Page 1117 - 1123 **DOI:** *https://doij.org/10.10000/IJLMH.112031*

INTERNATIONAL JOURNAL OF LAW MANAGEMENT & HUMANITIES

[ISSN 2581-5369]

Volume 4 | Issue 6

2021

Research in Metrology

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ABSTRACT

The need of research in Metrology segment is the need of today's consumer. The Legal Metrology subject is based on metric system with reference to Metre Convention held in Paris on 20 May 1875. Representatives of 17 countries were present for Metre Convention including United State of America. The treaty to form an International Law were signed in Paris on 1875 by the 17 representative nations. The legal metrology organization is based on the SI units. The definition of Si units are decided by the International Organization of legal metrology. The metrology is use for the protection of the consumers through the weights and measure department of various state. The enforcement rules of every state works specially for the consumers protection and use uniform standards throughout the country. The SI units which are verified and defined the General Conference of Weights and Measures (CGPM). In the 26th CGPM meeting held on 14th November 2018 the definition of kilogram, ampere, kelvin and mole were redefined in terms of permanently new fixed values of the plank constant, elementary cgarge, bolizmans constant and Avogadro constant respectively.

The department of Legal Metrology in the state is charged with the duty of the ensuring that the accurate weighment and measurement of goods in commercial transactions. The legal provisions are contained in enactment by parliament and state legislature supplemented by detailed rules. The state Legal Metrology Organization formerly known as Weights and Measures, responsible for accurate weighment and measurement of goods in commercial transaction are now required to ensure additional responsibilities of ensuring accuracy in other fields namely industrial production and protection human beings, animal and plants. Hence the development and research is required in Legal Metrology.

Keywords: *Legal Metrology, Consumer Protection, Base Units*

I. INTRODUCTION

The need of research in Metrology segment is the need of today's consumer. The Legal Metrology subject is based on metric system with reference to Metre Convention held in Paris on 20 May 1875. Representatives of 17 countries were present for Metre Convention including

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 [ISSN 2581-5369]

United State of America. The treaty to form an International Law were signed in Paris on 1875 by the 17 representative nations.

II. INTERNATIONAL BUREAU OF WEIGHTS AND MEASURES (BIPM)

An international organization was established by the Metre Convention by which member states act together on the matter related to the measurement science and measurement standard. It becomes intergovernmental treaty and this treaty are framed when lawful representative (Governments) of the serval state go through a ratification process. The headquarters in Saint Cloud, France. BIPM through Metre Convention through which member state act together on the International System of Units. Initially 61 countries were members of BIPM including India. The official language BIPM is French.

The function of BIPM has to provide the basis single, coherent system of measurement throughout the world. The international system of units is the modern form of metric system and it is only system of measurement with an official status in most of the countries in world.

Unit measurement starting with seven base units-

Second (s)	Unit of the Time
Metre (m)	Unit of the Length
Kilogram (kg)	Unit of Mass
Ampere (A)	Unit of Electric Current
Kelvin (K)	Unit of Thermodynamic Temperature
Mole (mol)	Amount of Substance
Candela (cd)	Luminous Intensity

The system allowed for an unlimited numbers of additional units called Derived Units and 22 derived units have been provided with special name and symbol. Also 7 base units and 22 derived units with special name and symbol maybe used in combination of other derived units.

The SI System provides 20 per-fixes of the unit names and symbols used when specified power-of-ten (i.e. Decimal) multiple and sub multiple of SI Units. The Metric-Prefix is the unit prefix that provides the basic unit of measure to indicate a multiple or submultiple of the unit.

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SI logo produced by BIPM

h	:	Plank constant
c	:	speed of light
Avcs	:	hyperfine tension frequency of cs
E	:	elementary charge
K	:	Boltsmans constant
Na	:	Avogadro constant
Kcd	:	Luminous efficacy of 540 THz radiation

The international system of units the SI is a decimal and metric system of units established in 1960 and periodically updated since then. The SI has official status in most countries including USA and UK.

III. METRICATION OR METRIFICATION

Metrication or Metrification is the process of converting the system of measurement traditionally used in the countries to the metric system. All over the world, nation have transitional form of their local and traditional units of measurement to the metric system. This process first adopted by France during 1790 and continuous, the metric system has not been fully adopted in all countries and sectors.

Speedometer used in USA & UK

IV. INTERNATIONAL COMMITTEE OF WEIGHTS AND MEASURES (CIPM)

The international committee of Weights and Measures consists of eighteen persons each of different nationality elected by the General Conference of Weights and Measures (CGPM) whose principle task to promote worldwide uniformity in unit of measurement. Since 2011 CIPM meets in two sessions per year at Pavillon de Brestuil, Saint Cloud, France. It discusses the reports presented by its Consultative Committee (CC). The reports of the meetings of the CGPM, the CIPM and all Consultative Committee (CC) are published by the BIPM.

In 1999 the CIPM established the Mutual Recognition Arrangement (MRA) which serves as the framework for the mutual acceptance of the national measurement standards and the recognition of the validity of calibration and measurement certificates issued bk the national metrology institute. The recent focus area of the CIPM has been the revision of SI units.

