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Department of Labour
TE TARI MAHI

Safety Lines

Contents

Water Drum Mismatch

This article, based on a report by Mike Jack of SGS M&I, outlines an interesting instance of cracking found in a water drum head during fabrication inspection at a workshop outside New Zealand.

The drum was for a water tube boiler operating at 15.5 barg and 0 250ºC. The design standard was AS 1228 - 2006 Pressure equipment - Boilers, and the design pressure 17.5 barg.

The construction drawing specified a water drum of 762mm internal diameter and 16mm nominal thickness, manufactured from ASTM A516 Gr70 plate. The head detail on the drawing called for a semi-ellipsoidal dished head, also of 762mm ID.

The manufacturer sourced its drum heads from an external supplier and decided to provide it with plate left over from the cutting of the steam drum for the same boiler. However, the steam drum was made from 22mm nominal thickness plate of the same grade as that for the water drum. Thus both the steam and water drum dished heads were formed from plate 22mm thick, albeit to the correct ID and ellipsoidal dimensions of the respective drum drawings.

The heads were subsequently produced and delivered to the boiler manufacturer, who welded the heads onto their respective barrels using the approved procedure qualification record and parameters of the welding procedure specification. The welding processes were gas tungsten arc welding / submerged arc welding, single vee. As a thicker than required material was used for the water drum head its finished outside diameter was obviously greater than that of the 16mm thick drum. The manufacturer chose to taper the head 4:1 to make the correct joint preparation.

Whilst the inspection and test plan called for a third party review of the fit ups of the head to circumferential weld, no such inspection or review of the head forming certificates took place by anyone other than the manufacturer's quality control department.

The first indication that something was wrong was when the radiographic report of one of the head circumferential seam welds highlighted cracking in the head parent metal perpendicular to the weld seam. Subsequent visual and surface methods inspection using magnetic particle inspection (MPI) revealed numerous cracks around the entire circumference.

In an effort to ascertain why the heads cracked, the material certificates for the drums and dished heads were again reviewed and found satisfactory, but the head forming certificates could not be located by the manufacturer's quality control department, so copies of the certificates had to be obtained from the dished head supplier.

The basic details of the head from the forming certificate confirmed, among other things, that the plate material was ASTM A516-03 Gr 70 22.0mm thick, the ID was 762mm, and there was no heat treatment after forming. The thickness around flange and knuckle generally ranged from 19.05 - 19.76mm with a minimum thickness of 18.7mm, it had a thickness loss greater than 10%, and it had been cold formed - spun with no heat treatment. The head certificate also stated the heads conformed to ASME Sec VIII Div 1, although the heads were supposed to be supplied to AS 1228.

Section 6.3.1 of AS 4458 - 1997 Pressure equipment - Manufacture allows for cold forming, but if the fibre strain is greater than 5% (as calculated in accordance with the standard) and if the dished end thickness exceeds 16mm the heads need to be heat treated. The actual strain was found to be 12.4%.

The other head on the water drum was examined using MPI but no surface breaking indications or cracking were found.

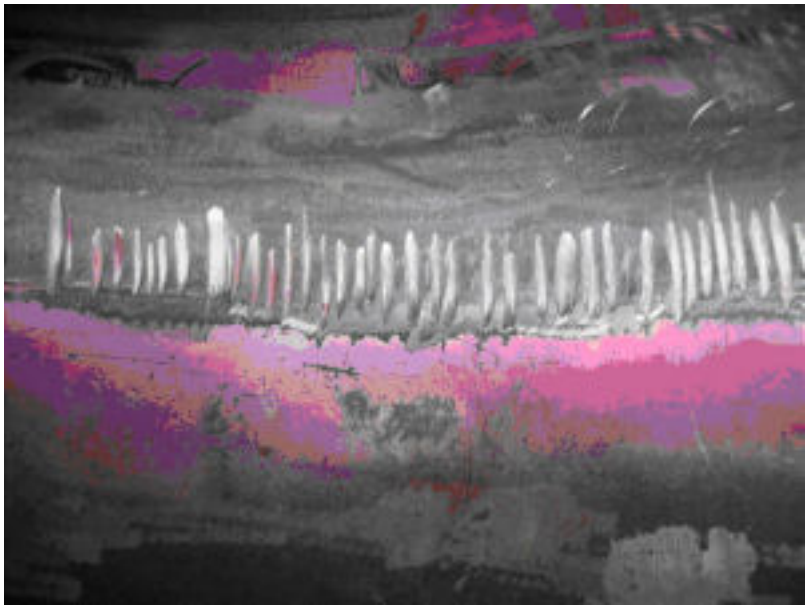
The initial reaction of the manufacturer was to grind the cracks out and repair by welding. However both water drum heads were cut off and discarded at the insistence of the vendor and third party inspection body, with new heads being ordered using the correct thickness plate. The barrel was cleaned up and the joint preparation re-made with additional surface methods on the preparation faces and heat affected zone from the previous weld to ensure against cracking or laminations at the face and adjacent parent metal.

