We have studied the interplay between the layered crystal structure and the $5f$ magnetism in uranium-based tetragonal compounds $U_n T In_{3n+2}$. Single crystals of U_2RhIn_8, $URhIn_5$ and UIn_3 were prepared by In self-flux method. The novel U_2RhIn_8 compound adopts the Ho_2CoGa_8-type structure with lattice parameters $a = 4.6056(6)$ Å and $c = 11.9911(15)$ Å. The behavior of U_2RhIn_8 strongly resembles that of related $URhIn_5$ and UIn_3 with respect to magnetization, specific heat and electrical resistivity except for magnetocrystalline anisotropy developing on stacking composition in the series UIn_3 vs. U_2RhIn_8 and $URhIn_5$. U_2RhIn_8 orders antiferromagnetically below $T_N = 117$ K and exhibits slightly enhanced Sommerfeld coefficient $\gamma = 47$ mJ·mol^{-1}·K^{-2}. T_N increases with increasing c/a ratio in contrast to the behavior of their $Ce_n T In_{3n+2}$ counterparts. Magnetic field leaves the value of the Néel temperature of $URhIn_5$ and U_2RhIn_8 unaffected up to 9 T. On the other hand, T_N increases with applied hydrostatic pressure up to 3.2 GPa with the $\partial T_N/\partial p$ coefficient resembling $URhIn_5$ and UIn_3. Thermal expansion of U_2RhIn_8 reveals a hysteretic behavior of the antiferromagnetic transition pointing to its 1st-order character. The magnetic structure of $URhIn_5$ obtained from neutron diffraction propagates with $\boldsymbol{k} = (^1/_2, ^1/_2, ^1/_2)$ and the magnetic moment $\mu = 1.65\ \mu_B$/U.