

Supplementary Information

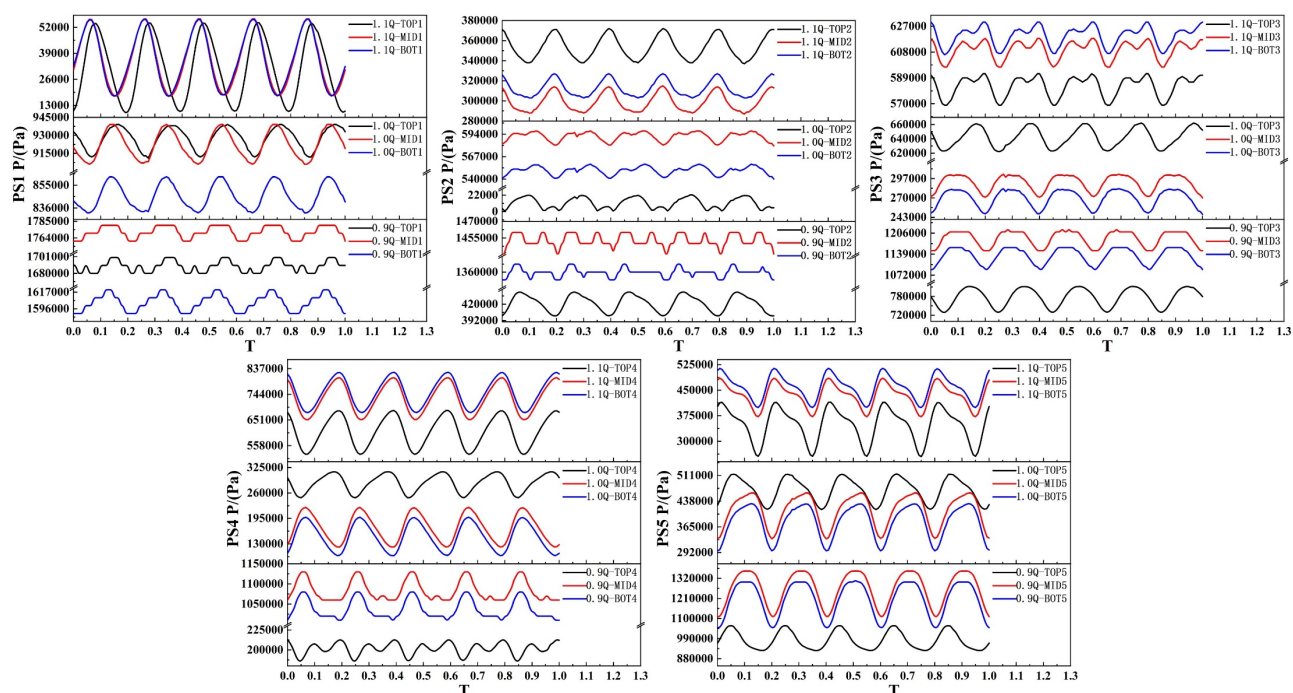


Fig. S1 Time-domain plot of pressure at different monitoring points on the pressure surface of impeller