V. CONSULTATIVE COMMITTEE (CC)

The CIPM has set up the number of consultative committees to assist its work. These committees under the authority of the CIPM. The president of each committee usually a member of CIPM and it is open to national metrology institutes of member state that are recognized most expert in the field and active in the field but lack of expertise to become members are able to attend consultative committee meetings as observers.

VI. GENERAL CONFERENCE ON WEIGHTS AND MEASURES (CGPM)

The CGPM is made up of delegates of the government of member state and observes from the association of the CGPM. Under its authority the International Committee of Weights and Measures executes an exclusive direction and supervision of the BIPM. General Conference receive the report of CIPM. The CGPM meets in Paris usually once in four years.

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Initially the metre convention was only concerned with Kilogram and Metre but in 1921 the scope of the treaty was extended to accommodate all principle measurements and hence all aspects of metric system. The 11th CGPM in 1960 approved the international system of units known as S I.

CGPM acts on behalf of governments of its member, it appoints member of the CIPM receive reports from the CIPM which is passes on to governments and national laboratories on member states, examine and where appropriate approves proposal from the CIPM in respect of change in of International System of Units. Also approves the budget for BIPM over $ 13 million in 2018 and it decided all major issues concerning the organization and department of the BIPM. The BIPM is the organization and CGPM is the general meeting of shareholders, the CIPM is the Board of Directors appointed by the CGPM as per the structures of stock corporation.

The CGPM recognizes two types of membership – full membership for those states that wish to actively participate in BIPM and associated membership for those countries that wish to participate in CIPM mutual recognition agreement (MRA). It is indicate that member state must have diplomatic relation with France. The CGPM meetings chaired by the president of French Academy of Science. At present as of 14 November 2018 there are 59 member states and 42 Associate states and Economies of CGPM. The 26th meeting held on 14th November 2018. In this meeting the kilogram, ampere, kelvin and mole were redefined in terms permanently new fixed values of the Plank constant, elementary charge, Boltzmann constant and Avogadro constant respectively.

VII. REDEFINED OF SI UNITS ON 26TH CGPM MEETING

1. Kilogram

Kilogram is the base unit of mass in the international system of units. The current metric system having unit symbol kg.

The kilogram was originally defined in 1795 as the mass of one liter of water. This was the simple definition but difficult to use in practice.

The latest definition of kilogram defined on three fundamental physical constants.

a. The speed of light c

b. A specific atomic transition frequency^vcs

c. The Plank constant

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2. Ampere

The Ampere symbol A the base unit of electric current, means electromagnetic force between electric conductors carrying electric current. The earlier CGS system had two different definition of current one is the same as SI units and other electric charge as the base unit, with the unit of charge defined by measuring the force between two charged metal plates. The ampere was then define as one coulomb of charge per second. In SI the unit of charge, the coulomb is define as the charge carried by one ampere during one second.

New definition in terms of invariant constant of nature, specifically the elementary charge took effect on 20 May 2019. The ampere is defined taking the fixed numerical value of the elementary charge e to be 1.602 176 634 X 10-19when expressed in the unit c which is equal to A and second in terms of ^vcs the unperturbed ground state hyper line transition frequency of the cesium – 133 atom.

3. Kelvin

The kelvin is the base unit of temperature in SI system having the unit symbol K. Kelvin calculated that the absolute zero was equivalent to – 273 degree celcius on the air thermometer of time. The absolute scale is known today as the kelvin thermodynamic temperature scale. Kelvin value of – 273 was the negative reciprocal of 0.00366 the accepted expansion coefficient of the gas per degree celciusrelative to the ice point, giving a remarkable consistency to the currently accepted value.

In 1954 in 10th CGPM kelvin scale its modern definition by designating triple point of water as its second definition point and assigned its temperature to exactly 273.16 kelvin.

a. Triple Point of Water

The single combination of pressure and temperature at which liquid (water), solid (ice) and gas (water vapor) can coexist in suitable equilibrium occurs at 273.1517 Ki.e. 0.0075 degree celcius and 32.0135 degree Fahrenheit and a partial vapor pressure 611.657 Pascal.

At that point it is possible to change all of the substance to ice, water and vapor by making arbitrarily small changes in pressure and temperature.

On 16 November 2018 a new definition of kelvin on the basis of triple point of water was exact the Boltzmann constant had measured value of 1.380 649 03 (51) x 10 -23 J/K with a relative standard uncertainty of 3.7 x 10 -7. Afterward the Boltzmann constant is exact and the uncertainty is transferred to the triple point of water, which is now 273.1600 (1) K.

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4. Mole

Mole is the unit of measurement of substance. The amount of substance means the number of discrete atomic – scale particle in it divided by the Avogadro constant N^. The amount of substance is simply the number of that constitute the substance. A mole of particle is defined as exactly 6. 022 140 76 x 1023particles which may be atom, molecule, ions or electrons.

For particle 1 mol = 6.022 140 76 x 1023 .

On 16 November 2018 after a meeting of scientist more than 60 countries at CGPM, all base units were defined in terms of physical constant. This means that each SI units including mole would not be define in terms of any physical objects but rather they would be define by constant that are in their nature exact. Such changes officially come into effect on 20 May 2019. Following such changes One Mole of substance was redefined as exactly 6.022 140 76 x 1023 elementary entities of that substance.

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 [ISSN 2581-5369]