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Hydrodynamic Force on a Cylinder Oscillating at Low Frequency

By -

BiblioGov. Paperback. Book Condition: New. This item is printed on demand. Paperback. 50 pages. Dimensions: 9.7in. x 7.4in. x 0.1in. The hydrodynamic force on a cylinder oscillating transversely to its axis is a nonlinear function of the displacement amplitude x_0 . We report measurements and numerical calculations of the force at frequencies low enough that δR , where δ is the viscous penetration length and R is the cylinder radius. For small amplitudes, the numerically calculated Fourier transform of the force per unit length, $F(\text{sub small})$, agrees with Stokes analytical calculation. For larger amplitudes, the force per unit length found by both calculation and measurement is $F(\text{sub small})C(x_0\delta, R\delta)$. The complex function C depends only weakly on $R\delta$, indicating that $x_0\delta$ is more appropriate as a scaling variable than the Keulegan-Carpenter number $KC = \frac{U_0}{\omega R}$. The measurements used a torsion oscillator driven at frequencies from 1 to 12 Hz while immersed in dense xenon. The oscillator comprised cylinders with an effective radius of $R = 13.4 \mu\text{m}$ and oscillation amplitudes as large as $x_0\delta = 4$ (corresponding to KC as large as 71). The calculations used similar conditions except that the amplitudes were as large as $x_0\delta = 28$. This...



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