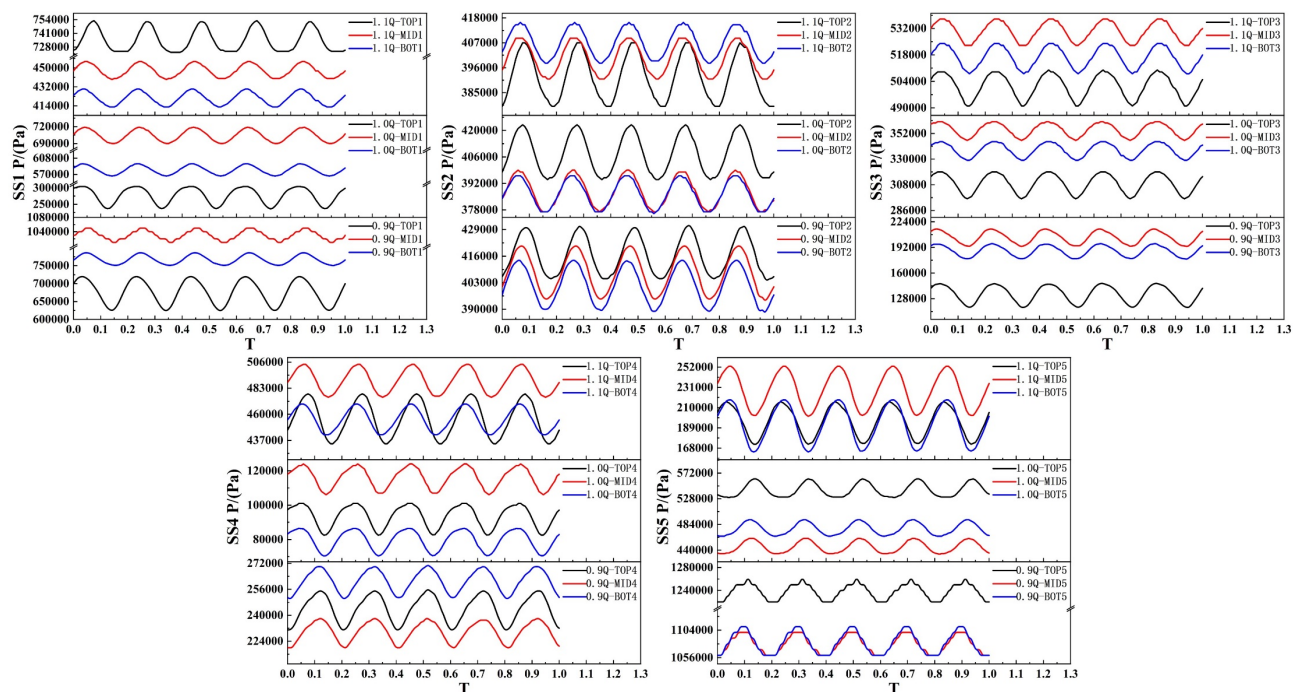


Fig. S2 Time-domain plot of pressure at different monitoring points on the suction surface of impeller

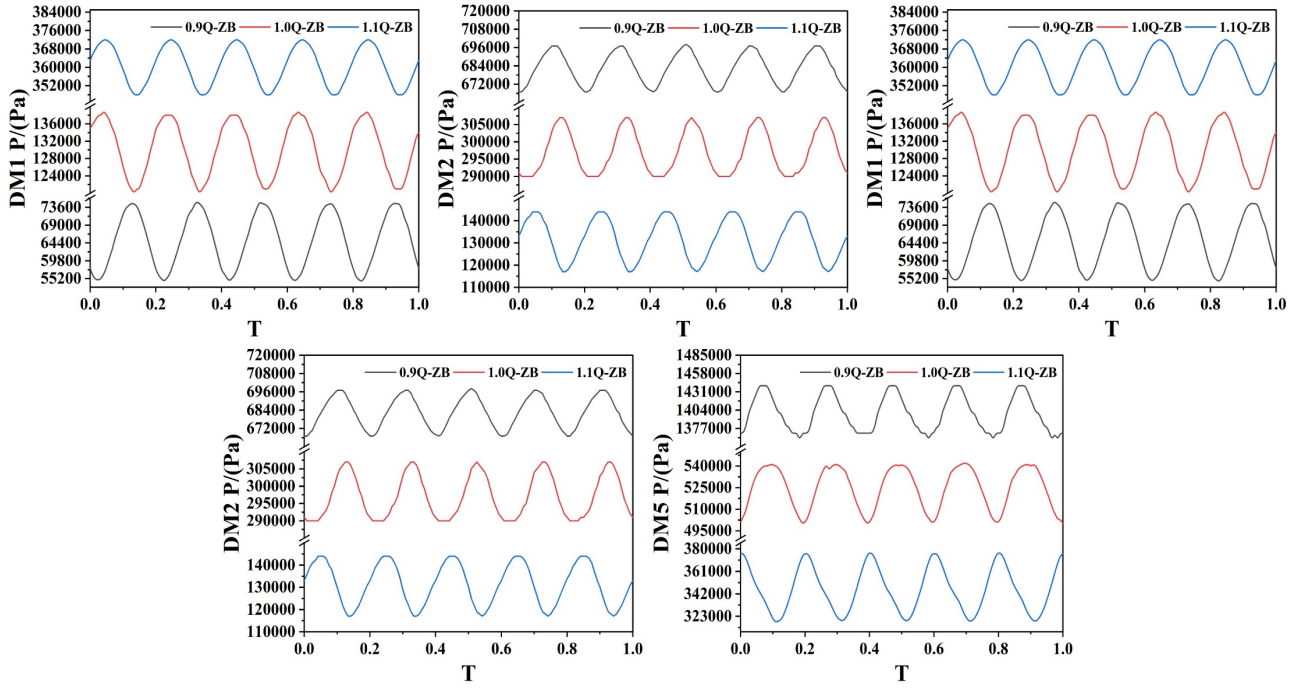


Fig. S3 Time-domain plot of pressure at different monitoring points on the inlet and outlet end faces of impeller

