TECHNICAL INFORMATION SHEET 030904

Recreational Craft Directive 2003/44/EC
Annex 1C Essential requirements for noise emissions
Explanations and examples of 'Froude number' and 'Power displacement ratio' calculations

The alternative to a full Pass-by sound test for craft with inboard or sterndrive engines without integral exhaust is to comply with two simple calculations.

1) The 'Froude number' is calculated by dividing the maximum boat speed V (m/s) by the square root of the waterline length L_{wl} (m) multiplied by gravitational constant, g=9.8 m/s^2

$$Fn = \frac{V}{\sqrt{(g.L_{wl})}}$$

2) The 'Power Displacement' ratio shall be calculated bt dividing the engine power P (kW) by the boat's displacement D (t) = P/D

If the calculated Froude number is equal to or lower than 1.1 ***and*** the Power displacement ratio is equal to or less than 40 then the craft is deemed to comply with the noise emission limits.

1. A typical motor cruiser could be as follows: -

Water line length lwl = 7.8 metres
Displacement D = 4 tonnes
Engine power P = 35hp = 26 kW
Speed V = 8knots = 4,1metres per second

The 'Froude number' would be calculated from:- $Fn = \frac{4.1}{\sqrt{(9,8 \times 7,8)}} = \mathbf{0,47}$

The Power Displacement ratio would be:- $P/D = \frac{26}{4} = \mathbf{6,5}$

As the 'Froude number' is less than 1.1 and the Power displacement ratio is less than 40 this boat is deemed to comply with the noise emission requirements.

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2. A sailing yacht could be as follows:-

Water line length lwl = 11,13 metres
Displacement D = 12,56 tonnes
Engine power P = 56hp = 42 kW
Speed V = 9knots = 4,6 metres per second

The 'Froude number' would be calculated from:- $Fn = \frac{4,6}{\sqrt{(9,8 \times 11,13)}} = \mathbf{0,44}$

The Power Displacement ratio would be:- $P/D = \frac{42}{12,56} = \mathbf{3,34}$

As the 'Froude number' is less than 1.1 and the Power displacement ratio is less than 40 this boat is deemed to comply with the noise emission requirements..

3. A semi-displacement power boat could be as follows:-

Water line length lwl = 10,44 metres
Displacement D = 9 tonnes
Engine power P = 430hp = 320 kW
Speed V = 22knots = 11,32 metres per second

The 'Froude number' would be calculated from:- $Fn = \frac{11,32}{\sqrt{(9,8 \times 10.44)}} = \mathbf{1,1*}$

The Power Displacement ratio would be:- $P/D = \frac{320}{9} = \mathbf{35,5}$

As the 'Froude number' is equal to 1,1 and the Power displacement ratio is less than 40 this boat is deemed to comply with the noise emission requirements.

***** Since the 'Froude number' is exactly on the limit, care should be exercised in the specification and calculations to ensure accuracy.

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4. A small inboard engine speed boat could be as follows:-

Water line length lwl = 4,9 metres
Displacement D = 0,9 tonnes
Engine power P = 150hp = 112kW
Speed V = 30knots = 15 metres per second
The 'Froude number' would be calculated from:- $Fn = \frac{15}{\sqrt{(0,8 \times 4,9)}} = \mathbf{2,16}$

The Power Displacement ratio would be:- $P/D = \frac{112}{0,9} = \mathbf{124.4}$

As this craft exceeds at least one of the calculation limits a full pass-by test using EN ISO 14509 will have to be undertaken.

