Maritime and Coastguard Agency

MARINE GUIDANCE NOTE

MGN 190 (F)

Fishing Vessels: The Premature Failure of Copper Pipes in Engine Cooling Water Systems

Notice to Fishing Vessel Owners, Operators, Skippers and Crew, Fishing Vessel Builders and Repairers.

This note supersedes Merchant Shipping Notice No. M.631

Summary

This Note updates and replaces Merchant Shipping Notice No. M.631 regarding the corrosion of copper pipes in engine cooling water systems.

Key Points

This Note:

- Advises of the possibility of premature pipe failure due to fatigue when pipes are incorrectly mounted and/or subjected to 'in service' vibration or similar cyclical loading.
- Gives guidance on piping design and installation practice to avoid premature pipe failure.

1.0 Introduction

1.1 A recent total loss of a fishing vessel was attributed to the failure of a seawater overboard discharge pipe in the cooling water system of the main engine. This subsequently caused the engine room to flood and the vessel to founder.

1.2 The pipe that failed was made out of copper or a copper alloy material and this showed no evidence of deterioration prior to failure, the failure being a total fracture of the pipe inboard of the shell side non-return valve.

2.0 Causes

2.1 Whilst the fractured pipe was not available for detailed examination, the nature of the failure indicated the following possible causes:

- A fatigue fracture of the pipe material brought on by vibration and/or incorrect mounting and residual loads;
- Erosion/corrosion of the inner surface of the pipe leading to loss of cross sectional area and, coupled with residual loads, fracture;
- Electrical Leakage corrosion of the pipe material due to incorrect earthing, short circuits, stray currents etc. leading to loss of cross sectional area and, coupled with residual loads, fracture.

3.0 Prevention

3.1 If care is taken at both the design and installation stages, the risk of the above types of failure occurring can be minimised.

4.0 Design stage

4.1 Fatigue

.1 In situations where it is known that the piping will be subjected to vibrating or fluctuating loads it is important that the support points are arranged to prevent loads and bending moments being introduced into the system.

.2 In situations where it is necessary for piping to traverse between live machinery and the rigid vessel structure and where there is the possibility of large relative displacements, then consideration should be given to the fitting of a suitable flexible pipe arrangement.

4.2 Corrosion / Erosion

In order to avoid problems of corrosion and erosion in copper pipes in engine cooling water systems it is important to select the correct material for the intended application. The following materials are recommended for the listed applications:

- Copper:
  - Seawater systems with fluid velocities up to 0.75m / sec
- Aluminium Brass:
  - Seawater systems with fluid velocities up to 2.5m / sec
- 90 / 10 Copper Nickel Iron alloy:
  - Seawater systems with fluid velocities up to 3.0m / sec
- 70 / 30 Copper Nickel alloy:
  - Seawater systems with fluid velocities up to 3.5m / sec

N.B. Internal obstructions, changes in pipe dia., connections, branches etc. may cause turbulence, and this can have the effect of locally increasing fluid velocities above the recommended pipe maximum. The pipe diameter selected therefore should allow for this effect.

4.3 Electrical Leakage corrosion

Corrosion due to electrolytic action on copper pipes in contact with seawater should be specially considered in craft with wooden or glass reinforced plastic hulls. A special earth plate is recommended to be fitted on the external underwater surface of the hull, with all earth connections being made directly to this plate and not to pipe work or ship side fittings.

N.B. Galvanic (bi-metallic) corrosion may also occur when different piping materials (eg copper and steel) are coupled together within a piping system

5.0 Installation stage

5.1 In order to avoid problems due to fatigue in copper piping systems, the following is recommended:

- all pipes should be annealed or stress relieved, on completion of bending and forming work, prior to installation;
- Pipes that do not align correctly with mating connections should not be forced into position;
- A sufficient number of pipe supports should be provided to support the load and to minimise vibration or movement, the supports should be adjusted in position, after the pipe has been mounted, to ensure that support point loads are not induced into the piping system;
- Rubber lined supports may be employed in order to ‘damp out’ any minor vibrations that are noted;

6. 0 Existing Vessel installations

6.1 For vessels already in service, it should be noted that it is not always possible to detect piping that is near to a ‘fatigue’ or corrosion type of failure. The owners should therefore give consideration, in instances where pipe elements are subject to vibration, or have been in service for some time, to:

- the annealing or replacement of this piping;
- the provision of additional supports;
- the installation of suitable flexible piping elements where vibration or pipe movement is noted.

6.2 Failures due to corrosion are typified initially by minor leakages, any pipe found to be leaking should be replaced.

Enquiries relating to the content of this MGN should be addressed to:

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