Where do Tank Owners go Wrong Using/Mis-using/Not Using SP031

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What is SP031?

- Standard for Repair of Shop Fabricated Aboveground Tanks for Storage of Flammable and Combustible Liquids
- It is intended to offer a process of repairing damage that occurs to shop built tanks
- This damage is often found during inspections
- Properly applied it can help address issues with the tank construction certification
- It does not address all forms of tank damage
- SP031 is not the only option, but it is usually the best option for UL listed shop built tanks

What gets Misunderstood with Repairs of shop-built tanks

- Not understanding the effects repairs may have on the tank certification process
- Failure to fully inspect the tank to identify all the issues the tank has
- Trying to repair damage, or a tank, outside the scope of SP031
- Not understanding the limits of repairs allowed in certain areas
- Failing to properly document and test repair
- Not getting a statement of suitability for use after the repair

Origin of SP031

- Followed the inspection standard SP001
- The original version came out in 2005 and was based heavily on the API 653 standard, which covers API 650 tanks
- Created by the shop-built tank industry to support the products they built, especially the designs that are not part of API 650
- Previously repairs were done using the API standards and good steel fabrication practice
- Due to costs associated with repairs it was only done to larger tanks, for smaller tanks replacement was the norm

AST Design Requirement per Fire code

- Per IFC: 5704.2.7 Design, fabrication and construction requirements for tanks. The design, fabrication and construction of tanks shall comply with NFPA 30. Each tank shall bear a permanent nameplate or marking indicating the standard used as the basis of design.
- Per NFPA 30: 21.4.2.1.1 Atmospheric tanks (storing flammable and combustible liquids) shall be designed and constructed in accordance with recognized engineering standards.

Tank Construction Requirements

- The tank storing the regulated liquid must be built and installed with the intent of storing the material being stored
- The tank owner must be able to provide documentation to the satisfaction of the AHJ to establish suitability.
- New tanks carry a certification tag (and have supporting documents) that say what the tank is intended to do
- Existing tanks should have a listing label and some supporting documentation, 3rd party inspection report

Shop built tanks

- Shop built tanks are built to a recognized standard at a dedicated fabrication facility
  - UL 80, 142, 142A, 2080, 2085
  - API 12 series or 650 Appendix J
- These shop facilities utilize equipment and techniques that are specific to the industry and are intended to allow for efficient construction, but can also make repairs challenging.
- The certification tags are placed by the builder and applies to the day of tank construction

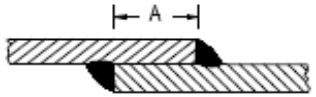
Figure 6.1
Shell joints

NO. 1

Double–welded U, V, bevel, or square groove butt joint.

NO. 2

Full penetration and complete fusion.



NO. 3

Double–welded full fillet lap joint, or single–welded full fillet lap joint on outside with 1–inch (25.4–mm) intermittent weld spaced not over 12 inches (0.3 m) on inside; minimum overlap, "A" – 1/2 inch (12.7 mm) for tank diameters 48 inches (1.2 m) or less, 3/4 inch (19.1 mm) for tank diameters over 48 inches (1.2 m).

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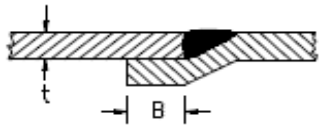
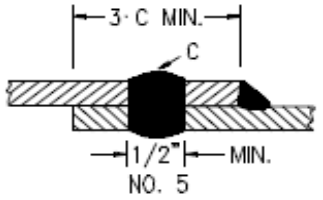


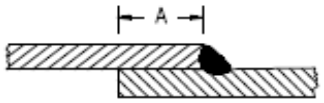
NO. 4

Groove weld equivalent in thickness to "t"; full penetration and complete fusion; minimum overlap, "B" – 1/2 inch (12.7 mm).



