# INLAND TANK BARGE INSPECTION AND REPAIR GUIDELINES

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## INLAND TANK BARGE INSPECTION AND REPAIR GUIDELINES

NVIC 7-68 is the Coast Guard's standard for gauging, allowable wastage, and determining the need for structural renewal. ABS Rules and MSM Volume II provide additional guidance.

#### 1.0 Allowable Repair Section

The following is a guide for the structural repair of lakes, bays, sounds (L/B/S) and river tank barges, 300' and less in length. It was originally developed by MSD Baton Rouge from inspector experience and reflects common repair practice. It has been modified based on input from supervisors and inspectors at MSO New Orleans. It is intended to promote safe, consistent repairs. It is not intended to preempt a marine inspector's judgment, experience, or responsibility. Feedback is encouraged!

It must be stressed that each inspection and repair is unique and will not look exactly like one of the figures shown in this guide. In many cases there will be damage resembling a combination of several of the examples shown and may be accompanied by wastage as well. Therefore, no one should expect to use this as a simple cookbook. This should neither bind industry to use these repairs nor bind the Coast Guard to always accept these repairs or rules. In all cases the ONUS is with industry to propose a safe and acceptable repair.

This guide shows typical conditions found in various areas of a barge and some common acceptable repairs. See both the text and the figures for specific guidance. These guidelines assume that the scantlings remain the same and that proper materials that meet the ABS Rules are used.

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#### 2.0 Tank Barge Inspection/Repair Process

In preparation for a drydock, ISE, CTI or major repair inspection, the following sequence may be followed by the Coast Guard and barge owner/operator: The barge owner/operator will conduct a thorough barge survey and prepare a detailed written proposal of requirements for the intended inspection or repairs. The Coast Guard will review the proposal and physically inspect as much of the barge as necessary to determine if the intended work list is adequate to achieve the required inspection of repairs. Upon completion of the agreed upon work, the Coast Guard will verify the repairs without significant changes or additional requirements assuming the original survey/written proposal by the owner/operator was accurate, and issue the appropriate documentation.

#### 3.0 Cargo Tank Internal Examination (CTIE)

The scope of the CTIE exam consists of an examination of the internals of all cargo tanks, including but not limited to framing, piping, sounding devices, closure devices, and all attached appurtenances (MSM 8.B.). For externally framed gravity tank double hull barges in black oil service, only the minimum amount of cargo tank cleaning in order to obtain a marine chemist's certificate endorsed as "safe for entry" is required provided, cargo is stripped to a minimum, Marine Chemist required water blankets are kept to a minimum or removed and for safety the liquid level in the tanks must be below all installed piping systems (cargo and heat coils etc.) in order to prevent tripping hazards.

If, during the physical inspection of the cargo tanks, an isolated area within the tank appears to have a problem, then localized cleaning should be done in order to make a closer inspection. If there are several suspicious areas or problems are widespread within a tank, then thorough cleaning of the cargo tank may be required. A marine chemist or industrial hygienist may require yet further cleaning should hot work be necessary to effect repairs.

#### 4.0 Temporary Repairs On Tank Barges

When there is an occurrence on a tank barge, such as a hull leak to a void tank, which does not render the vessel unseaworthy or create a hazardous condition, the vessel owner/operator may propose short-term temporary repairs. If approved, the temporary repair must be inspected by the local OCMI. An 835 or Permit To Proceed will be issued that defines the operating constraints of the vessel until permanent repairs are effected.

#### 5.0 Minimum Longitudinal Strength & Plate Thickness Requirements

On 8 October 1993, the Coast Guard published a final rule that establishes minimum longitudinal strength and plate thickness requirements for tank vessels that carry oil cargoes. These regulations also established periodic gauging requirements of these vessels after they reach the age of 30 years.

