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Particle-particle and particle-wall interactions in a second-order fluid AREZOO M. ARDEKANI, ROGER H. RANGEL, University of California, Irvine, DANIEL D. JOSEPH, University of Minnesota — The motion of a sphere normal to a wall is investigated. The normal stress at the surface of the sphere is calculated and the viscoelastic effects on the normal stress for different separation distances are analyzed. The contribution of the second-order fluid to the overall force applied to the particle is an attractive force towards the wall. Results are obtained using Stokes equations when $\alpha_1 + \alpha_2 = 0$. In addition, a perturbation method utilized for a sphere very close to a wall and the effect of non-zero $\alpha_1 + \alpha_2$ is considered. Moreover, viscoelastic potential-flow theory is used and the results are compared with the other methods. Similarly, the forces acting on two fixed spheres in a second-order uniform flow are investigated. For flow along the line of centers or perpendicular to it, the net force is in the direction that tends to decrease the particle separation distance. For the case of flow at arbitrary angle, unequal forces are applied to the spheres perpendicularly to the line of centers. These forces result in a change of orientation of the sedimenting spheres until the line of centers aligns with the flow direction. These results are in agreement with experimental studies on the motion of two settling spheres in a viscoelastic fluid which show that particles line and chain up in the direction of flow.

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