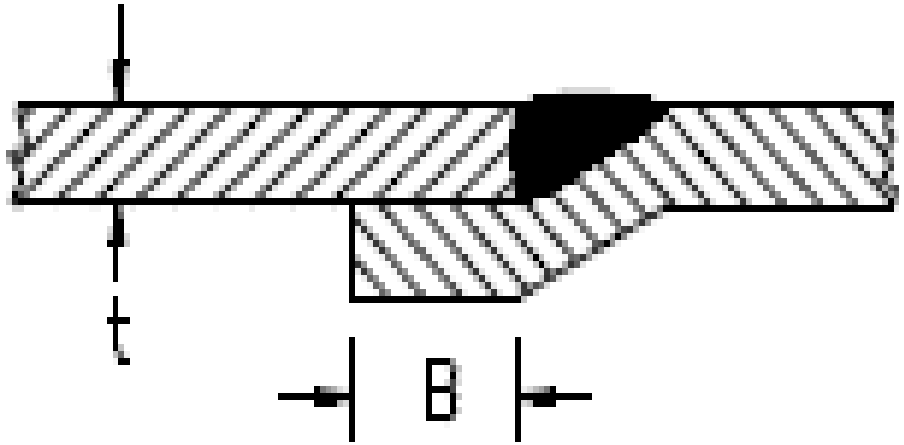
NO. 5

Full fillet weld on outside; "C" is 1/2 inch (12.7 mm) minimum diameter lock weld spaced not over 12 inches.



NO. 6

Single–welded full fillet lap joint; minimum overlap, "A" – 1/2 inch (12.7 mm) for tank diameters 48 inches (1.2 m) or less, 3/4 inch (19.1 mm) for tank diameters over 48 inches (1.2 m). This joint shall not be used on tanks with a diameter greater than 65 inches (1.65 m) unless it is used on the shell of the secondary containment tank where the secondary containment shell is in direct contact with the primary tank.



NO. 4

Groove weld equivalent in thickness to "t"; full penetration and complete fusion; minimum overlap, "B" – 1/2 inch (12.7 mm).