This incident raises a number of concerns, such as the following, especially as the manufacturer was an approved coded workshop:

1. The heads were welded onto the barrel of the water drum without first checking the head forming certificate.
2. A check for fibre elongation was not requested to be done during the head forming process.
3. The purchase order to the head forming company did not specify any form of heat treatment following the cold forming.
4. The manufacturer did not seek approval from the client and inspection body regarding using the incorrect plate thickness.
5. The third party inspection point on the inspection and testing plan was missed for fit up inspection at the appropriate time.
6. There appeared to be a lack of understanding of the reasons why the head forming certificate was so critical during this process.

A review of the steam drum head forming certificate and additional non destructive testing carried out (ultrasonic, MPI and hardness survey) on the steam drum heads revealed no injurious defects and the calculated fibre elongation for the steam drum heads was less than 5% with less than 10% thinning.

Typical cracking initially seen with MPI



During grinding out of cracks by manufacturer.

Boilers Code - Applicability of Part 1 to Hot Water Boilers

The introductory paragraph of Part 8: Pressurised Hot Water Boilers of the Approved Code of Practice for the Design, Safe Operation, Maintenance and Servicing of Boilers refers to 'the applicable provisions of part 1 of this code'. The purpose of this article is to direct the reader to those provisions of part 1 which are applicable.

The PECPR Regulations define 'boiler' in such a way as to exclude 'hot water boiler'. However, within part 1 of the code of practice the term 'boiler' is used in a more generic way and can sometimes be taken to include 'hot water boiler'. (The term 'hot water boiler' is also used explicitly in this part.)

The instances in part 1 where it is appropriate to consider the subject matter relevant to hot water boilers are given in the following table:

Applicability of content to hot water boilers

Reference	Applicability of content to hot water boilers
1.1	Hot water boilers are specifically mentioned in the 3rd and 4th paragraphs. The remainder is generally applicable except where obviously not.
1.2	The 1st and 3rd from last paragraphs Notes: 1. Taking the 1st paragraph in context, the word 'boiler', and the words 'all commercial and industrial boilers' should be taken as including hot water boilers. 2. Taking the 3rd from last paragraph in context, the words 'other boiler types' should be taken as including hot water boilers.
1.4	Those definitions required to support the other applicable parts of the code of practice
1.5	All except 1.5.2 and 1.5.5
1.6	All
1.10	All
1.11.1	All except 1.11.1.1 and 1.11.1.2 Although hot water boilers are not singled out for additional seismic requirements, as is the case for water tube and shell boilers, the design criteria in the design standard will require that seismic loads be taken into account. In the absence of more specific guidance, and if deemed appropriate for the configuration of the hot water boiler under consideration, it may be expedient to adopt the provisions of 1.11.1.2.
1.11.2	All
1.11.3	All except 1.11.3.6
1.11.4	All
1.12	All
1.13	All
1.15.1	All
1.15.5.2	All
1.16	All
1.21.	All Note: There is some redundancy with 8.5 and 8.6
1.22	All
1.23	All except 1.23.1, the words 'and steam plant' in 1.23.6, and 1.23.15 Note: 8.3 is complementary to 1.23 with some minor redundancy.
1.24	All except 1.24.1
1.25	All except 1.25.3
1.26	All except the words 'and ancillary steam plant' in 1.26.1, 1.26.2, the second sentence of 1.26.5, and 1.26.6.2
1.27	All except 1.27.1
1.28.1	All
1.28.3.3	All Note: Taking this in context, the phrase 'all other boilers' should be taken as including hot water boilers.
1.29	All except those parts of table 1.2 and its notes which do not pertain to hot water boilers Note: 1.29.10 should be read in relation only to those parts of 1.15 which are shown here to be applicable - i.e. 1.15.1 and 1.15.5.2.
1.30	All
1.31.5	All Note: Taking this in context, the phrase 'all other boilers' should be taken as including hot water boilers.
1.34	All

Hydraulic In-situ Testing of Safety Valves

AS/NZS 3788 gives some warning (in the Notes to 4.7.4.1) as to the limitation of in situ testing by applying an additional hydraulic or pneumatic force to the valve stem - as well as mentioning its advantage over visual inspection. This type of testing is widely accepted and we would not wish to discourage its use. It should be noted though that the assisted lift does not provide certainty with respect to achieving full lift, blowdown setting or re-seat, and can not replace strip down and visual inspection during internal inspection of the equipment.

