The **CIMAC WG 14 UR 'Unified Rules for Vibration Analysis and Measurement'** had the task to create unified rules for vibration analysis and measurement, holding liaison with ISO/TC 108/SC2 and ISO/TC 108/SC2/WG2. As a result of the work IACS UR M68 on 'Dimensions of propulsion shafts and their permissible torsional vibration stresses' has been issued.

This paper summarises M68 as final report of the CIMAC WG 14 and is intended to provide a quick survey of the main requirements.

M68 : SUMMARY

Dimensions of propulsion shafts and their permissible torsional vibration stresses.

1. Scope

This Unified Rule (UR) applies to propulsion shafts such as intermediate and propeller shafts of traditional straight forged design and which are driven by rotating machines.

2. Alternative calculation methods

Alternative calculation methods may be considered by the classification society. Any alternative calculation method is to include all relevant loads on the complete dynamic shafting system under all permissible operating conditions. Consideration is to be given to the dimensions and arrangements of all shaft connections.
Moreover, an alternative calculation method is to take into account design criteria for continuous and transient operating loads (dimensioning for fatigue strength) and for peak operating loads (dimensioning for yield strength). The fatigue strength analysis may be carried out separately for different load assumptions.

This UR M 68 replaces URs M33, M37, M38, M39 and M48.
This UR M 68 applies to ships contracted for construction on or after 1 July 2006.

3. Material limitations

Where shafts may experience vibratory stresses close to the permissible stresses for transient operation, the materials are to have a specified minimum ultimate tensile strength (σ_B) of 500 N/mm^2. Otherwise materials having a specified minimum ultimate tensile strength (σ_B) of 400 N/mm^2 may be used.
For use in formulae in this UR, σ_B is limited for:

- carbon and carbon manganese steels
- alloy steels
- propeller shafts.

4. Shaft diameters

Shaft diameters are not to be less than that determined from formula, where diameters, factors for type of propulsion installation, factors for the particular shaft design features, kW/RPM and σ_B of the shaft material.

5. Permissible torsional vibration stresses

The alternating torsional stress amplitude is understood as $(\tau_{max} - \tau_{min})/2$ as can be measured on a shaft in a relevant condition over a repetitive cycle.
Torsional vibration calculations are to include normal operation and operation with any one cylinder misfiring (i.e. no injection but with compression) giving rise to the highest torsional vibration stresses in the shafting.
For continuous operation the permissible stresses due to alternating torsional vibration are not to exceed the values given by some formulae.

Where the stress amplitudes exceed the limiting values of τ_C for continuous operation, including one cylinder misfiring conditions if intended to be continuously operated under such conditions, restricted speed ranges are to be imposed which are to be passed through rapidly.

Restricted speed ranges in normal operating conditions are not acceptable above 80 % RPM.
Restricted speed ranges in one-cylinder misfiring conditions of single propulsion engine ships are to enable safe navigation.

Notes

Shafts complying with this UR satisfy the following:

A. Low cycle fatigue criterion (typically < 10^4), i.e. the primary cycles represented by zero to full load and back to zero, including reversing torque if applicable.

B. High cycle fatigue criterion (typically > 10^7), i.e. torsional vibration stresses permitted for continuous operation as well as reverse bending stresses.

C. The accumulated fatigue due to torsional vibration when passing through a barred speed range or any other transient condition with associated stresses beyond those permitted for continuous operation.

Explanation of k and c_K.

The factors k (for low cycle fatigue) and c_K (for high cycle fatigue) take into account the influence of:

- stress concentration factors (scf)
- notch sensitivity
- combination of statistical influence and notch sensitivity.