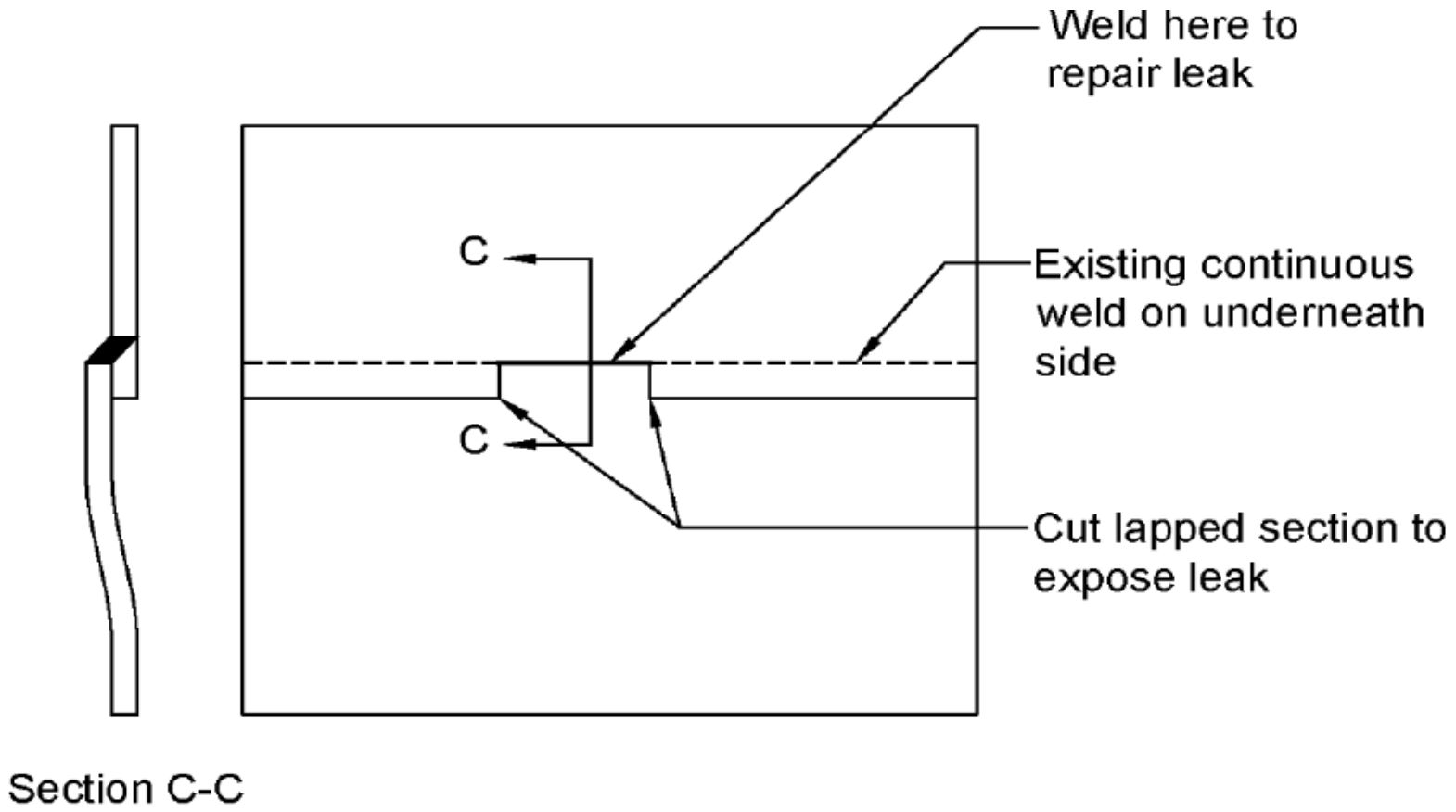


FIGURE 7.1.3.4 A
LAP WELD REPAIR 1

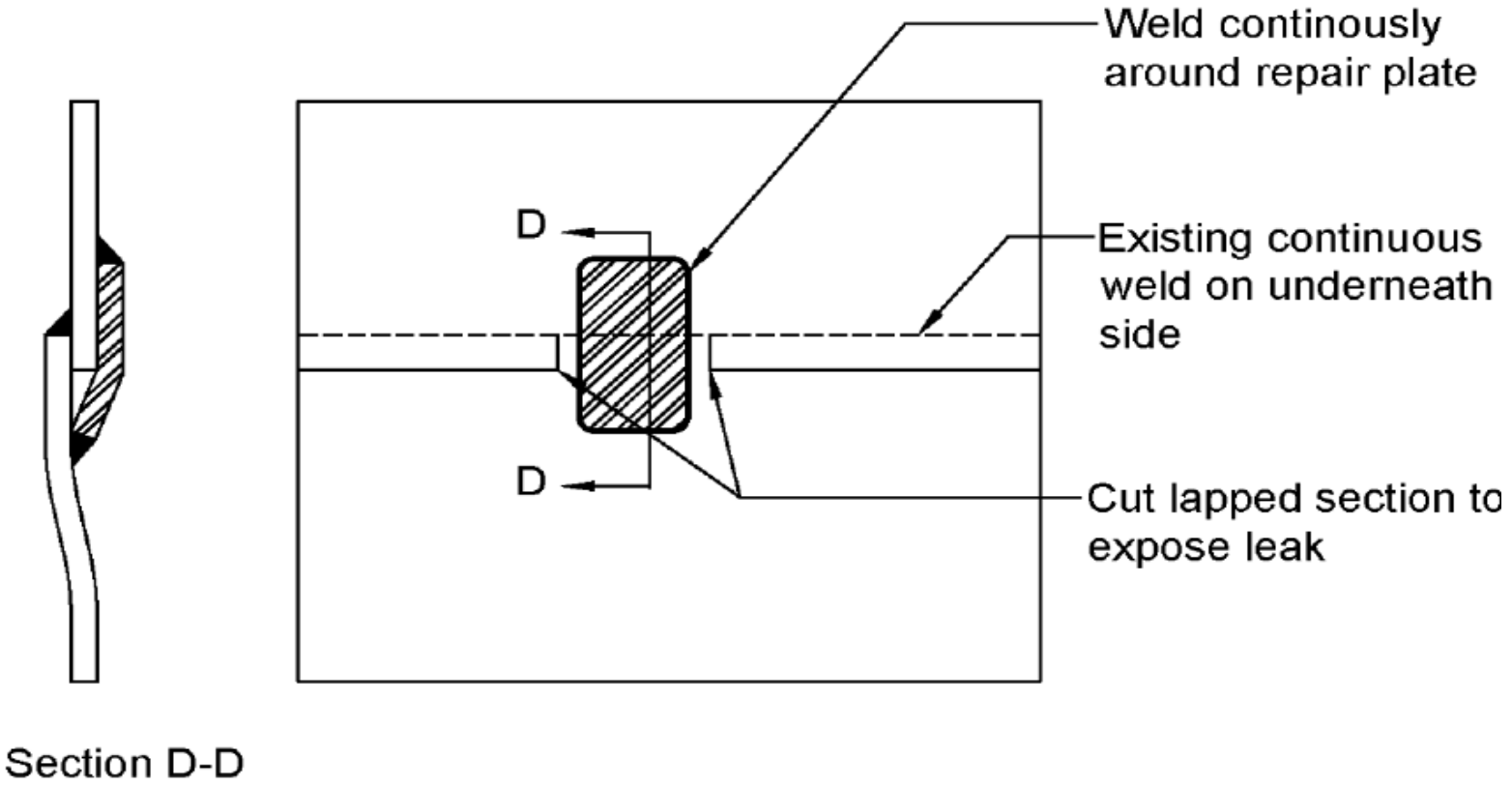


FIGURE 7.1.3.4 B
LAP WELD REPAIR 2

Third Party Listing Options for Storage Tanks

- Underwriters Laboratory (UL) certification
- Underwriters Laboratory of Canada (ULc)
- Southwest Research Institute (SwRI) certifications
- API certification
- ASME certification
- PE certification of specialty vessels
- Manufacturer Qualification of Vessel

Changes to a certified tank

- Any modifications or changes made to the shell of the tank can affect the status of the original certification
- Manufactures can, in theory, make repairs and changes to tanks they built and maintain certification, to a point.
- Any modifications to a tank after the tank is put in service tank must be done in accordance with good engineering practice and must be accompanied by proper documentation to the satisfaction of the AHJ

Tanks that may not be possible to fix/modify

- UL 80 tanks, these are generally not repairable
- Protected/insulated tanks (UL 2080, 2085) as their design is specific to the UL file and only the manufacturer has access to the necessary information to repair one
- Concrete Encased ASTs : These are usually protected tanks so only the original manufacturer could make change
- Non metallic tanks, see manufacturer

API Tanks

- API tanks are built to a published standard
- The tank builders must follow the standard, which includes qualifications of fabricators, materials to be used and standard of construction
- The tank will carry and API certification plate that can confirm original construction
- An API certified individual must over see construction and establish the tank meets the API standard
- A final report is prepared after the repair or modification to document what is done to confirm tank is suitable for use
