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To:	All Surveyors
Applicable to flag:	All Flags
Subject:	Rudder and Rudder Posts/Horn Defects
Reference:	CLASS-Dry-dock survey-Rudder

RUDDER AND RUDDER POSTS / HORN DEFECTS

Rudder Horns

Many points on these subjects have been covered from time to time as per these attachments and other discussions. All Surveyors should be familiar with the problems. However, in the interest of keeping the details in the forefront, we are editing this attachment to list defects and problems encountered in the past as a reminder.

The steel castings of stern frame horns have, in a number of cases, been found fractured in the area of the bossing for the lower gudgeon, see sketch. This critical area should be cleaned and examined at close range when examining the vessel in drydock.

Any suspicious surface imperfections should be explored thoroughly with magnetic particle, dye penetrant or ultrasonic method. Suspicious areas may also be chipped out and ground smooth to remove minor surface imperfections. Any findings and the necessary repairs carried out should be reported upon in the report of the drydocking.

Fractures have been found on numerous vessels in way of the rudder horn connection to the shell plating. These fractures may appear in different locations, including inside the rudder trunk and adjacent compartments. These areas are to be closely examined at each drydocking survey.

Semi-Balanced Rudders

Loose pintle nuts and excessive bearing clearances are often encountered. Portable plates on the Rudder for access to the pintle nuts should be removed at each Special Survey for complete examination. These should also be checked at drydocking surveys where both nut, locking devices and spacers, if fitted, should be examined for efficiency. If repairs are carried out, these should be fully reported upon.

The vertical distance of the rudder proper should be determined in relation to the stern frame horn. Should this clearance be found to be less than 1/4 in., corrective measures to the carrier bearing should be taken and the carrier bearing should be examined.

Vessels having a Rudder Post

Fractures have been found, upon examination at close range, in the rudder post casting just above or below the gudgeons. Similar fractures have been found in the rudder frame casting. In some cases the fractures in the rudder post extend from or into the core hole closing plates on after side of the rudder post.

At the regular drydock survey the rudder frame casting and the rudder post casting should be carefully examined at close range for possible fractures. When conditions are suspect, the rudder post casting should be test drilled about 6" above the welded joint to determine if water has entered the rudder post.

Should water be found in the rudder post, the post should be tested to locate the origin of the leakage. If repairs necessitate the removal of the rudder, the pintle clearances as well as the rudder alignment should be carefully checked.

Should water be found in the rudder or fractures found in the vicinity of the rudder frame gudgeons, a portion of the rudder side plating should be removed for examination of the cast rudder frame arms to which the horizontal diaphragms are attached. Particular attention should be directed to the casting at the mid-height of the rudder.

Tapered Rudder Stocks

There have been failures of the locking devices for rudder stock nuts on designs using tapered fit attachment between rudder and rudder stock. Such failures will permit the rudder stock nut to back off, so that the interference at the taper fit between the stock and the rudder is lost, damaging both the keys and tapers, which might lead to serious rudder damage.

In order to try to prevent, insofar as practicable, this type of trouble on vessels having this arrangement in lieu of the bolted palms, the Surveyors should suggest to Owner's representatives that the keeper and the nut should be carefully examined at regular intervals. Should there be indications of failure of the keeper, or a loose fit, it should be removed for inspection, and consideration should be given to additional or possibly more substantial arrangements.

Rudder Pintles

From studies that have been done over the years and a review of survey reports it can be concluded that pintles are without a doubt the main known cause for loss of rudder. In most cases the loss could be attributed to a lost pintle.

It is very important that the tightness of rudder pintles should be determined to the satisfaction of the Surveyor each time a vessel is physically drydocked. Surveyor is to confirm that the locking arrangements are in place and will effectively prevent the nut from becoming slack and thus avoiding loss of the pintle and subsequent loss of the rudder.

In connection with pintle locking devices you are reminded that the arrangements should be such that the pintle cannot work free. In at least one instance, the pintle backed off and left the nut securely held in place by a clip welded to the rudder frame casting. It is essential that the nut be positively secured to preclude "turning" of the pintle.

In view of these casualties, it is recommended that, when a pintle is found loose or is withdrawn for any other reason, it be examined by magnetic particle or other suitable method, particularly adjacent to the sleeve and between the threads and the small end of the taper. In the course of a drydock survey the condition of the pintle bushings, sleeves, nuts, and locking devices should be carefully examined as far as is practicable. The discovery of a loose pintle would, for example, justify its removal for further examination and verification of proper fit.

When replacing pintles ensure that the pintle tapers are firmly seated in the gudgeons with sufficient contact, say at least 65%, and particularly at the big end. Wastage can be built-up by properly controlled welding procedures. Alternatively, certain approved bedding compounds may be acceptable, subject to approval of Conarina Technical Office.

