The Absolute Measurement of Inductance

This paper [1] represents the first Bureau of Standards scientific contribution of Edward B. Rosa, Chief Physicist and first Division Chief (Electricity Division) of NBS. Rosa was an outstanding and prolific physicist and writer, having provided the basis for the century-long international pre-eminence of NBS/NIST in electrical metrology. He authored or co-authored some 75 NBS papers ranging in topic from fundamental electrical measurements through practical papers on electromagnetic calculations and applied measurement techniques to descriptions of basic work in electrolysis and photometrics. As an example of his breadth of interest, Rosa invented an ingenious respiration calorimeter with Wilbur O. Atwater that was to prove highly useful in subsequent pioneer investigations of food values and problems of nutrition in this country. Towards the end of his career he carried out an exhaustive study of government research and its relation to the federal budget, which had an influence on the establishment of the Bureau of the Budget, the predecessor of the present Office of Management and Budget. His name is pronounced "Ro-zay," with emphasis on the second syllable.

The first Director of the Bureau, Samuel Wesley Stratton, found that the most urgent task of this new appointment was to find an outstanding individual to plan and direct the electrical research program that had dominated the arguments for the creation of the Bureau. His attention was drawn to Edward Bennett Rosa. Rosa (1861-1921), of Dutch ancestry, had taught physics and chemistry after getting his B.S. degree at Wesleyan University in Connecticut and then entered the Johns Hopkins University as a graduate student in physics under Henry A. Rowland. Receiving his doctorate in 1891, he returned to Wesleyan as associate professor of physics, becoming full professor the next year. Stratton hired him as a physicist at $3,500, and a decade later, with his electrical group firmly established as the premier division of the Bureau, he was made chief physicist.

The paper [1] reflects an early commitment to outstanding work in the electrical metrology field by a fledgling organization. This was in response to overwhelming needs in U.S. industry for a single, consistent basis for measurements of power, current, impedance, and voltage to support the electrical power industry, the transition of manufacturing from mechanical to electrical power, and the burgeoning electrical instruments industry, as well as the growing position of the U.S. in world trade and science.

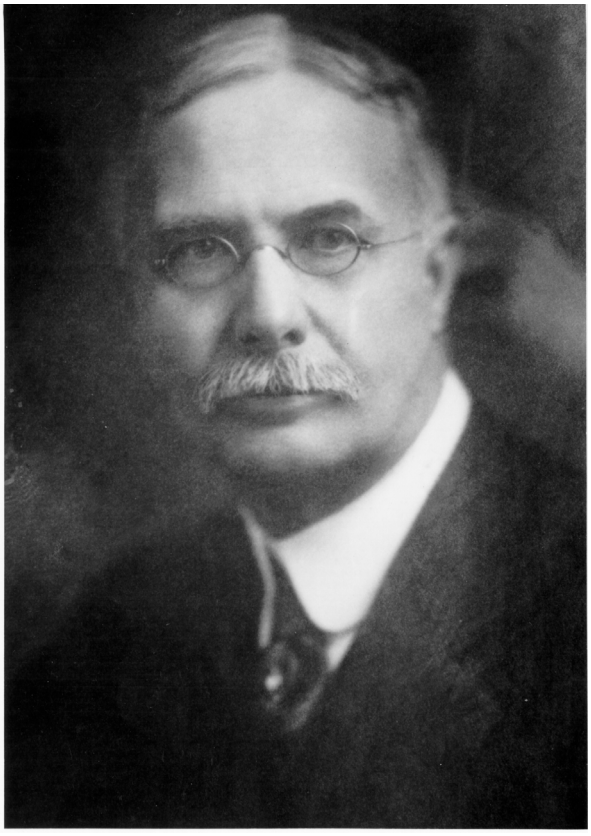

Fig. 1. Edward B. Rosa, who set the pace for the high level of research at the Bureau in its first two decades. Rosa probably sat for this portrait about 1915, but according to Francis Silsbee, who knew him, it could have been made at almost any time, for Rosa did not change much in all his years at the Bureau.

At the 1908 International Conference on Electrical Units and Standards in London, it was recommended that representatives of the National Measurement Institutes (i.e., counterparts to NBS/NIST) should meet and agree on new values of international units as defined by the mercury ohm and silver voltameter. In April and May 1910, the International Technical Committee met in Washington at NBS. Scientists from Germany, France, and Great Britain brought standard resistors and standard cells that had been carefully evaluated in terms of their national units. As Chief of the Electricity Division, Rosa headed this committee. Comparisons made at the meeting showed that the

resistance unit represented by the German standards was only 1×10^{-5} larger than that of the British. Results of work then in progress under Rosa were in reasonable agreement, and the committee recommended that all countries use, as the international ohm, the mean of the values found by Germany and Great Britain [2,3].

The present NIST impedance calibration laboratory (ICL) promotes the use of the SI units farad and henry through capacitance and inductance calibrations for customers, both inside and outside NIST. The ICL provides calibrations of nominal-valued capacitors in the range from 0.001 pF to 1 μF in the frequency range from 100 Hz to 10 kHz. Customers include aerospace companies, instrumentation companies, the U.S. armed forces, secondary calibration laboratories, and other U.S. and foreign national laboratories. The ICL also provides capacitance calibrations at 1 kHz that are used by the high-frequency calibration laboratories at NIST for their calibrations at frequencies above 1 MHz.

The SI impedance unit, the henry, is obtained from the capacitance and resistance units, the farad and ohm. The ICL provides calibrations of inductors in the range 50 mHz to 10 Hz in the frequency range from 65 Hz to 10 kHz. The inductance value is found using the Maxwell-Wien bridge [4], which derives the value of the inductor by comparison against two resistors and a capacitor.

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Bibliography

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