- API has inspection and repair procedures for their tank designs

UL Listed Tanks

- UL has construction standard for various tanks
- Tank builder must follow construction standards and use approved procedures
- UL also performs 3rd party certification for tank builders
- UL standards applies only to new tanks and new tank manufacturers
- UL does not have an inspection or repair standard (Ulc* has a repair standard)
- UL will, for a fee, do a field recertification, but will also base inspection on original construction standard.

*Ulc 676 STANDARD FOR REFURBISHING OF STORAGE TANKS FOR FLAMMABLE AND COMBUSTIBLE LIQUIDS

Where do folks go wrong with SP031?

- Failure to fully assess the tank prior to making repair
  - Not identifying all damage on tank
  - Repair cost exceeding the cost of the tank
- Trying to repair damage beyond the scope of the standard
- Failure to properly document repairs
- Failure to comply with local regulations
- Using the standard on a tank not covered by the standard

SP031 is intended to address “ordinary” damage and modifications

- Address damage from corrosion, both exterior or interior
- Minor physical shell damage
- Minor shell replacement/patching
- Bottom/end replacement to address repairs at formed flange (knuckle)
- Allow for minor modification to meet changes in operation

SP031 is not intended to address "Extraordinary Damage"

- Things considered "other" damage per SP001 (10.3.6.2)
  - Fire damage
  - Natural Disaster
  - Excess Settlement
  - Overpressure
  - Damage from cracking in steel
- Significant physical modifications of tank
  - Increase in tank size
  - Reuse of a tank for purpose other then original intent

Other Extraordinary Damage

- Physical Damage
  - Collision during shipping/relocation
  - Mishandling tank
  - Vehicle Collision damage
  - Tank testing mishap
  - Other