It is the responsibility of the inspection body to issue a certificate of inspection only after ascertaining the safety of the equipment. In ascertaining equipment safety, the equipment inspector who recommends issuing the certificate may place reliance on such techniques as seem appropriate and to the extent influenced by knowledge of the techniques and history of the particular equipment. International experience indicates that the extension of internal inspection intervals of pressure vessels and boilers, and the associated longer times between overhaul of relief valves, gives rise to more seized valves due to weather ingress or product leakage.

It would be expected that the following factors be considered in connection with the use of hydraulic in situ testing of a safety valve (in lieu of visual inspection of components) for the issue of a certificate of inspection (where such certification does not require internal equipment inspection):

1. The type of equipment.
2. The known history of the valve, including such factors as:
    a. last recorded strip down and visual inspection of components
    b. last recorded overhaul;
    c. last recorded accumulation test (in the case of a boiler) or operational lift;
    d. last recorded time the valve was manually eased, if applicable;
    e. maintenance records.

A new valve must be inspected and may need to be pre-tested, prior to being fitted (see 4.7.2 of AS/NZS 3788) and stripped down at the first scheduled inspection of the equipment, then periodically thereafter at the discretion of the inspector, taking into account factors mentioned above.

The valve should always be stripped down at internal inspection of the equipment

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Cranes Code of Practice - Note on Electrical Protection (Amended)

The following article is reprinted from the previous Safety Lines (No. 75, November 2007), amended by the addition of the last paragraph:

In Part 3 of the Approved code of practice for cranes it is stated in 3.1(7) that 'At first commissioning, a chartered professional engineer (electrical) is to certify that the electrical installation and control circuits are appropriate and ... '. Due to lack of chartered professional engineers (electrical) available to engage in this type of work, current industry practice is for this to be carried out by a registered electrician.

Also in the note of 3.4(2) it is stated that '... the repair must be designed by a chartered professional engineer ...'. In this case too the current practice is, where an electrical repair is only to the original condition, a registered electrician is employed in the task. Other work in terms of alterations is designed by an appropriately qualified chartered professional engineer and design verified.

The foregoing notes on current practice do not represent a change to the Approved code of practice for cranes, but demonstrate a way of 'taking all practicable steps to achieve the outcome' where it is presently difficult to strictly follow the code.

Lift Radius Measurement - Mobile Cranes

There seems to be a need in some cases for inspectors to improve accuracy of measurement of the dimension from slew ring to the lift line during mobile crane inspections. Whilst high precision is not called for, reasonable care in taking this measurement will contribute to the accuracy of conclusions drawn from observations involving load moment assessments.

Common sources of inaccuracy (in addition to those caused by wind, tape level estimate, etc) are:

1. Measuring from the estimated slew ring centre at the crane body side to the estimated lift line taken parallel to the crane body side
2. Measuring to the visualised lowered lift line, due to the load being suspended above the measuring tape height (in combination with 1 above)

Where possible, after the load test has been completed, the test weight should be brought down to ground level, with the rope still taut. A measurement can then be taken to the load line.

The distance from the slew centre line to the load line can be established by measuring from the load line to a suitable part of the crane and adding a known (from manufacturer's documentation) or derived distance from there to the slew ring centre. It is this distance from the crane measurement point to the slew centre which sometimes proves slightly awkward to determine in practice. If possible a measurement can be taken to the slew ring or a crane feature concentric with the slew ring. To this must be added the radius of the ring or feature, which may either be known or calculated (e.g. from the body width and distance in from the body side). Alternatively if the boom is accurately aligned with the vehicle's fore and aft centre line, a central part of the crane body could be used. In this case also the distance from the measurement point to the slew ring centre must be found.

Plastic Pipe for Pressure Applications

The purpose of this article is to provide an update on the acceptability of non metallic pipe and fittings for compressed air piping systems. This replaces the article of the same title which appeared in Safety Lines issue number 40 (December 1998).

Non-metallic piping systems are acceptable for compressed air providing the piping materials and fittings comply with the following standards:

- AS/NZS 4129 Fittings for polyethylene (PE) pipes for pressure applications
- AS/NZS 4130 Polyethylene (PE) pipes for pressure applications

The design must comply with AS 4041 Pressure piping (optionally ASME B31.3).

