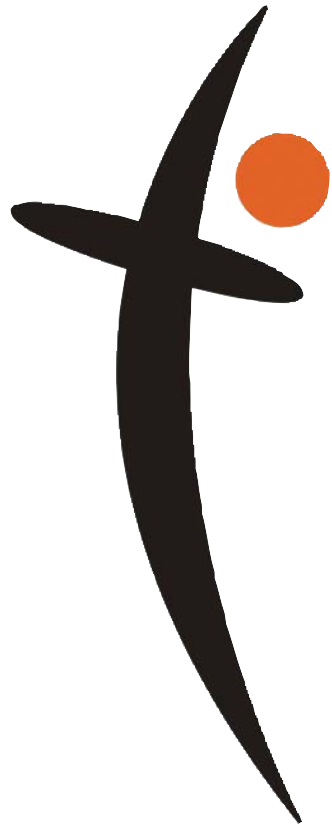


# Traceability and traceable calibrations

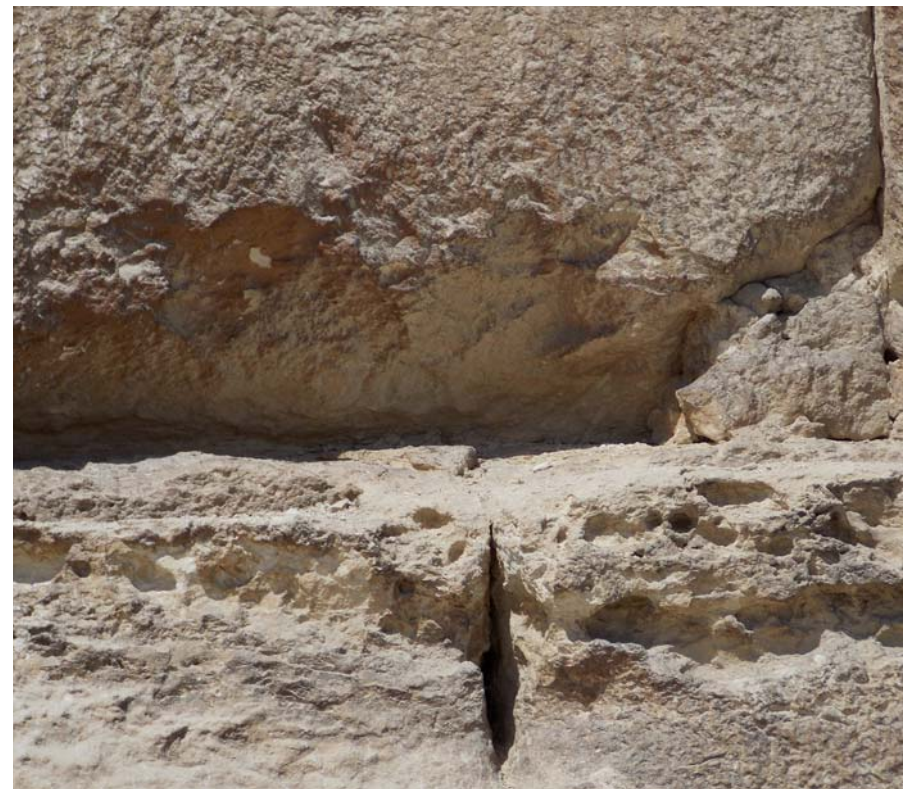
by Neville Tayler, South African National Accreditation System



The concept of traceability can mean many different things to different people. To the scientific community, and more specifically the test and calibration fraternity, traceability is the shortened form of "metrological traceability" and is used in preference to the more formal term. To be concise the VIM (the international vocabulary of metrology – basic and general concepts and associated terms) has defined metrological traceability as the "property whereby the result can be related to a reference through a documented unbroken chain of calibrations each contributing to the measurement uncertainty".

The definition however does little to highlight the importance of traceability, the ability to trace any measurement back to a single source. The Egyptians understood the fundamental necessity for exact measurement when cutting and honing the large blocks of sandstone used in the construction of the pyramids of Giza. The unit used for dimensional measurement at this time was the cubit.

This picture below taken at the pyramids of Giza illustrates how closely these large stone



Stone blocks from pyramids of Giza.



blocks, each in excess of 1 m<sup>3</sup> fit snugly together, no mortar has been necessary to fill gaps. This precision would not be possible if each and every stone mason had used a measuring instrument that was not adjusted or calibrated to read as closely as possible to a master. These measuring instruments were then traceable to the master against which they were calibrated.

Besides the construction industry, both modern and ancient, measurement is used extensively in ensuring fair trade. There are a number of references in the biblical scriptures to fair trade, one of which appears in the book of Proverbs and in a modern translation simply says "the Lord wants weights and measures to be honest, and every sale to be fair". How is this fairness achieved? This fairness is achieved when the purchaser receives the correct quantity, volume and mass of materials, goods or produce that have been bought.