- These issues may be addressed by the tank builder or a Professional Engineer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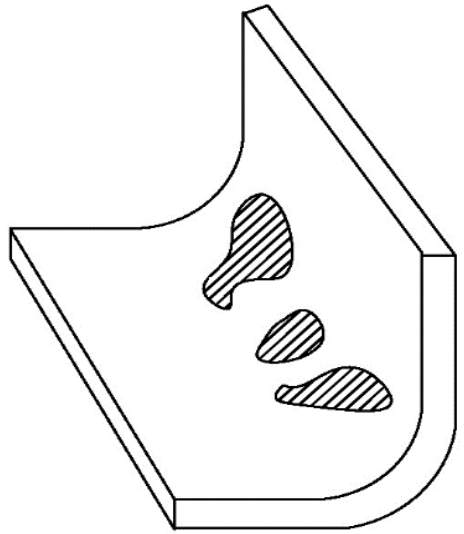
Inspection Before Repair

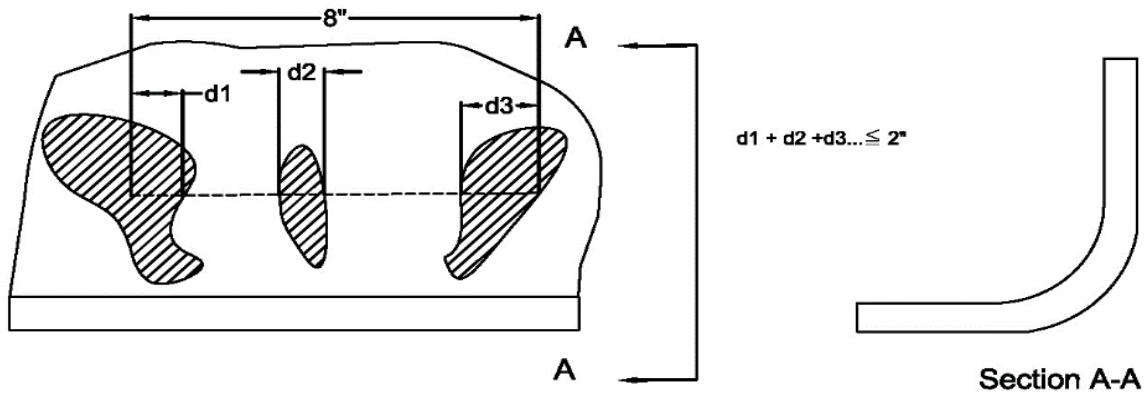
- The need for repair is usually identified during an inspection
- The Inspector should inspect the entire tank and identify all items that require repair
- This way the full scope of repair can be identified and effected
- One of the large costs of repair can be getting the tank ready for repair
- Must establish the tank construction standard so the proper repair standard is selected (AST Record)

Repair at Tank Knuckle

- Shop built tanks use a formed flange on the tank end
- Bending in the flange induces some stresses in the tank end as the flange is formed
- Doing excessive repairs, cutting, welding, in that area can affect the plate strength
- Limited to 2 inches of repair for each 8 inches of knuckle area
- Knuckle extends from 3” in each direction
- If the knuckle area damage exceeds that limit the bottom/end must be replaced