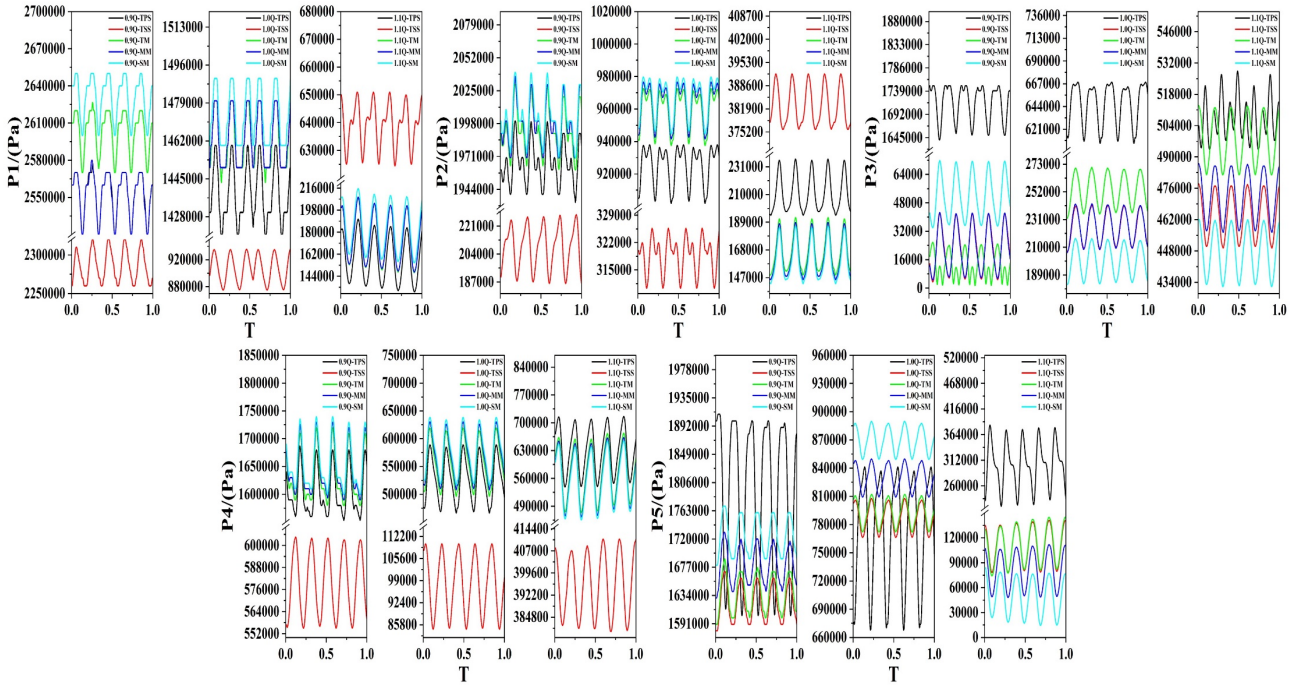
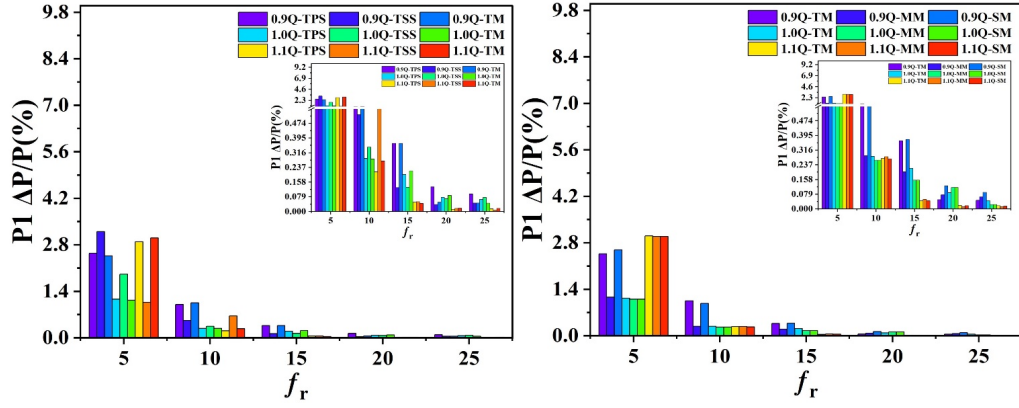
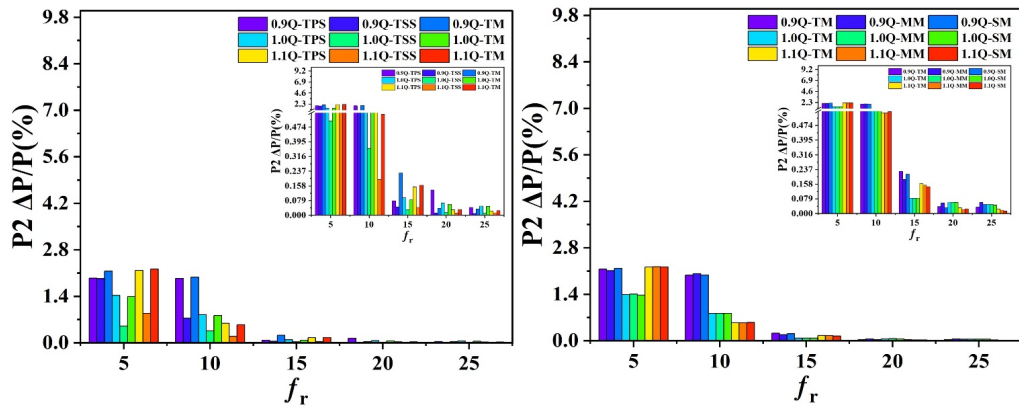