Additionally, the Coast Guard has determined that the "as-required" versus "as-built" minimum section modulus and plate thickness standards in accordance with the current applicable Rules of a recognized classification society (ABS) are an acceptable basis for any evaluation, <u>regardless of the vessel's original construction</u>.

These "as-required" standards are contained in 46 CFR 32.59-1. However, it will still be the responsibility of the vessel operators to prepare appropriate engineering analysis to establish the "as-required" design of their vessels.

## 6.0 Tank Tops and Decks

These members form the upper portion of the longitudinal box girder. They should be checked for wastage caused by corrosive vapors in the cargo tank vapor space, wastage in the heat affected zone around deck pipe penetrations, fractures, tears, buckling, and creases. Plates that pop or are soft when walked on are signs of thinning and broken welds. These conditions are signs of significant weakness and working of the hull and require more in depth inspection and plate renewal. Wastage of underdeck structural members should be spot checked at the CTIE.

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#### 7.0 Hatches

Hatches or manholes to voids are critical to maintaining watertight integrity, preventing downflooding, and preventing internal wastage. They are to be closely checked by light test or chalk test, and their latching mechanism tested. In several cases, voids have flooded when another single void was holed, due to downflooding through hatches that were wasted and couldn't seat and latch. Flush hatches are particularly vulnerable to this. Seating surfaces and latches may be built up and ground, or cropped and renewed.

Water routinely entering through hatches accelerates wastage of structural members, particularly horizontal members. Wastage in way of hatches, including clingage (scaling, sheets of rust) under the bottom corner of cargo tanks on double skin barges, should be checked.

#### 8.0 Cargo Tanks

Cargo tanks should be repaired as original, except as noted for lapped joints. On double skin tank barges, any deflection of the cargo tank or it's immediate supporting structure may require immediate permanent repairs based upon the inspector's overall examination of the affected area. On single skin tank barges, only minor bottom and sideshell set-ins in way of the cargo tanks are permitted, unless specifically addressed in this guide. Cargo/ballast bell mouth waster plates and sounding tube striker plates should be in place and should not be excessively worn.

#### 9.0 Rake Ends

Set-ins in rakes are normal and have little effect on longitudinal strength of the hull. Rakes should be evaluated for -

- \* Watertight integrity and the ability to provide reserve buoyancy;
  - Ability to repeatedly serve as a shock absorbing system to protect the cargo tanks;
- Ability to carry and distribute push/pull/tow/notch loads.
- ¥

Any damage that could result in propogation of a fracture into tank tops, sideshell or bottom plating.

#### 10.0 <u>Bilge Knuckle</u>

Bilge knuckles are highly stressed and are critical to longitudinal and overall strength of the barge. They are typically formed of heavier section than the shell plate. They can only be inspected on drydock, and should be as near to original as possible when coming off-dock. Bilge knuckles should be sighted longitudinally and should be fair, with no radical changes between the rakes. Set-ins in way of the rakes should be evaluated the same as the rest of the rake. Knuckles should be repaired as original; changes in dimensions or materials can create stress risers. Any fracture in the knuckle between the rakes should be further investigated for cause, with overall strength of the barge in mind.

Sharp or deep set-ins of bilge knuckle between the rakes have a notching effect that reduces longitudinal strength and local impact resistance. One "Rule of Thumb" is that the thicker the knuckle is compared to the adjacent plate, the more critical its integrity is. As an example, some double skin tank barges have transversely framed bottoms and heavy bilge knuckle. Bottom longitudinal strength is carried in the knuckle, the bottom plate, and the tank bottom, and set-ins in the radius or bottom of the knuckle can severely reduce longitudinal strength when hogged, racked, or grounded.

The following should be used as guidelines for requiring bilge knuckle renewal:

- Smooth set-ins greater than 1''/1', >2" max depth.
- Sharp set-ins, E.G., > 2.5"/1'.

Obvious loss of radius in either the vertical or horizontal axis due to indentation.

