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| Title: | Shell-to-Bottom Leak Check Using Dye Penetrant Product | Agenda Item # 650-2066 |
| Date: | 5/19/2023 | |
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| Purpose: | To align API 650 testing requirements for the shell-to-bottom joint weld (corner weld) with current industry practices | |
| Source: | API 650 13 th Edition Errata 1 Jan. 2021 | |
| Revision: | Rev. 2 in Green Original API 650 Text in Black | |
| Impact: | None. In API 650, only correcting test method and verbiage to align with what is currently done in the industry. | |
| Rationale: | <ul style="list-style-type: none"> • API 650 states Dye Penetrant product as a leak test method on the shell-to-bottom joint is an acceptable option. However, the current application methods are not correct for one option of application. Also, wrong terminology is being used. We should not use the acronym (PT) when using Dye Penetrant products to perform a “thru-leak test method”. • Would like to add testing with dye under the “Pen-Oil” section, due to several colleagues having an issue with creating a new acronym to describe testing with dye products as a “thru-leak” test method. The test method to be used on this joint should only be a “thru-leak” test method. • Also, it should be stated that both solvent type and water washable type dye penetrant products are both made with petroleum (oil) based products. Which means placing dye, used as a leak test method under the “Pen-Oil” section would make sense. • Would like to delete the MT method as an option in section 7.2.4.1. But keep MT and PT as an option in 7.2.4.3. By keeping the MT and PT test methods in sec. 7.2.4.3, this would continue to give maximum flexibility in welding sequencing. In unusual cases/circumstances where someone wanted to apply the outside weld first and/or the Purchaser/Owner does not allow diesel testing or testing with oil-based products. • Adding temperature requirements for both diesel and dye use. Diesel typically begins to gel/stiffen at below 10°F, however low-quality fuels may begin to gel/stiffen at or prolong freezing temperature of 32°F. So, this is the reason for a range of use without pre-heat beginning at 33°F for diesel. | |
| Current document: | | |
| API 650 | See sections 7.2.4 & Annex T | |

Proposed document:

API 650

Add and delete as shown into API 650-----

7.2.4 Shell-to-Bottom Welds

7.2.4.1 The initial weld pass inside the shell shall have all slag and non-metals removed from the surface of the weld and then examined for its entire circumference ~~both~~ visually. ~~and by one of the methods to be agreed to by Purchaser and the Manufacturer.~~ Next, the completed weld pass inside the shell shall have be examined for its entire circumference both visually, and by one of the methods to be agreed to by Purchaser and the Manufacturer. ~~If method "a or b" is applied, either inside or outside weld may be deposited first. If method b, c, d, or e is applied, the inside weld shall be deposited first:~~

- ~~a) magnetic particle (MT);~~
- ~~b) applying a solvent liquid penetrant to the weld and then applying a developer to the gap between the shell and the bottom and examining for leaks after a minimum dwell time of one hour;~~
- ~~c) applying a water soluble liquid penetrant to either side of the joint and then applying a developer to the other side of the joint and examining for leaks after a minimum dwell time of one hour.~~
- a) (Pen-Oil); Applying a high flash-point penetrating oil such as light diesel to the gap, (un-welded side) between the shell and the bottom, letting stand for at least four hours, and examining the weld for evidence of wicking. When using the light diesel method, the base material surface temperature shall be between 1°C (33°F) and 52°C (125°F), unless the light diesel is proven to work at temperatures outside these limits.

Or as an alternative, applying a solvent or water-soluble liquid penetrant dye to gap, (un-welded side) between the shell and the bottom, then applying developer to the welded side of the joint and examining for leaks after a minimum dwell time of one hour. When using this alternative method, of using dye products to test the joint, the base material surface temperature shall be between 4°C (40°F) and 52°C (125°F), unless the dye product is proven to work at temperatures outside these limits, either by testing or Manufacturer's recommendations.

Note: In both cases (light diesel or dye products) local heating or cooling is permitted as long as the base material and weld surface temperature remains in the ranges as stated above, throughout the examination.

Note: Residual oil or dye may remain on the surfaces yet to be welded even after the cleaning required below and contamination of the subsequent weld is possible.

- b) **Vacuum box (VB);** Applying a bubble-forming solution to the weld, using a right-angle vacuum box, and examining for bubbles.