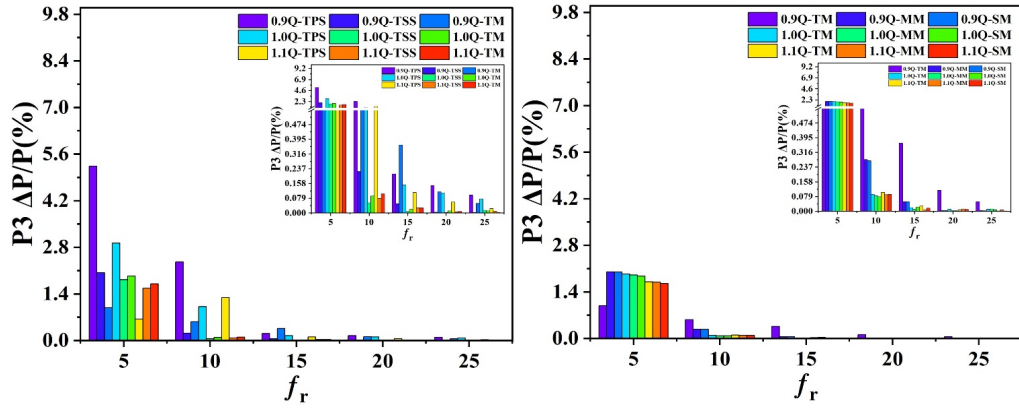
Fig. S4 Time-domain plot of pressure at different monitoring points of impeller clearance



