Radiation exposure of aircrew personnel has obtained special emphasis by a European Council decision to consider the increased radiation level at high altitudes in the Earth’s atmosphere as occupational exposure. The radiation field at typical jet cruising altitudes arises from cascade-like interaction processes of primary cosmic rays with the top layers of the atmosphere and is composed of various charged and uncharged particles in a broad energy range. The metrological assessment of all constituents with reasonable detection efficiency commonly requires a large set of experimental devices. Lithium fluoride thermoluminescent dosemeters (TLDs) evaluated according to the high-temperature ratio (HTR) method represent an appropriate alternative. The methodology was developed at the Atomic Institute of the Austrian Universities to determine absorbed dose and average LET of a mixed radiation field of unknown composition. The relative intensity of combined peaks 6 and 7 in the LiF glow curve compared with the main peak 5 are used as an indication of the average LET. Extensive irradiation campaigns with high-energy ions of different Z ranging from H to Fe established a HTR vs. LET calibration curve. The HTR method has previously been applied with great success on several space missions (including measurements onboard space station Mir, space shuttles, bio-satellites and the International Space Station) as well as in radiotherapeutic dosimetry. Within this paper measurements on several north-bound and equatorial flight routes originating from Vienna, Austria, and Cologne, Germany, are reviewed. The obtained route dose rates range from $2.1 \mu\text{Sv/h}$ to $6.7 \mu\text{Sv/h}$ and are compared with Monte Carlo simulations by means of the well-established algorithm CARI-6M, taking into account accurate route and altitude profiles on a 10-minutes scale. Contrary to previous releases of the program, the CARI-6M calculations proved to be in general agreement with the experimental data, although the values for north-bound routes are still underestimated by up to 15% as neutrons contribute roughly 60% of the dose equivalent. However, the most important insufficiency common to all simulations concerns the treatment of irregularly occurring solar flares.