Vibrational assignments of fundamental, combination and overtone bands in the main isotopomer of gaseous trans-formic acid are reported from spectra either newly or previously recorded using high-resolution Fourier transform spectroscopy and intracavity laser absorption spectroscopy. A total of 62 bands, with 32 newly reported ones, were observed from the lowest energy band \( v_G \) at 626.16 cm\(^{-1}\) up to \( 4v_1 \) at 13284.1 cm\(^{-1}\). Among these bands, 43 were firmly assigned, and 16 tentatively. Effective vibrational constants were obtained. The normal modes of vibrations were further characterized using\( \textit{ab initio} \) calculations providing fundamental band intensities and normal mode nuclear displacements. The analysis of the rotational structure in the first CH stretch overtone band (\( 2v_2 \)) and in the second OH stretch overtone band (\( 3v_1 \)) was performed. Some rotational information could also be obtained for \( 3v_2 \) and two close-lying bands, extracted from strong overlapping formic acid dimer bands.