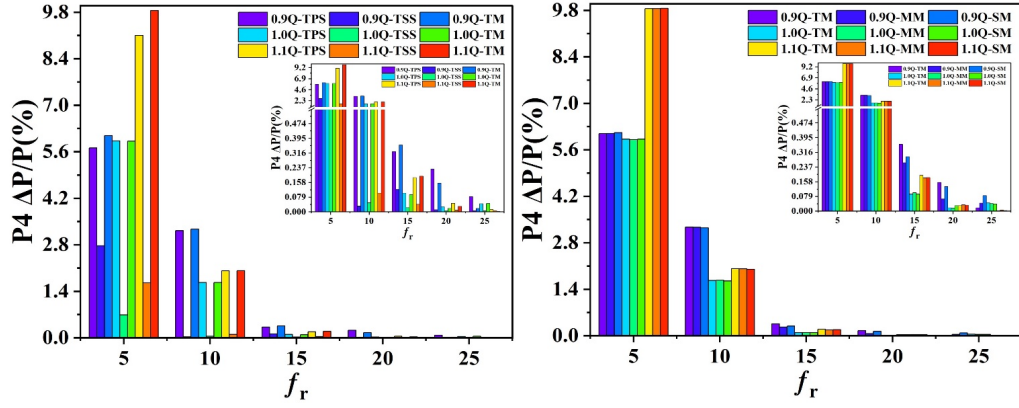
(a) P1 monitoring point



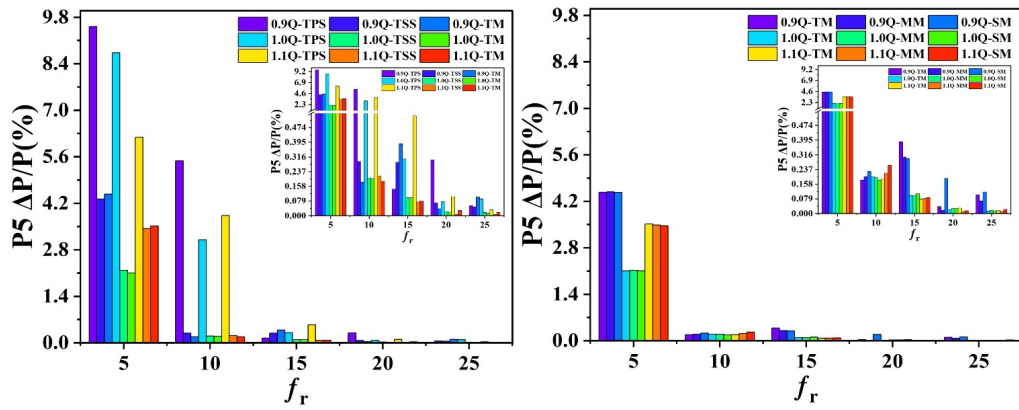
(b) P2 monitoring point



(c) P3 monitoring point



(d) P4 monitoring point



(e) P5 monitoring point

Fig. S5 Spectrograms of pressure at different monitoring points of impeller clearance

