner plate shall not exceed 2:1
2. T_{max} shall not exceed 750° F

Section VIII, Divisions 1 & 2 – Increase in Minimum Manhole Size

Currently the minimum size of elliptical or obround manholes used for inspection openings on pressure vessels over 36 in. ID is either 11 in. x 15 in. or 10 in. x 16 in. This revision will increase the mandatory minimum elliptical or obround manhole size to 12 in. x 16 in., and brings Section VIII into alignment with Sections I and IV. This revision is a long overdue improvement in safety, recognizing the increase in average girth of inspectors over the past 50 years. You will see the changes to UG-46(g)(1) and AD-1020.1 in the upcoming 2001 Edition.

Final Word

ASME Forms Task Group for Heat Recovery Steam Generators

by Sandy Babka, HSB Codes and Standards

Currently there are hundreds of installations of heat recovery steam generators (HRSG) around the world and still more in progress. Although most HRSGs are new relative to most existing utility and power boilers, it has become evident that they have their own sets of problems in design, fabrication, operation, and maintenance.

These units are being constructed in accordance with ASME Section I, Power Boilers, in some jurisdictions, and ASME Section VIII, Division 1, Pressure Vessels, in others. Neither Code adequately addresses the complex design and fabrication characteristics of this type of equipment. For example, materials that are allowed in Section I do address the higher temperature service issue, but concerns such as creep and fatigue are not accounted for. There is a higher possibility of corrosion in this application as well. The materials that are better able to resist corrosion are not allowed in Section I construction but they are allowed in Section VIII.

Even if either Code addressed all of the design, material and fabrication issues, HRSGs experience many different operational conditions than a standard power plant boiler. A plant can profit significantly from its ability to provide power quickly when it is needed. While the gas turbine and other equipment in the system have been designed to accommodate these quick start-ups and frequent cycling, in some cases the HRSG has not. No manufacturer gives the owner/user a set of operating instructions or maintenance guidelines that encompasses all of the different components in the system. Yes, the turbine will function properly and efficiently if started in this manner and the load is applied at this point, but what about the piping downstream?

How do you get the same corrosion resistant properties in a material allowed for Section I construction as those found in Section VIII allowable materials? How do you account for the high cyclic life of these units when choosing materials, design, fabrication techniques and maintenance? What happens to the piping downstream when a sudden load is applied and there is a drastic temperature differential? These are but a few of the questions that are being asked by owner/users, jurisdictions, manufacturers, and inspection agencies.

During the ASME Boiler & Pressure Vessel Committee meeting held in Los Angeles, CA the week of September 11, the Executive Committee agreed to form a Task Group under Section I, Power Boilers, to investigate several key issues regarding HRSGs. The Task Group will look into failure modes as they relate to materials, design, and fabrication. Also on the agenda is exploring the idea of some type of operating guidelines book, similar to ASME Sections VI and VII, and an "interface control document" to give some direction in determining the best maintenance and operation practices with relation to the other components of the system.

If you are an owner/user, fabricator, jurisdiction or just interested in attending or learning more about the Task Group, contact Roger De Cesare, P. E., at ASME International (202-785-3756 or e-mail decesarer@asme.org).

Keeping Current with the Pressure Equipment Directive

In the last issue we included an insert with some useful Web sites and publication sources for those involved in exporting pressure vessels to the European Union. This quarter's PED article is on Choosing a Conformity Assessment Module to Comply with the Pressure Equipment Directive.

To obtain a copy of this quarter's article, a glossary of terms, and a binder in which to store these references, please call Louise Curtis at 800-472-1866, extension 5024, or send an e-mail to louise_curtis@hsb.com.

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