

Title:	Shell-to-Bottom Leak Check Using Dye Penetrant Product		Agenda Item # 650-2066
Date:	Original - 5/19/2023 Rev. 6 Date: 11/19/2024		
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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, Rev. 3 in Blue, Rev. 4 in orange, Rev. 5 in Red, Rev. 6 in purple Original API 650 Text in Black		
Impact:	<p>Substantial Minimal Impact:</p> <ul style="list-style-type: none"> • Additional test added. Both Either the initial and/or final weld pass (internal side) to be tested. • Add temperature ranges allowed for both diesel and dye. • Add required visual qualifications for examiners 		
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. • Straw Poll results during May 2024 Spring Committee meeting reflected overwhelming support to test both the initial and final pass of the internal shell-to-bottom joint. There are compelling reasons to test both the initial and final weld pass on the “service side” (internal side of the joint). First it is obviously a good choice to test the initial pass to ensure no defects such as cracks are being welded over while completing the fillet weld. However, if anyone has tested enough of these joints, they would eventually find that after a successful test of the initial test, there are times that the final/completed weld can have a leak path. That is why I feel the final “service-side” (internal) weld should also be tested. I would ask, at what point in the welding sequence are bottom seams, Shell seams, floating roof seams, cone roof seams, pontoon seams, nozzles/manways tested? These seams/joints, and All other seams/joints are tested or examined after welding is completed or the “final” weld is applied and cleaned off. The final weld internal of the shell-to-bottom should be no different than the previously mentioned weld seams/joints. • Standardized hold time no matter if diesel or dye is used as leak test method, to 4-hours minimum (preferably held overnight) for using either method. This was strongly recommended by several committee members. • Due to less than 100% support to test <u>both the initial and final pass</u>, it has been purposed that we allow the contractor (with agreement of Purchaser), to test “<u>Either</u>” the initial <u>or</u> final weld pass on the Internal shell-to-bottom joint. I believe this is a good bipartisan agreement that will provide good, adequate testing of the joint. • Removing verbiage that would have allowed light diesel or dye to be used outside the stated temperature ranges. • Impact rating is lowered to minimal, due to only one test is required, just like before. • Due to straw poll results, in Fall (Dallas) meeting, it is agreed to change back to only testing the initial pass on the internal side of the joint by leak testing. • Due to changes to 7.2.4 section, 7.3.4 revised to reflect changes, which in turn also required changes to Annex T. 		

<p>Current document:</p> <p>API 650</p>	<p>See sections 7.2.4 & Annex T</p>
<p>Proposed document:</p> <p>API 650</p>	<p>Add and delete as shown into API 650-----</p> <p>7.2.4 Shell-to-Bottom Welds</p> <p>7.2.4.1 Both The initial and final weld pass inside the shell shall have all slag and non-metals removed from the surface of the weld and Either The initial or final weld pass inside the shell shall then be examined for its entire circumference both visually, and by one of the following methods below to be agreed to by Purchaser and the Manufacturer. If method "a" 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:</p> <p>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, (preferably held overnight) and examining the opposite welded side for evidence of wicking. When using the light diesel method, the base material surface temperature, and the light diesel or other high flash-point penetrating oil, shall be between 1°C (33°F) and 52°C (125°F), unless the high flash-point penetrating oil is proven known to work at temperatures outside these limits. light diesel is proven to work at temperatures outside these limits.</p> <p>Or as an alternative to light diesel, 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 four hours, (preferably held overnight). When using this alternative method, of using dye products to test the joint, the base material surface temperature, and the dye materials shall be between 4°C (40°F) and 52°C (125°F), unless the dye product is proven known to work at temperatures outside these limits, either by testing or Dye Manufacturer's recommendations.</p> <p>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.</p> <p>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. Staining or residual from oil, diesel, or dye need only be cleaned to the extent necessary in order that a sound weld can be deposited.</p> <p>b) Vacuum box (VB); Applying a bubble-forming solution to the weld, using a right-angle vacuum box, and examining for bubbles.</p> <p>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.</p> <p>b) Vacuum box (VB); Applying a bubble-forming solution to the weld, using a right-angle vacuum box, and examining for bubbles.</p>

7.3.4 Examination and Testing of Sump Welds

Welds of sumps shall be examined visually for any potential defects and leaks. This examination shall be performed before installation and may be conducted in either shop or field. Visual examination acceptance and repair criteria are specified in 8.5. In addition, all welds shall be leak tested by one or any combination of the following methods.

- 1) Vacuum box in accordance with 8.6 utilizing an appropriate size and shape vacuum box.
- 2) Pressurized solution film test treating the sump as a small tank in accordance with J.4.2.2.
- 3) Penetrating oil/dye testing per 7.2.4.1.d) a).
- 4) Liquid penetrant testing with no indications per 7.2.4.1.e) 8.4.

Annex T
(Informative)
NDE Requirements Summary

Process	Welds Requiring Inspection	Reference Section
Air Test	Pressurized solution film test treating completed sump welds as a small tank in accordance with J.4.2.2. Not required if completed Sump welds are VB, PT, or Pen oil tested.	7.3.4

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 Both The initial and completed final 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
Pen. Oil	Penetrating oil/dye testing of completed Sump welds per 7.2.4.1.a). Not required if completed Sump welds are VB, PT, or Air-Test per J.4.2.2	7.3.4

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
PT	Liquid penetrant testing with no indications of completed Sump welds per 8.4. Not required if completed Sump welds are VB, Pen-Oil, or Air-Test per J.4.2.2	7.3.4

Process	Welds Requiring Inspection	Reference Section
VB	First Completed Both Either The initial and or completed final 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
VB	Vacuum Box in accordance with 8.6 utilizing an appropriate size and shape vacuum box, all completed Sump welds. Not required if completed Sump welds are PT, Pen-Oil, or Air-Test per J.4.2.2	7.3.4

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~~) for application of materials.**
Examiner to meet the following - API Std. 650, Section 8.5.1

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

For Committee Review Only