Who can forget the famous words attributed to Marie Antoinette when told that the peasants were hungry as they had no bread: "Then let them eat cake". There is some debate about whether she was actually responsible for this utterance; however the bread riots were one of the factors which lead up to the French revolution and ultimately resulted in her demise at the guillotine. At that time the French peasantry would pay out almost half of their income on their staple food, bread. The two years prior to the revolution there had been poor harvests and harsh winters. This resulted in shortages and increases in the price of bread. The authorities responded by fixing the price of bread. The bakers denied the opportunity to increase prices in response to the increase in the prices of the wheat and grains used to bake the bread reduced the size of the loaves that they were baking. The regulation of bread therefore required access to "traceable measures", measures that would ensure that customers received what they had paid for, and that from village to village the measure of bread received would be equal.

The French were fundamental in the introduction of the SI international system of units, and it is little wonder that the BIPM (International Bureau of Weights and Measures) is today located in the suburbs of Paris, as short distance from the Seine river. The

BIPM was formed on 20 May 1875 when 17 member states signed the metre convention in Paris. The French government placed the grounds at Parc de Saint-Cloud at the disposal of the BIPM. One of the tasks assigned the BIPM was to establish fundamental standards and scales for the measurement of the principle physical quantities and maintain the international prototypes. The first units to be defined were the metre and the kilogram, and these were represented by two platinum artefacts. The kilogram today remains the last remaining SI unit to be represented by a physical artefact. The metre and kilogram are today supplemented by another five base SI units, these being the second (time), ampere (electric current), kelvin (temperature), mole (amount of substance), and the candela (luminous intensity).

In South Africa the National Physical Research Laboratory was established in 1946 as a division within the CSIR and this signalled the first foray into establishing a National Metrology Institute in South Africa. South Africa signed the metre convention and became a member of the BIPM in 1964.

Today the mandate for the designation, maintenance and dissemination of the National Measurement Units is entrusted to the National Metrology Institute of South Africa (NMISA). On 28 March 2007 the President of South Africa signed into law the Measurement Units and Standards Act, Act 18 of 2006, establishing NMISA as a public entity of the Department of Trade and Industry (dti)'s technical infrastructure. Whilst the NMISA has the mandate for the dissemination of the national measurement standards. Whilst the NMISA has the mandate for the dissemination of the National Measurement Standards, the South African National Accreditation Body (SANAS) was mandated in terms of the Accreditation for Conformity Assessment, Calibration and Good Laboratory Practice Act, Act No. 19 of 2006, to accredit calibration laboratories in that area of metrology.

SANAS, the sole National Accreditation body in South Africa, started its existence 36 years

ago. Since its inception SANAS has shown exceptional growth, and today is one of the largest accreditation bodies in the world. SANAS is a full member of the International Laboratory Accreditation Cooperation (ILAC) and SANAS employees participate both in its activities and decision making committees.

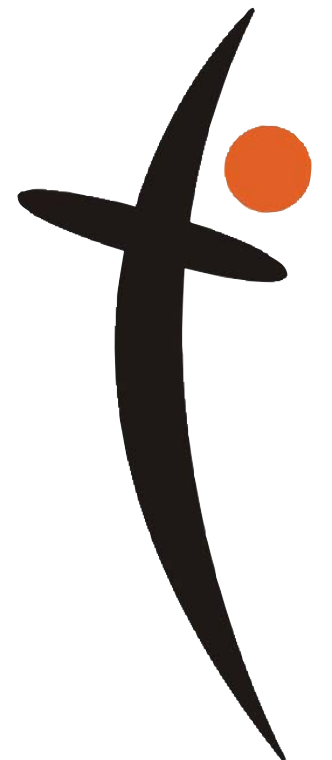
In January 2013 ILAC published the P10 document "ILAC Policy on the Traceability of Measurement Results". This document superseded the previous version published in 2002, and its requirements are supplementary to the requirements for traceability already included in the ISO/IEC 15025:2005 Standard. ILAC P10 describes the specific routes with which an accredited calibration laboratory must comply in order to ensure traceability of the calibrations which they perform; these include calibrations performed by (i) a NMI such as NMISA for services covered by the Mutual Recognition Arrangement (MRA) (ii) a calibration laboratory accredited by an accreditation body recognised by ILAC or a regional body recognised by ILAC, (iii) and under exceptional circumstances, calibrations performed by NMI or calibration laboratories not recognised under options (i) & (ii) but which may be accepted where the accreditation body has policy in place to ensure that the requirements for metrological traceability have been ensured.

Within South Africa, SANAS has accredited approximately 220 calibration laboratories, covering diverse fields of metrology including dimensional, mass, volume, viscosity, density, pressure, temperature, electrical DCLF and RF, time and frequency, gas, acoustics, vibration, force, torque and liquid flow. These laboratories are located throughout South Africa with the largest number being in Gauteng. These calibration laboratories are a source of metrological traceability for testing laboratories, verification laboratories and organizations certified to ISO 9000, where calibration of measuring equipment is a requirement. Details of accredited laboratories are available from the SANAS website; this includes access to the schedule or scope of accreditation for each

laboratory, which describe those calibrations or measurements, the applicable ranges and the calibration and measurement capability (CMC). The CMC represents the smallest uncertainty which a laboratory can quote on a calibration certificate or report which they issue.

SANAS continues to process applications from calibration laboratories seeking to obtain the recognition afforded by SANAS and its international partners, for the calibrations which it performs, and in so doing ensures ongoing access to metrological traceability necessary for manufacture, testing and certification of South African goods and agricultural produce, to facilitate fair trade, and to ensure that measurements made for any legal purpose are correct and within the specified accuracy.

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