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The topological character of a semiconductor is governed by the parity of the conduction and valence band. In topological insulators, band topology was proven to be non-trivial, as the parity of the conduction and valence bands appears to be inverted compared to commonly known semiconductors. Under certain symmetry consideration, this inverted band parity leads to topological surface states (TSS). However, no direct assessment of this band inversion can be made using conventional experimental probes, apart from the observation of topological surface states upon its occurrence. We address this problem through a comprehensive investigation of the bulk and surface band structure of $Pb_{1-x}Sn_xSe$ topological crystalline insulators near the band inversion that is known to occur versus x. We use magnetooptical infrared Landau level spectroscopy to quantify the band structure in MBE grown TCI and trivial $Pb_{1-x}Sn_xTe$ and $Pb_{1-x}Sn_xSe$ films. We extract the bulk Fermi velocity and band gap, and find that the bulk Fermi velocity exhibits a behavior that directly reflects the occurrence of the band inversion. The behavior of the Fermi velocity through the band inversion is thus presented as a universal criterion to assess the parity of bulk bands and their inverted or non-inverted character. This result can be analytically modelled using a 6-band perturbative **k.p** theory in the vicinity of the band inversion where the bulk band structure is nearly gapless. The observation of a cyclotron resonance resulting from TSS in the TCI regime also corroborates our findings. This approach can be generalized to other systems that exhibit a topological phase transition such as HgCdTe and certain Weyl and Dirac semimetals.