In recent years, the application of time-domain adjoint methods to improve large, complex underground tomographic models at the regional scale has led to new challenges for the numerical simulation of forward or adjoint elastic wave propagation problems. An important challenge is to design an efficient infinite-domain truncation method suitable for accurately truncating an infinite domain governed by the second-order elastic wave equation written in displacement and computed based on a finite-element (FE) method. In this paper, we make several steps towards this goal. First, we make the 2-D convolution formulation of the complex-frequency-shifted unsplit-field perfectly matched layer (CFS-UPML) derived in previous work more flexible by providing a new treatment to analytically remove singular parameters in the formulation. We also extend this new formulation to 3-D. Furthermore, we derive the auxiliary differential equation (ADE) form of CFS-UPML, which allows for extension to higher order time schemes and is easier to implement. Secondly, we rigorously derive the CFS-UPML formulation for time-domain adjoint elastic wave problems, which to our knowledge has never been done before. Thirdly, in the case of classical low-order FE methods, we show numerically that we achieve long-time stability for both forward and adjoint problems both for the convolution and the ADE formulations. In the case of higher order Legendre spectral-element methods, we show that weak numerical instabilities can appear in both formulations, in particular if very small mesh elements are present inside the absorbing layer, but we explain how these instabilities can be delayed as much as needed by using a stretching factor to reach numerical stability in practice for applications. Fourthly, in the case of adjoint problems with perfectly matched absorbing layers we introduce a computationally efficient boundary storage strategy by saving information along the interface between the CFS-UPML and the main domain only, thus avoiding the need to solve a backward wave propagation problem inside the CFS-UPML, which is known to be highly ill-posed. Finally, by providing several examples we show numerically that our formulation is efficient at absorbing acoustic waves for normal to near-grazing incident body waves as well as surface waves.