Geometrical defects on the surface of wind turbine blades can severely degrade the blade during operation and lead to reduced lift, which in turn reduces the power output of the turbine. This paper presents an automated surface geometry inspection system, which is designed based on manufacturing requirements. Estimating the measurement uncertainty and establishing traceability is difficult for huge, freeform objects. An approach based on the Modular Freeform Gauge (MFG) method is presented and used to estimate the measurement uncertainty of the system. An expanded measurement uncertainty of 665 μm (k=2) was established for the system and verified by measurements on a 55 meter long blade.