



TECHNICAL CIRCULAR No. 451 of 05th December 2017

To: All Surveyors/Auditors

Applicable to flag: All Flags

General Cargo Ship Inspection 1

Reference: **Hull Survey**

1. Periodical classification surveys

The purpose of carrying out the periodical hull surveys is to detect possible structural defects and damages and to establish the extent of any deterioration. To help achieve this and to identify key locations on the hull structure that might warrant special attention, knowledge of any historical problems of the particular ship or other ships of a similar class is to be considered if available. In addition to the periodical surveys, occasional surveys of damages and repairs are carried out. Records of typical occurrences and chosen solutions should be available in the ship's history file.

- Special Survey
- Annual Survey
- Intermediate survey
- Dry-dock survey
- Damage and repair survey

2. Structural damages and deterioration

Structural damages and deterioration imply deficiencies caused by:

- excessive corrosion
- design faults
- material defects or bad workmanship
- navigation in extreme weather conditions
- loading and unloading procedure
- wear and tear
- contact (with quay side, ice, touching underwater objects, etc.) but not as a direct consequence of accidents such as collisions, groundings and fire/explosions.

Deficiencies are normally recognized as:

1. material wastage
2. fractures
3. deformations

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2.1 Material wastage

In addition to being familiar with typical structural defects likely to be encountered during a survey, it is necessary to be aware of the various forms and possible location of corrosion that may occur to the decks, holds, tanks and other structural elements.

General corrosion appears as a non-protective, friable rust which can occur uniformly on hold or tank internal surfaces that are uncoated. The rust scale continually breaks off, exposing fresh metal to corrosive attack. Thickness loss cannot usually be judged visually until excessive loss has occurred. Failure to remove mill scale during construction of the ship can accelerate corrosion experienced in service. Severe general corrosion in all types of ships, usually characterized by heavy scale accumulation, can lead to extensive steel renewals.

Grooving corrosion is often found in or beside welds, especially in the heat affected zone. The corrosion is caused by the galvanic current generated from the difference of the metallographic structure between the heat affected zone and base metal. Coating of the welds is generally less effective compared to other areas due to rough surfaces which exacerbate the corrosion. The grooving corrosion may lead to stress concentrations and further accelerate the corrosion. Grooving corrosion may be found in the base material where coating has been scratched or the metal itself has been mechanically damaged.

Pitting corrosion is often found in the bottom plating of ballast tanks. If there is a place which is liable to have corrosion due to local breakdown of coating, pitting corrosion starts. Once pitting corrosion starts, it is exacerbated by galvanic current between the pit and other metal.

Erosion which is caused by the effect of liquid and **abrasion** caused by mechanical effect may also be responsible for material wastage.

2.2 Fractures

In most cases fractures are found at locations where stress concentrations occur. Weld defects, flaws, and where lifting fittings used during the construction of the ship are not properly removed are often recognized as areas of stress concentration when fractures are found. If fractures have occurred under repeated stresses which are below the yielding stress, the fractures are called fatigue fractures. In addition to the cyclic stresses caused by wave forces, fatigue fractures are also caused by vibration forces derived from main engine or propeller especially in the afterpart of the hull. If the initiation points of the fractures are not apparent, the structure on the other side of the plating should be examined.

Fractures may not be readily visible due to lack of cleanliness, difficulty of access, poor lighting or compression of the fracture surfaces at the time of inspection. It is therefore important to identify, clean, and closely inspect potential problem areas.

Fracture initiating at latent defects in welding more commonly appear at the beginning or end of a run of welding, or rounding corners at the end of a stiffener, or at an intersection. Special attention should be paid to welding at toes of brackets, cut-outs, and intersections of welds.

Fractures may also be initiated by undercutting the weld in way of stress concentrations. Although now less common, intermittent welding may cause problems because of the introduction of stress concentrations at the ends of each length of weld.

It should be noted that fractures, particularly **fatigue fractures** due to repeated stresses, may lead to serious damage, e.g. a fatigue fracture in a frame may propagate into shell plating and affect the watertight integrity of the hull. In extreme weather conditions the shell fracture could extend further resulting in the loss of part of the shell plating and consequent flooding of cargo hold.

2.3 Deformations

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Deformation of structure is caused by in-plane load, out-of -plane load or combined loads. Such deformation is often identified as local deformation, such as deformation of panel including stiffener, or global deformation; such as deformation of structure including plating, beam, frame, girder, floor, etc. If in the process of the deformation large deformation is caused due to small increase of the load, the process is called buckling.

Deformations are often caused by impact loads/contact and inadvertent overloading. Damages due to **bottom slamming and wave impact forces** are, in general, found in the forward part of the hull, although stern seas (pooping) have resulted in damages in way of the after part of the hull. In the case of **damages due to contact** with other objects, special attention should be drawn to the fact that although damages to the shell plating may look small from the outboard side, in many cases the internal members are heavily damaged.

Permanent buckling may arise because of overloading, overall reduction in thickness due to corrosion, or contact damage. Elastic **buckling** will not be directly obvious but may be detected by coating damage, stress lines or shedding of scale. Buckling damages are often found in webs of web frames or floors. In many cases this is due to corrosion of webs/floors, too wide a spacing of stiffeners or wrongly positioned lightening holes, man-holes or slots in webs/floors. Finally, it should be noted that inadvertent overloading may cause significant damages. In general, however, major causes of damages are associated with excessive corrosion and contact damage.

2.4 Structural detail failures and repairs

If replacement of defective parts must be postponed, the following temporary measures may be acceptable at the surveyor's discretion:

- (a) The affected area may be sandblasted and painted in order to reduce corrosion rate.
- (b) Double may be applied over the affected area. In case of bucking under compression, however, special consideration should be paid.

REFERENCES:

- **CONARINA class**

ATTACHMENTS: No.

Kindest Regards,
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