Thoroughly clean all residual examination materials from the as yet welded surfaces and from the unwelded gap between the shell and bottom. Remove defective weld segments and reweld as required. Reexamine the repaired welds and a minimum of 150mm (6 in.) to either side in the manner described above. Repeat this clean-remove-repair-examine-and-clean process until there is no evidence of leaking. Complete all welding passes of the joint both inside and outside the shell. Visually examine the finished weld surfaces of the joint both inside and outside the shell for the entire circumference.

Annex T
(Informative)

NDE Requirements Summary

| Process | Welds Requiring Inspection | Reference Section |
|---------------|--|---------------------|
| MT | First pass of the internal shell-to-bottom weld unless examined by penetrating oil or PT or VB. Not required if the final weld is tested by pressure (see 7.2.4.2), or if agreed to by Purchaser and the final weld is tested by MT, PT, or VB. | 7.2.4.1a |

| Process | Welds Requiring Inspection | Reference Section |
|----------|---|---|
| Pen. Oil | First Completed pass of the internal shell-to-bottom weld if approved instead of MT, VB, or PT . Not required if the final weld is tested by pressure (see 7.2.4.2), or if agreed to by Purchaser and the final weld is tested by MT, PT, or VB. (See 7.2.4.3) | 7.2.4.1a 7.2.4.2 7.2.4.3 |

| Process | Welds Requiring Inspection | Reference Section |
|---------------|---|--------------------------|
| PT | First pass of the internal shell-to-bottom weld if approved instead of MT. | 7.2.4.1b or c |

| Process | Welds Requiring Inspection | Reference Section |
|---------|--|---|
| VB | First Completed pass of the internal shell-to-bottom weld if approved instead of MT, PT, or Pen- Oil. Not required if the final weld is tested by pressure (see 7.2.4.2), or if agreed to by Purchaser and the final weld is tested by MT, PT, or VB. (See 7.2.4.3) | 7.2.4.1b 7.2.4.2 7.2.4.3 |

Definitions:

- MT** = Magnetic Particle Examination
- Pen-Oil** = Penetrating Oil/**Dye** Test
- PT** = Liquid Penetrant Examination (**Surface Examination**)
- RT** = Radiographic Testing
- UT** = **Ultrasonic Testing**
- VB** = Vacuum-Box Testing
- VE** = Visual Examination

Acceptance Standards:

MT: ASME Section VIII, Appendix 6 (Paragraphs 6-3, 6-4, 6-5)

PT: ASME Section VIII, Appendix 8, (Paragraphs 8-3, 8-4, 8-5)

RT: ASME Section VIII, Paragraph UW-51(b)

Tracer Gas: API Std. 650, Section 8.6.11.b

UT: For welds examined by UT in lieu of RT, acceptance standards are in Annex U.6.6 For UT when RT is used for the requirements of 7.3.2.1, the acceptance standard is as agreed upon by the Manufacturer and Purchaser.

VB: API Std. 650, Section 8.6.9

VE: API Std. 650, Section 8.5.2

Pen-Oil: No evidence of wicking or thru-leaks allowed.

Examiner Qualifications:

MT: API Std. 650, Section 8.2.3

PT: API Std. 650, Section 8.4.3

RT: ASNT SNT-TC-1A or ISO Std. 9712 Level II or III. Level-I personnel may be used under the supervision of a Level II or Level III with a written procedure in accordance with ASME Section V, Article 2.

Tracer Gas: None

UT: For welds examined by UT in lieu of RT, the examiner must be ASNT-TC-1A, CP-189, or ISO Std. 9712 Level II or Level III per API Std. 650 Annex U.4.1. For UT when RT is used for the requirements of 7.3.2.1, the required qualifications are ASNT-TC-1A or ISO Std. 9712 Level II or Level III. A Level I may be used with restrictions, see API Std. 650, Section 8.3.2.

VE: API Std. 650, Section 8.5.1

VB: API Std. 650, Section 8.6.4

Pen-Oil: None (Competent personnel)

Procedure Requirements:

MT: ASME Section V, Article 7

PT: ASME Section V, Article 6

RT: A procedure is not required. However, the examination method must comply with ASME Section V, Article 2.

Acceptance standards shall be in accordance with ASME Section VIII, Paragraph UW-51(b)

UT: For ~~Shell~~ welds examined by UT in lieu of RT, ASME Section V, Article 4 and API Std. 650 Annex U.3.5. For welds when RT is used for the requirements of 7.3.2.1, ASME Section V.

VB: API Std. 650, Sections 8.6.2, 8.6.5, 8.6.6, 8.6.7, and 8.6.8

VE: None

Tracer Gas: API Std. 650, Section 8.6.11.a

Pen-Oil: API Std. 650, Section 7.2.4.1.a