This method may also be used for other intermediate and propeller shafts that are mainly subjected to torsion. Shafts subjected to considerable bending, such as in gearboxes, thrusters, etc. as well as shafts in prime movers are not included. Further, additional strengthening for ships classed for navigation in ice is not covered by this method.

2.2.7.2 IACS UR M68.3 Material limitations

Where shafts may experience vibratory stresses close to the permissible stresses for transient operation, the materials shall have a specified minimum ultimate tensile strength (σ_B) of 500 MPa. Otherwise materials having a specified minimum ultimate tensile strength (σ_B) of 400 MPa may be used.

Close to the permissible stresses for transient operation" means more than 70% of permissible value.

For use in the formulae in this method, σ_B is limited as follows:

— for C and C-Mn steels up to 600 MPa for use in [2.2.7.4], and up to 760 MPa for use in [2.2.7.3]
— for alloy steels up to 800 MPa
— for propeller shafts up to 600 MPa (for all steel types).

Where materials with greater specified or actual tensile strengths than the limitations given above are used, reduced shaft dimensions or higher permissible stresses are not acceptable when derived from the formulae in this method.

2.2.7.3 IACS UR M68.4 Shaft diameter (rule diameter)

Shaft diameter shall result in acceptable torsional vibration stresses, see [2.2.7.4] or in any case not to be less than determined from the following formula:

$$d_{\min} = F \cdot k \cdot \sqrt[3]{\frac{P}{n_0} \cdot \frac{1}{1 - \frac{d_i^4}{d_0^4}} \cdot \frac{560}{\sigma_B + 160}}$$

where:

d_{min} = minimum required diameter unless larger diameter is required due to torsional vibration stresses, see [2.2.7.4]

d_i = actual diameter of shaft bore [mm]

d_0 = actual outside diameter of shaft [mm].

If the shaft bore is ≤ 0.40 d_0, the expression $1 - d_i^4/d_0^4$ may be taken as 1.0.

F = factor for type of propulsion installation
= 95 for intermediate shaft in turbine installation, diesel installation with hydraulic (slip type) couplings, electric propulsion installation
= 100 for all other diesel installations and propeller shafts

k = factor for particular shaft design features, see [2.2.7.6]

n_0 = shaft speed (rpm) at rated power

P = rated power (kW) transmitted through the shaft (losses in bearings shall be disregarded)

σ_B = specified minimum tensile strength (MPa) of shaft material, [2.2.7.2].

The diameter of the propeller shaft located forward of the inboard stern tube seal may be gradually reduced to the corresponding diameter for the intermediate shaft using the minimum specified tensile strength of the propeller shaft in the formula and recognising any limitation given in [2.2.7.2].

2.2.7.4 IACS UR M68.5 Permissible torsional vibration stresses

The alternating torsional stress amplitude shall be understood as $(\tau_{max} - \tau_{min})/2$ measured on a shaft in a relevant condition over a repetitive cycle.