Inconsistency of Thermodynamic Quantities under Different Standard State Pressures

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Standard state pressure (SSP) had originally been identified to be a single value, 101.325 kPa, exactly agreeing with standard atmospheric pressure, which was rigorously defined in ITS-27. These standard pressures had followed the conventional normal atmosphere, which had been widely accepted in chemistry since the 19th century. In 1982, however, IUPAC recommended to change the value of SSP to 100 kPa. Today, two different values are used as SSP, because the IUPAC value has not perfectly prevailed yet in chemical thermodynamics. Double standard situation of SSP gives trouble to database users, who don't care the value of SSP. The IUPAC SSP makes standard entropy of a gaseous substance just 0.11 $J \cdot K^{-1} \cdot mol^{-1}$ bigger than those under the old SSP. However, the difference sometimes grows to an unignorable magnitude as temperature increasing. For example, standard Gibbs energies of formation of crystalline $Na_2SO_4 \cdot 10H_2O$ under two standards differ each other by 0.56 $kJ \cdot mol^{-1}$ at T = 298.15 K, because this substance includes many atoms which have gaseous reference states. Doubtlessly, SSP should be unified to a single value in order to eliminate such inconsistency. However, under the IUPAC SSP, there has been a serious inconvenience that normal boiling points under standard atmospheric pressure can not be utilized for close evaluation of thermodynamic quantities. The authors strongly insist that SSP should be 101.325 kPa.