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Wave propagation in materials with non convex equation of state OLIVIER HEUZE, STEPHANE JAOUEN, HERVE JOURDREN, CEA/DIF, Bruyeres-le-Chatel, France — Exhaustive studies have described the behaviour of materials and wave propagation across them when they obey to Bethe's first condition. This means that the equations of state and the isentropes in the (P,V) plane are convex and that the sound speed is an increasing function of the density. In that case, steady dynamic pressure waves are compression shock waves or expansion fans. But materials can often reach states where this condition is violated. This happens for instance with phase transitions, dissociations, near the critical point, and in BZT fluids. Across these thermodynamic states, wave propagation has been studied only in a few specific cases by Zel'dovitch, Duvall, Plohr, Menikoff, Brun and their co-authors, but the general case remained to be explained. Our purpose is to provide the explanation of the successive waves which can occur in the general case when a wave propagates through a material with a non convex equation of state. We show that decrease of the sound speed introduces isentropic compression waves in the middle of shock waves and released shocks in the middle of expansion fans. After basic phenomena explanations, we illustrate them on the example of a virtual material which gathers all these cases. Hydrocode calculations based on this material show the difficulties of numerical schemes to reproduce the physical features.

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