ΦM12 is the first example of a T=19l geometry capsid, encapsulating a recently sequenced genome. The structure reveals the pattern for assembly of 1140 HK97-like capsid proteins, pointing to interactions at the pseudo three-fold symmetry axes that hold together the asymmetric unit. The particularly smooth surface of the capsid, along with a lack of accessory coat proteins encoded by the genome, suggest that this interface is the primary mechanism for capsid assembly. Two-dimensional averages of the tail, including the neck and baseplate, reveal that ΦM12 has a relatively narrow neck that attaches the tail to the capsid, as well as a three-layer baseplate. When free from DNA, the icosahedral edges expand by about 5 nm, while the vertices stay at the same position, forming a similarly smooth, but bowed, T=19l icosahedral capsid.