Twisted Rudder Stocks

The following general advice can be given with regard to twisted rudder stocks:

A. When a rudder stock is twisted the extent of the repair will depend on the following parameter:

   < = angle of twist in degrees
   L = length of stock over which the twist appears uniform
   d = diameter of twisted portion of stock

B. When < is less than or equal to 5L/d the stock may be accepted for further service without any form of heat treatment provided the Surveyor is satisfied by visual and magnetic particle examination that the stock is free from surface cracks or other significant defects.

C. When < is greater than 5L/d the stock is to be removed and given either a full annealing or normalizing heat treatment. A suitable temperature range for either of these treatments is 860 to 900C then a soaking period of not less than 30 minutes per 25 mm of diameter. For full annealing the stock is to be cooled slowly in the furnace, while for normalizing it is to be cooled in air.

D. The furnace used for the heat treatment required by (C) should be large enough to take the entire stock and should be properly equipped with means for temperature measurement and control.

E. Where necessary a new keyway is to be cut and weld repairs are to be carried out in accordance with an approved procedure and, where possible, should be completed prior to the heat treatment required by (C).

F. On completion of heat treatment the surfaces of the portion of the stock affected by

twisting are to be suitably cleaned and examined by magnetic particle methods.

G. Subject to satisfactory results from magnetic particle examination and to compliance with the above requirement for heat treatment, repair of the rudder stock may be regarded as permanent.

The Repair of Forged or Cast Steel Rudder Stocks and Pintles by Welding

The following notes are intended for the general guidance of Surveyors when it is proposed to carry out any form of weld repair to rudder stocks or pintles. These notes do not apply to the weld cladding of rudder stocks or pintles in way of the bearings as an alternative to the fitting of shrunk on liners.

Size and location of defects

Repairs, except those of an emergency nature, should only be attempted when the depth and location of the defective area is such as to provide adequate access for welding and inspection.

Facilities for repair

The welders employed for the repairs are to be experienced and competent to carry out this type of work. Whenever possible, the rudder stock should be removed from the ship and the repairs carried out in a properly equipped workshop under controlled conditions.

Removal of defects and preparation for welding

Complete removal of all defective material is essential for a successful repair. However, the material removed should be the minimum consistent with this and the excavation should be shaped so as to allow good access for welding. The complete removal of all defective material is to be verified by magnetic particle examination before welding is commenced.

Welding consumables

These should be of an approved low hydrogen type depositing weld metal with mechanical properties similar to that of the forging.

Pre-heating

Because of the relatively large mass and the consequent chilling effect, it is recommended that in all cases an adequate area around the repair should be pre-heated to about 100^{O}C. This pre-heat should be maintained until the repair is completed. Pre-heating temperature in excess of 100^{O}C may be required.

Welding

As far as practicable, all welding should be done in the downhand position.

Inspection after welding

The surplus weld metal should be removed by machining or grinding and the surface of the

repair area smoothed to a satisfactory profile. The area should then be checked for freedom from cracks and other defects by magnetic particle examination. Where extensive repairs have been carried out, ultrasonic examination may also be requested at the discretion of the Surveyor.

Heat treatment:

a. A stress relieving heat treatment is to be carried out after completion of the repairs. A suitable temperature range is 600 to 650^{o}C with a soaking period of 1 hour per 25 mm thickness of the repaired section.

b. Rudder stocks and pintles should be treated in a furnace properly equipped with means for temperature measurement and control. In general, the furnace should be large enough to take the entire rudder stock. If welding is confined to a small area, the post weld heat treatment may be restricted to a suitable local area, subject to the Surveyor's agreement.

Final inspection

After heat treatment and final machining or grinding has been completed the repaired area should be re-examined by a magnetic particle method.

"Simplex" Type Rudders

Survey points to watch for:

Fractures at sharp change of section on underside or rudder axle palm (top), also at top of taper on lower end of rudder axle.

Rudder load being carried by conical-faced "emergency" bearing on lower end of rudder (to shoe piece). (Actually, there should be a slight clearance [1 to 3 mm] at this bearing under drydocking conditions with after peak tank empty).

Excessive wastage of rudder axle adjacent to the bronze sleeves. This normally should be dealt with by cleaning, wire brushing, painting or epoxy coating. Weld build-up of the axle forging is not recommended, unless the excessive wastage extends over at least 25% the area surface, and then only with proper approved procedure and heat treatment.

Excessive wastage on rudder axle lower-end taper or of the axle between the bottom taper and the lower bronze sleeve. The latter should be protected with paint or epoxy coating. The taper may need to be re-machined however, to ensure tightness of the axle in the seating.

Insufficient locking arrangements or slack nut on rudder axle lower end securing.