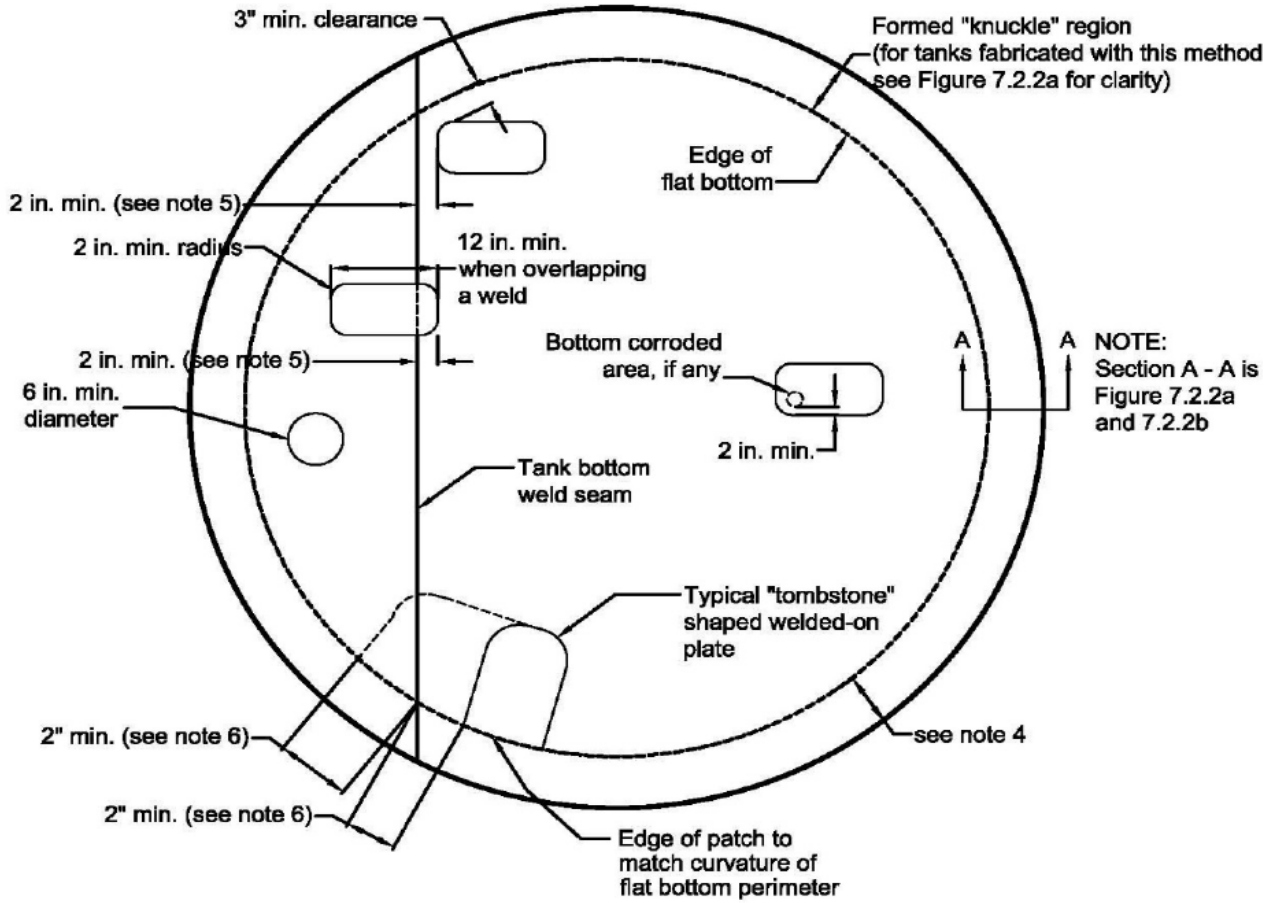
Knuckle Area





Tank Shell Repairs

- Most repairs involve addressing corrosion
- Repair by welding, patching or material replacement
- Welder must be properly certified
- A certified welder will use the proper welding technique and materials
- Material used must be compatible with the tank
- There are setbacks to place patches near seams
- There are minimum sizes and shapes for patches, generally 6” is the smallest patch, the corners are generally rounded, or “tombstone”



NOTES:

1. Dimensions are given from toe of fillet welds or to centerline of butt-weld.
2. Dimensions apply to existing, new and new-to-existing welds.
3. These rules apply to lap-welded and butt-welded bottoms.
4. Welded patches are not permitted in formed knuckle region.
5. When the edge of a weld-on patch plate is approximately parallel to a bottom seam, the edge shall be a minimum of 2 inches from the bottom weld seam.
6. Edge of "tombstone" plate must be 2 in. min. from edge of tank bottom weld. Therefore, if the plate is placed closer than 2 inches from weld, the plate must overlap the weld as shown by the dotted line.