Longitudinal framing, and overscantling knuckle that is verified vs the ABS Rules, should be considered as factors that mitigate the severity of bilge knuckle set-ins.

## 11.0 Floors and Underdeck Frames

Shaped and flanged structural members should be inspected and repaired the same as for other shaped members discussed later. If unflanged, see Figure 1. Horizontal or diagonal crushing or folding under the cargo tanks indicates a loss of shell plate and tank bottom support, and a reduced gap for pinnacle grounding, and should be cropped/renewed/inserted. See Figure 2. Isolated crushing within 4" of the shell may be accepted if there is close frame spacing (24" or less) and the adjacent frames are intact, otherwise, renew. Be sure to check the attaching fillet weld for cracks that may propagate to the shell. Vertical folds under cargo tanks don't affect load carrying ability and don't require repair. Any distortion at frame ends in way of trusses/K-frames/chords

should be cropped and renewed.

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FIGURE 1 UNFLANGED PLATE FLOOR FRAME REPAIR





1. ANGLES MUST NOT EXTEND TO KNUCKLE RADIUS.

2. LAP MAY NOT BE USED IN CARGO TANK BOUNDARIES.

3. CROPPED CORNERS MUST BE RADIUSED.

4. TOP FILLET MUST BE AT LEAST 6" FROM TANK BOTTOM.

5. WELDER QUALIFIED RESTRICTED, OR WELD GREATER THAN 6" FROM BOTTOM.

6. IF BOTTOM PLATE NOT REPLACED, PLATE LAP INSERT OR BUTT MAY BE SCRIBED IN.

7. SAME REPAIR ACCEPTABLE FOR PLATE CVK/CENTERLINE VOID BULKHEAD.

7.

# 12.0 Lapped Plates and Joints

Since the previous figures and many of the repairs to follow permit the use of lapped joints, this section is included to provide some specific guidance on the joining of members and/or plates.

Lapped joints have two (2) disadvantages, compared to a similar full penetration butt joint:

They are not as strong.

In the cargo tank, they complicate gas freeing and finding and repairing leaks.

They also have several advantages, compared to a similar full penetration butt joint:

Fit up is easier and less critical.

Edge preparation isn't necessary.

Less welding skill is required for a sound weld.

They don't require back gouging.

Combined experience has shown that the advantages of a good lap joint can offset their disadvantages and make them suitable in most applications. The joint in Figure 2, used to repair a bottom longitudinal, is an example. A good butt joint in this application requires good fit up, a difficult overhead weld on the underside of the flange, and stress relief at the shell/plate joint. The lapped joint requires virtually no fit up or edge preparation, no stress relief, no difficult welds, and has proven adequate strength in service. While a good full penetration butt joint is always preferred, lapped joints may be adequate in many repair applications.

Lapped joints are not to be used in the cargo tank unless the original joint was lapped. Lapped joints in single skin tank barges develop small cargo leaks that are difficult to locate and repair; whenever possible during repairs on these vessels, replace lapped joints with butt joints, unless the butt repair would produce a less than satisfactory repair.

On all barges, lapped joints may be used in voids and rakes for repairs, and laps do not have to be replaced with butts. Several typical applications are shown in the figures.

Doublers are lapped plates used to restore or increase strength to weak or wasted plate or structural members. Use requires technical approval for permanent repairs, per NVIC 7-68, and isn't allowed in the cargo tank for temporary repairs. Properly installed bell mouth waster plates and rub bars are not doublers.

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Figures 1 through 4 illustrate the application of lapped joints.

## FIGURE 3 PLATE INVERTED ANGLE CLIP OR SPLICE



- 1. MAY BE USED TO CONNECT SHELL PLATE ANGLES WITHOUT BUTT WELDING ANGLES.
- 2. ANGLE CLIP MUST BE FILLET WELDED ALL AROUND TO OTHER ANGLES AND PLATE, AFTER THE PLATE SEAM HAS BEEN WELDED.
- 3. THIS REPAIR MAY NOT BE USED IN THE CARGO TANKS.