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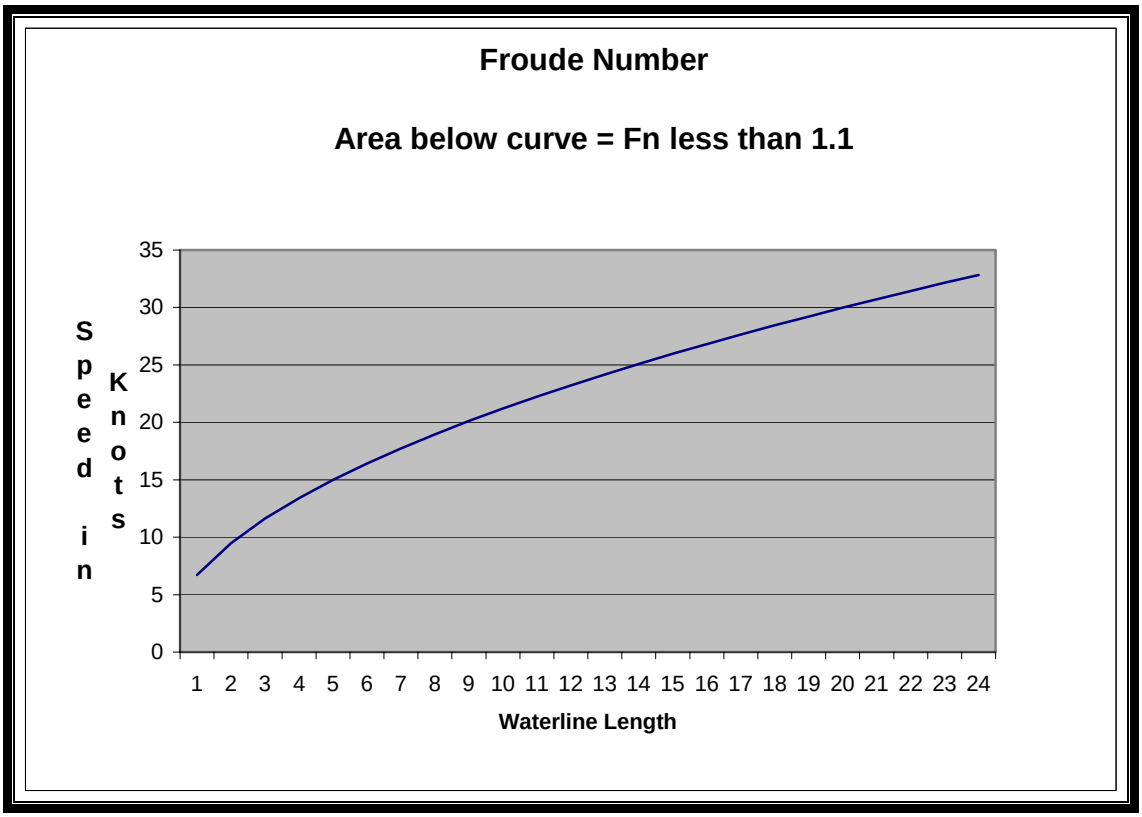
Charts for calculating Froude number and Power /Displacement ratio

Chart for Froude Number



*Waterline length in metres.

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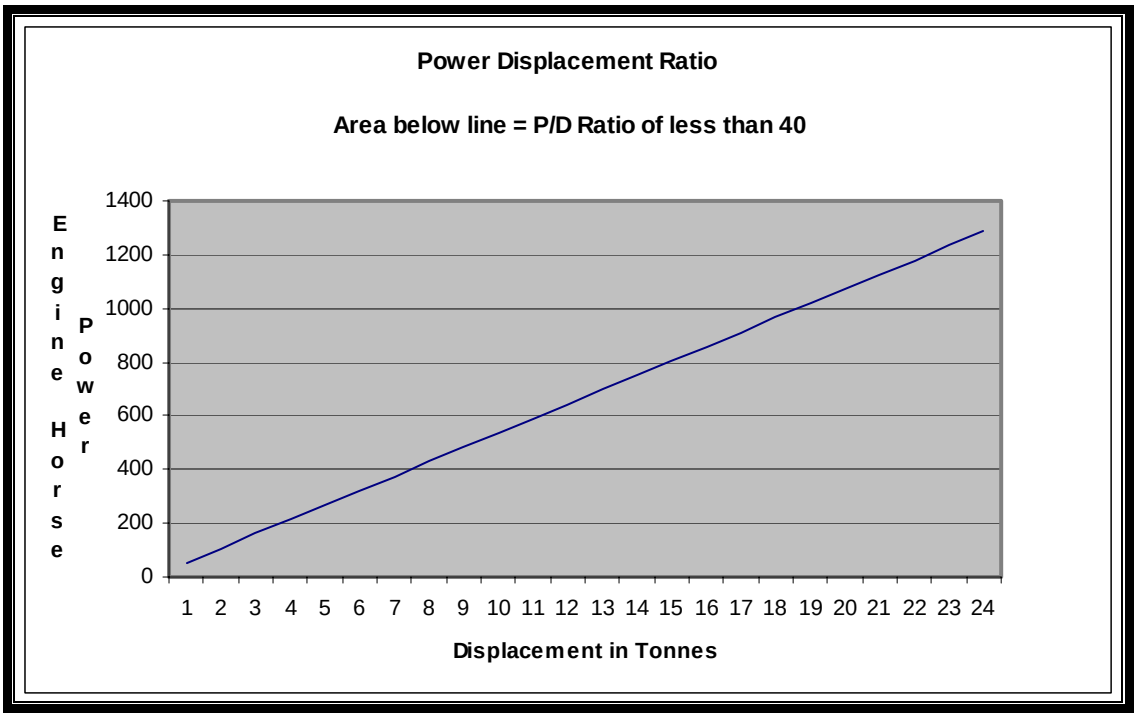
Chart for Power Displacement Ratio



*Engine power is shown as Horse Power. For kilowatt rating convert hp x .75

In order to demonstrate compliance both calculations have to be satisfied and the engine(s) must be installed in accordance with the manufacturer's specifications.

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