Testing after Repair

- The tank repair plan should included anticipated testing
- Visual inspection of repair
- Tank repairs must be tested, several options available
- If the repair is considered “Significant” then do an integrity test per original tank construction standard of the entire tank (pressure test, vacuum test on double wall)
  - STI document R912 should work for most UL 142 listed tanks
- Document all tests and results

TABLE 8.3
USE OF TESTING METHODS

Type or description of repair	Required Test methods	Notes
Bottom weld patch	VB	
Shell to bottom weld	DPT, H, or PT	
Bottom patch plate	DPT, P, H, PT or VB	
Shell spot weld	DPT, P, H, or PT	No PT if coating covers weld, or inside and not accessible
Shell patch	DPT, P, H, or PT	No PT if coating covers weld, or inside and not accessible
Shell penetration	DPT, P, H, or PT	No PT if coating covers weld, or inside and not accessible
Horizontal tank head penetration	DPT, P, H, or PT	No PT if coating covers weld, or inside and not accessible
Horizontal tank shell to head joint	DPT, P, H, or PT	
Roof patch	DPT, P, or PT	No PT if coating covers weld, or inside and not accessible
Roof penetration	DPT, P, or PT	No PT if coating covers weld, or inside and not accessible
Primary bottom	DPT, P, H, VC, G, or VB	
Full double bottom system	VC, P, G, or DPT	
Roof, shell, or bottom seams	DPT, P, H, VC, or VB	
Bottom replacement	DPT, P, H, VC, G, or VB	
Insert plate	DPT, P, H, VC, or PT	
Reinforcing plate	D & T, or DPT	
Addition of sump - visible	DPT, P, H, or PT	
Addition of sump - not visible	DPT, P, H, or PT	
Double-wall interstitial	P, VC, or G	
Support replacement	DPT or PT	

NOTE: Visual examination of all repairs and modifications is required. See paragraph 8.2.

D & T – Drill and Tap
DPT – Dye Penetrant Testing
G – Tracer Gas
H – Hydrostatic
P – Pneumatic Pressure Test
PT – Highly Penetrating Oil Test
VB – Vacuum Box
VC – Vacuum Test

Documentation after Repair

- Should have original inspection with findings that triggered repair or description of modification
- Identify the original tank certification (AST Record)
- Modification or Repair Report from SP031
- Summary of all repairs with results of Inspections
- Certifications of parties involved
- Results of any testing
- Depending on circumstances there must be an updated inspection report that includes a determination of suitability of service
  - May include an updated AST record form
- Any approvals required by AHJ

Final Inspection Form (Appendix B)

Steel Tank Institute SP031

Date _____

Modification or Repair Report

OWNER INFORMATION

Name	Address	Phone

FACILITY INFORMATION

Name	Address	Phone

REPAIR PERSONNEL

Name	Address	Phone	Signature	Qualifications
			_____	o Tank manufacturer o Other _ o ASME welder o AWS welder

INSPECTION PERSONNEL

Name	Address	Phone	Signature	Qualifications
			_____	o Tank manufacturer o Other __ o STI SP001 Inspector No._____ o API 653 Inspector No._____

TANK INFORMATION

Standard of Construction	Tank No._____ Regulatory ID number (if applicable) _____ _____	Type of Construction
o UL Standard _____ o SwRI Standard _____ o API Standard _____ o Other _____		o Horizontal o Rectangular o Single wall o Other _____ o Vertical o Double bottom o Double wall _____

Capacity	Substance stored	Special construction notes
_____	_____	_____

TYPE OF MODIFICATION PERFORMED (indicate all applicable items)

o New piping connection, size _____ o Fitting removal, size o New manway, size

o Second bottom Knuckle type bottom? o Yes o No

Notes:

_____

_____

_____

TYPE OF REPAIR PERFORMED (indicate all applicable items)

o Crack or weld repair o Lap patch

o Head or bottom Knuckle type? o Yes o No

Notes:

_____

_____

_____

TESTING OF REPAIR OR MODIFICATION (indicate all applicable items)

Test method(s)

o Visual o Drill and tap (D & T) o Liquid penetrant (DPT) o Helium tracer gas (G) o Hydrostatic (H) o Pneumatic pressure

o Highly penetrating oil (PT) o Vacuum Box (VB) o Vacuum (VC) o Other _____

Significant repair? o Yes o No Notes: _____

_____

_____

- Attach sketches, photographs, and testing reports. This record shall be kept by the tank owner for the life of the tank.

Questions?

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224-286-6469


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