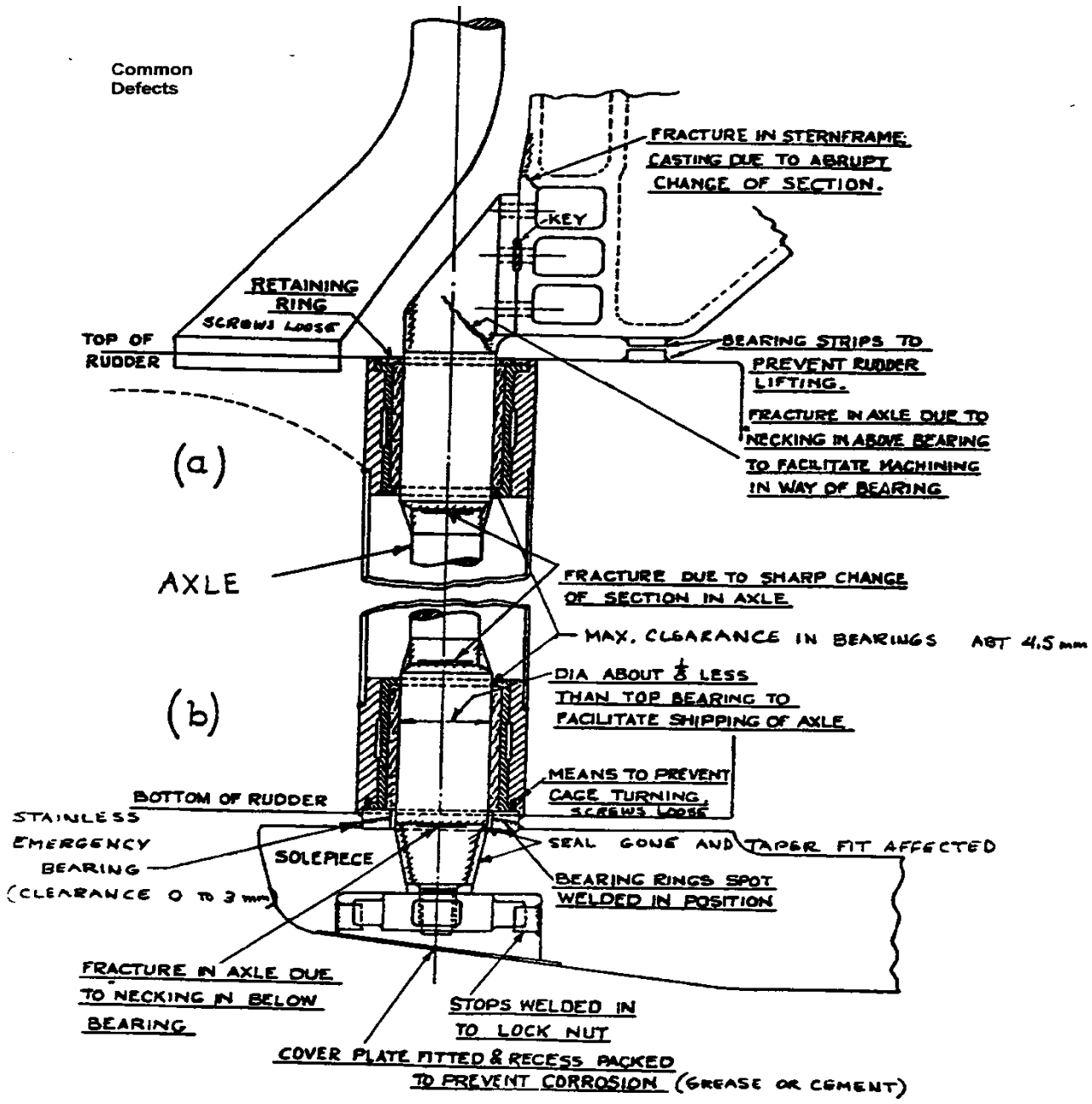
Loose or fractured palm bolts at upper end.

"Notches" or stress raisers at top or bottom of rudder axle. These should be smoothed out as possible.

Excessive clearances of rudder axle in rudder bearings (4.5 mm maximum recommended).

Gudgeon retaining rings (for the lignum-vitae staves) not properly secured.

With axle tight in lower taper (in shoe piece), palm at upper end of axle should bolt up without any "springing" or forcing to line-up holes.



Deutsche Werft "SIMPLEX" Type Rudder

Fig. 1 Potential Rudder damages

REFERENCES:
CONARINA SURVEYOR INSTRUCTIONS-CLASSIFICATION

ATTACHMENTS:
No.

Kindest Regards,
Cosmin Bozenovici
Naval Architect – Conarina Technical Head Office