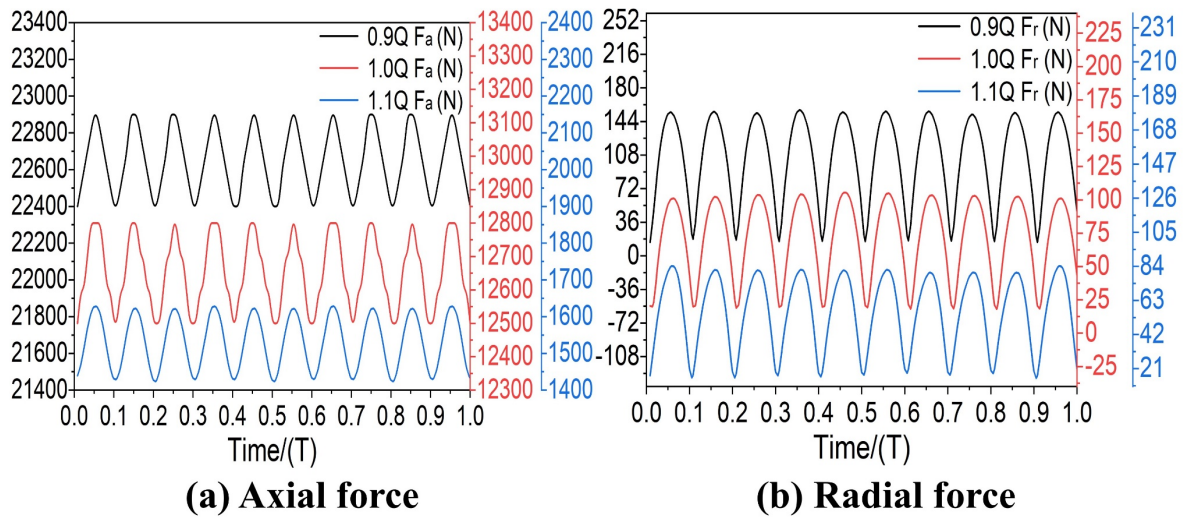


Fig. S6 Time-domain diagrams of axial and radial forces on the impeller

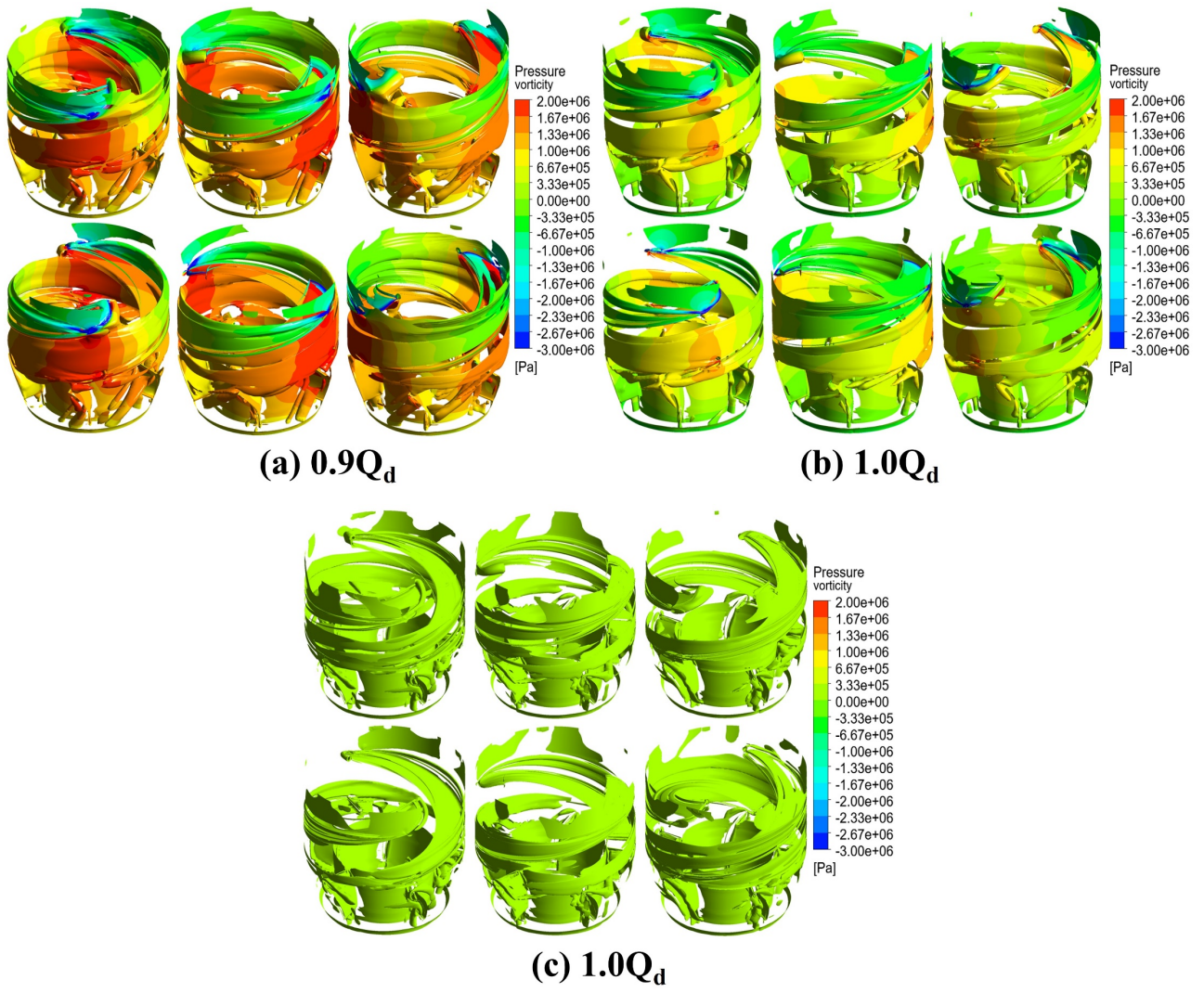


Fig. S7 Pressure distribution on vortices iso-surfaces for $Q_2 = 2 \times 10^5 \text{ s}^{-2}$ at different flow rates