## FIGURE 4



- 1. SEE FIGURE 3 ALSO.
- 2. PROPERLY SCRIBED FIT PREFERRED. ONLY INSERT PLATE SHOULD BE USED FOR TENSION LOADS.
- 3. FILLER PLATE MAY BE USED BETWEEN SIDE CHORD AND SIDE LONGS.

#### 13.0 Shell Plate Set-Ins

The severity and need for repair of shell set-ins depends upon location, orientation (transverse/longitudinal), sharpness, size, and framing. Each must be evaluated on a case by case basis. A set-in seen on the outside that may need repair should also be looked at from the inside, to evaluate the effect on the structure inside. They should be evaluated for their effect on overall hull strength, particularly with regard to longitudinal strength and effect on the cargo tank, as well as for their effect on local strength and resistance to further groundings or impacts.

Sharp set-ins are those that are obviously sharp, where the plate forms an angle of less than 135 degrees (2.5" depth/1' span) in any direction, or where the internal attached framing is abruptly tripped. Sharp set-ins should be cropped/renewed/inserted in all cases in the gunwale or shell plate between the rakes, and in the bottom of forward rakes.

If the set-in is smooth (1" deep/1' span, < 4" max depth) it may not require repair. The internal members in way of these set-ins are to be intact and connected and in accordance with the specific guidelines for that type of member.

In the bottom plate between the rakes, the orientation and depth are more critical because of their effect on hull buckling when hogged or grounded. For smooth longitudinally oriented set-ins, apply the 1"/1', <4" rule.

Any transversely or diagonally oriented smooth bottom set-in should be looked for it's potential to buckle the hull, and the orientation and type of internal framing. For longitudinally framed bottoms, apply the 1"/1', < 4" rule across the set-in. For transversely framed bottoms, apply the same rule, and additionally, if the length of the setup exceeds 25% of the beam, crop/renew/insert, regardless. Large round set-ins should be treated the same. Depending on severity, set-in less than 25% of beam may require renewal.

Set-ins in the rakes have no effect on longitudinal strength, and the 1"/1', < 4" rule should be applied.

#### 14.0 <u>Bulkheads</u>

If crushing occurs at the ends of watertight bulkheads, an air test should be required. A water head test to deck level should be required if watertight strength is suspect. Stopwaters should be provided and checked at all lap joints in way of watertight bulkheads. See Figure 6. If crushing or distortion of swash or watertight bulkheads extends more than 4" from the shell, or the crush angle reaches 90°, crop/renew/insert. Bottoms of watertight bulkheads, including the collision bulkhead, may be repaired with a lapped insert if it is not in the cargo tank and is continuously welded on both sides. Similar to Figure 2.

FIGURE 5 WING VOID WATERTIGHT/SWASH BULKHEAD REPAIRS



- WELDING TO SHELL TO BE AS ORIGINAL.
- BUTT/LAP JOINT LOCATION OPTIONAL, EXCEPT AS NOTED. 2.



#### 15.0 Shaped Structural Members

Any bending, twisting, buckling, crushing, or other distortion of shaped or flanged structural members, e.g., angles, channels, I-beams, and pipe stanchions, shall be cropped and renewed unless otherwise specifically allowed by this guide. In general, allowed distortions are located in way of the shell plate in voids and rakes. If distortion is associated with wastage, crop and renew.

With the exception of minor crushing or rolling of side chords shown in Figures 7 and 8, truss/K-truss members are to be free of crushing or distortion. In general, any loss of truss strength is to be avoided. Any distortion of tank or bulkhead panel stiffeners, flanged or unflanged, indicates loss of strength and requires renewal.

See Figure 9 for side chord insert. Figures 10 and 11 show some allowable chord repairs.

