Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Consistency and realizability requirements for stochastic diffusion models for variable-density turbulent mixing J.R. RISTORCELLI, J. BAKOSI, Los Alamos National Laboratory — Rational turbulence model development has applied principles that ensure consistency with the physical conservation laws and statistical constraints. Examples are the principles of invariance and realizability (Lumley, Adv. Appl. Mech., 18, 1979, pp. 123–176), and linearity and independence of passive scalars in mixing (Pope, Phys. Fluids, 26, 1983, pp. 404–408). Models that violate these principles can produce unphysical results. We discuss modeling principles and constraints for variable-density multi-material turbulent mixing. We develop the consequences of the mass conservation law for multi-component mixtures for random-walk methods in variable- density turbulence. In such flows the density fluctuations can be larger than the mean density and several important constraints restrict the functional forms of mixing models. One consequence of the constraints developed is that the coefficient of the Wiener process (if nonzero) must be nonlinear and coupled to the other mass fractions to ensure consistency with mass conservation. Typical Langevin-type models for these processes violate these constraints peculiar to variable-density mixing.

J. Bakosi
Los Alamos National Laboratory

Date submitted: 05 Aug 2011 Electronic form version 1.4