HERA Courses and Seminars

HERA Training Centre is offering the following courses and seminars over the remainder of 2008:

Activity	Dates
ASME V (NDE) and ASME IX (Welding) - 2007 Editions	28 February
Refresher Welding Inspection	22 - 23 April 23 - 24 September
Elevating Work Platform Inspection	24 April 2 October
Welding Inspection	14 - 18 April 11 - 15 August
Ultrasonic Testing Theory and Ultrasonic Weld Testing	5 - 9 May
Radiographic Theory and Interpretation of Weld Radiographs	12 - 16 May
Pressure Equipment Inspection	7 - 11 April 4 - 8 August
Ultrasonic Wall Thickness	27 - 29 May
Surface methods	16 - 20 June 3 - 7 November
Management Appreciation in Non-Destructive Testing	17 July
Welding Defects - Causes Remedies and Inspection	23 October

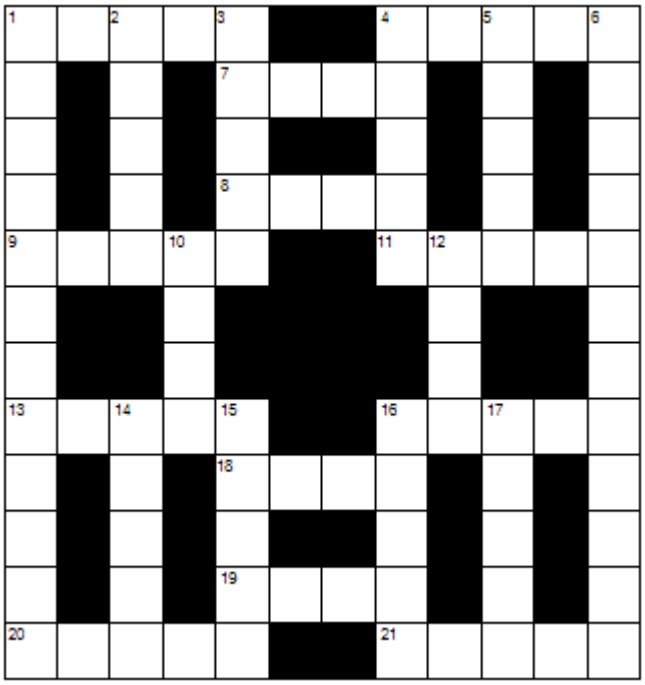
The venue for the above courses and seminars in Auckland is:
HERA House
17 - 19 Gladding Place
Manukau City
South Auckland

Note: Enrolment closes 7 days before start of course or seminar.

To enrol contact:
HERA Training Centre
P O Box 76134
Manukau City
Phone: 09 262 2885
Fax: 09 262 2856
Email: admin@hera.org.nz

For further information about courses and seminars visit www.hera.org.nz and click training centre or contact:
Peter Hayward
Phone: 09 262 4847
Email: peter.hayward@hera.org.nz

Puzzle Place



Answers include abbreviations and acronyms.

Answers can be obtained by email from robin.bain@dol.govt.nz.

ACROSS

1 Inverse of capacitance unit
4 Ornamental head-dress
7 One time
8 Gather from a large amount
9 Fabricate
11 Goodbye
13 Things
16 Brownish yellow
18 Accreditation body
19 Furnace
20 Relaxes
21 Expel

DOWN

1 Remove caffeine
2 Shaving implement
3 Proportional to mass x acceleration
4 Unit of magnetic flux density
5 Excuse
6 Equipment
10 Unit of mass
12 Flat circular object
14 Mischievous mythological beings
15 Fine fabrics
16 O3
17 Dwelling

Answers to Safety Lines Issue 70 Crossword

Across

1 Sequentially
5 Inedible
9 Gas
10 Nut
11 Overland
12 Penguins
13 Nee
14 Een
15 Scruples
18 Spaciousness

Down

1 Sanguineness
2 Urn
3 All
4 Youthfulness
5 Isotopes
6 Eyeliner
7 Brachial
8 Endorses
16 CFC
17 Eon

Disclaimer

Every care is taken in the provision of information in Safety Lines but it is the reader's responsibility to confirm the accuracy of such information against relevant current legislation and approved codes of practice prior to placing reliance on it. The earlier the issue of Safety Lines, the more obviously important this becomes, as legislation and approved codes of practice may change over time.

Nothing in any issue of Safety Lines that contradicts any current legislation or approved code of practice may be relied upon. The Editor would appreciate being notified of any instance of such contradiction in an issue of Safety Lines, which was published after the publication of the current legislation or approved code of practice being contradicted.

For more information about Safety Lines, contact Robin Bain

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