Angles and bar stock on edge that serve as shell plate stiffeners, e.g., bottom or side shell angle longs, may have smooth bends associated with smooth plate set-ins/set-ups. See Figure 12. Smooth set-ins, within the limits of acceptable plate set-in, may not require renewal if -

- They stay in their original longitudinal alignment of the member;
- They are connected to the plate;
- \* They don't roll, twist, or buckle;

+

The shaped member's flanges stay in the same orientation to the plate as original, throughout their length.

Isolated, individual bottom plate and side shell plate stiffeners that are rolled or buckled may be accepted on a case-by-case basis if the adjacent members are intact.

No distortion of shaped members, including the smooth bending discussed above, is permitted in members required to support bilge knuckles or gunwales with radius' greater than 12".

# FIGURE 7 DOUBLE SIDE BARGE CRUSHING AT SIDE CHORDS



FIGURE 8 VOID/RAKE SIDE CHORD ROLL 0-15



15' ROLL MEASUREMENT

Y (IN.)

1.0

1.3

1.5

1.8

2.0

2.3

X (IN.)

4

5

6

7

8

9

10 2.6 11 2.8 3.1 12 "ISOLATED" CHORDS ROLLED UP TO 151. WITHOUT TWIST WASTAGE, OR CRUSHING. NEED NO REPAIR. "ISOLATED" MEANS LEAST OF:

**\*NONE CONSECUTIVE** \*NOT MORE THAN 1 PER VOID \*NOT MORE THAN 20% OVERALL **\*NONE IN CARGO TANKS** 

END VIEW

# FIGURE 9 SIDE CHORD INSERTS



SQUARE BUTT

ANGLE BUTT

TIGURE 10 SIDE CHORD ANGLE CLIP



SIDE CHORD ANGLE CLIP, NOT TO BE USED IN CARGO TANK. LIMITED USE ONLY, NOT MORE THAN 10% OF CHORDS AND NOT MORE THAN TWO (2) PER CHORD.

# FIGURE 11 VOID/RAKE SIDE CHORD SET-INS



- 1. IF CHORD IS LOCATED AT A K-FRAME, NO DAMAGE OR DISTORTION, OTHER THAN IN CHORD, IS PERMITTED.
- 2. SEE INDIVIDUAL REPAIR DETAILS.



END VIEW





## 16.0 <u>Clips</u> See Figures 3, 10, 11

Clips are small sections of flat plate, angle, or channel used to connect structural members. Existing clip repairs shall be carefully inspected. If they have failed, crop and renew as original without clip; reinstallation of a failed repair is not acceptable. With the exception of Figure 3, clips shall not be used within the cargo tank.

#### 17.0 <u>Miscellaneous</u>

Corner brackets and tripping brackets should be repaired or renewed if more than 1 is tripped in a local area.

## 18.0 <u>Fractures</u>

Fractures, tears, and cracks require investigation into their cause, and proper permanent repair. The presence of more than 2 previous repair welds in a local section (immediate area) of shell plate, knuckle, corner wrapper, or gunwale indicates that more fractures are likely. The area should be cropped and renewed.

For permanent repairs of impact tears, particularly in rakes and deck knuckles, safe end/V/weld, and evaluate at future ISE/DD. True tension cracks and fractures should be treated on case by case basis, safe end/V/weld if not crop/renew. Rewelding of previously welded fractures and tears is not acceptable.

#### 19.0 <u>Shell Tank Perpendiculars</u>

As shown in Figure 13, angles or channels shall not extend to the shell or tank because of the possibility of rupturing either/both membranes in the event of a set-in/set-up.

#### 20.0 <u>Wear Thinning and Rub Bars/Pads</u>

Wear thinning of side and end shell plate occurs at high friction areas, including rake ends, bulkhead ends, in way of framing, at gunwales, at corner wrappers, at lap joints, at bilge knuckles, and in stern push notches. Coatings are relatively ineffective in these wear areas. If left unchecked, plating is readily susceptible to puncture tears and tensile fractures. Wear thinned areas should be gauged, and if wear exceeds 25%, crop and renew. Rub bars should only be added over sound metal, but their addition should be encouraged. Limited pad welding may also be considered. Rub bars should be tapered to avoid snagging and tearing, and existing rub bars should be checked at the welds for fractures that might propagate into the plate. Rub bars should not be used as doublers to restore structural strength or watertight integrity.

