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# Precursor Kibble (Watt) balance for the revision of the kilogram for South Africa

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According to International Bureau of Weights and Measures (BIPM), the International System of Units (SI) will undergo a major change in November 2018. The base units will then be based on fundamental physical constants. Currently, the kilogram is the only base unit that is still based on an artefact, a Platinum-Iridium Alloy cylinder known as the International Prototype Kilogram (IPK). All mass measurements are traceable to the IPK. There is a drift between the IPK and national prototypes (IPK copies) at an average rate of 50μg per century, which indicates that the primary mass reference standard is unstable. The IPK will be replaced by a Kibble (Watt) balance. Kibble balance is an electromechanical weight measuring instrument that measures the mass of a test object through the strength of an electric current and voltage. The Kibble balance method has been proposed to overcome the drifting challenge since it can provide a link between the macroscopic mass m and Plank's constant h as the fundamental physical constant and realize the kilogram within a few parts in 10<sup>8</sup>. The National Metrology Institute of South Africa (NMISA) and University of Cape Town (UCT) Physics department, have embarked on a joint project to construct the first Kibble balance in South Africa and most probably on the African continent. Prototypes have been developed from Lego blocks, 3D printing and using an old equal-arm mass balance. Experimental results from the Kibble balance (comparing calibrated mass pieces with the measurement results) indicate that the system may be feasible. Any measurement performed and expressed as a number without been accompanied by any statement of uncertainty, is incomplete. All uncertainty measurements evaluations and expressions should be according to the ISO-recommended framework, the so-called "Guide to the Expression of Uncertainty in Measurement", or ISO-GUM. An ISO-GUM method has been applied to give a full uncertainty assessment on all the major sources of uncertainty incorporated within the prototype Kibble balance contributing to less than 1% relative uncertainty achieved from gram-level mass measurements of the balance. This paper discusses the results from all the prototypes, major measurement uncertainty contributors and improvements/ future for the real system.

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Prof. Andy Buffler
University of Cape Town
andy.buffler@uct.ac.za
And
Dr Aletta Karsten
National Metrology Institute of South Africa(NMISA)
AKarsten@nmisa.org

**Primary authors:** Dr KARSTEN, Aletta (NMISA); Prof. BUFFLER, Andy (University of Cape Town); Mr POTGIETER, Henk (National Metrology Institute of South Africa); Mr MAMETJA, Thapelo (University of Capetown and National Metrology Institute of South Africa)

**Presenter:** Mr MAMETJA, Thapelo (University of Capetown and National Metrology Institute of South Africa)

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