This study proposes an extension of the high-order compact gas-kinetic scheme (CGKS) to compressible flow simulation in an arbitrary Lagrangian-Eulerian (ALE) formulation in unstructured mesh. The ALE method is achieved by subdividing arbitrary mesh into tetrahedrons and integrating flux function in a local coordinate system at the cell interface to ensure geometric conservation law. The scheme incorporates a compact reconstruction with third-order accuracy for updating both cell-averaged conservative flow variables and their gradients. HWENO-type nonlinear reconstruction and gradient compression factors are adopted to improve the accuracy and robustness of the scheme. A multi-stage multi derivative (MSMD) time-stepping method is also implemented to achieve high-order time accuracy with fewer middle stages. The scheme is used to study problems involving moving boundaries. The radius basic function method is used to determine grid velocity. Both cylinder and airfoil cases are calculated by our method.