# FIGURE 14 SPIGOT PATCHES

SPIGOT PATCHES MAY BE USED AS DOCKING PLUGS IN VOIDS AND RAKES. USE OF A FLAT LAP PLATE IS NOT ALLOWED. EXISTING SPIGOTS SHOULD BE CHECKED FOR WELD WASHOUT AND FRACTURES IN THE HEAT AFFECTED ZONE. THE FOLLOWING LIMITATIONS MUST BE OBSERVED:

- MUST BE AT LEAST 2' FROM ANY BULKHEAD SEAM OR LAP; 1.
- 2.
- CUTOUT MUST BE AT LEAST 6" DIAMETER; IF LARGER THAN 9" CUTOUT, MUST BE FULL PENETRATION INSERT SHOWN BELOW; 3.
- 4. IN CARGO TANK MUST BE MACHINED AND FULL WELDED FROM BOTH SIDES, AND NDT MUST BE CONDUCTED (UT).









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(MACHINED)

FULL JOINT PENETRATION

FORMED SPIGOT PATCH GENERALLY NOT ACCEPTABLE

#### 21.0 <u>Welding</u>

These guidelines assume the use of welders and weld procedures that meet the ABS Rules for hull welding of tank barges. Repair facilities should be encouraged to develop "standard" weld repair procedures, and qualify all of their welders in these procedures. MSO New Orleans has sent a letter on welding requirements to all repair and construction facilities in the NOLA Inspection Zone.

Welded repairs of watertight or oiltight boundaries shall not be permitted if tank air test pressure remains on the opposite side of the weld, or if the metal is not free of soap and water from previous air testing.

Pad welding of pits in cargo tanks may be conducted if the guidance in ABS Circular 453 is followed. It is not a substitute for plate replacement in badly pitted areas and should not be used for fracture repair. At minimum, it requires a minimum of 0.25" of original material left, at least 3" between pad welding areas, and the maximum diameter of any pad weld is 12".

Welds below the waterline or in contact with corrosive liquids in the cargo tanks are to be checked for adequate caps. Flush or washed out welds shall be cleaned and built up by an accepted procedure.

Fractures shall be repaired per NVIC 7-68. Weld sequence and stress relief shall be per the NVIC, ABS Rules, AWS Guide for Hull Welding, and other recognized references.

"Pick Ups", or isolated broken fillet welds at the connection of structural members or structure to plate, are typically the result of poor welds or impact damage. In most cases, they can be gouged and rewelded.

Only all-position welding rod is to be used unless specifically approved by the OCMI.

#### 22.0 <u>Tow Knees, Bitts, Cavals</u>

Damage must be evaluated for strength under load, the possibility of further damage, watertight integrity, and cargo integrity (if applicable). Damaged supporting structure should be renewed, fractures safe ended and repaired. Tears or fractures that affect watertight integrity may be temporarily repaired until next gasfreeing at the discretion of the inspector. Tears or fractures that affect the cargo tank should be temporarily repaired until the cargo is removed, then permanently repaired before reloading. Permanent repairs should be required prior to return to service if tow, fleeting, or surging while moored could result in complete failure.

# 23.0 <u>Testing of Repairs</u>

All steel repairs should be tested in accordance with NVIC 7-68, the ABS Rules, and 46 CFR. Particular attention should be paid to repairs to the cargo tank and to lapped joints. Welded joints in cargo tanks, in way of structural members (e.g., a butt welded plate seam near the intersection of the CVK and transverse framing) may require RT or MT Inspection.

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