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**Kingdom of Cambodia
Nation Religion King**

Ministry of Industry, Mines and Energy

**Law
on
Metrology of the Kingdom of Cambodia**

Unofficial Translation

Chapter 1 General Provision

Article 1-

The objective of this law is to determine the mechanism and rules of the management of metrology within the Kingdom of Cambodia.

Article 2-

The purpose of this law shall:

- Assure a good and fair trade
- Create the correct use of metrological instruments
- Assure the best interest of suppliers and users of products goods and services.
- Assure the improvement of the quality of goods, products, services and management.
- Determine the identification and removal of Technical barriers to trade and harmonization of trade transactions within the framework of legal metrology.
- Create a credible environment for the use of metrological instruments in trade activities and other businesses in health, security and environment.
- Facilitate the development of science and technique for economic development.

Article 3-

This law shall cover the implementation of manufacturing, importation, installation, use, repairs, maintenance and the exposure for sale of metrological instruments within the Kingdom of Cambodia.

Article 4-

As used under this law, the important words shall be as follows:

- Metrology means the science and the management of weights and measures.
- Metrological Instrument means the weighing and measuring instrument used in metrological field.
- Minister means the Minister in charge of industry, who manages all activities and services related to the metrology within the Kingdom of Cambodia.
- Authorized units of measurement means weights and measures units of metrology.
- Calibration means technical methodologies that calibrate the metrological instruments.
- Verification officer means competent officer prescribed by this law.
- Equipment means a weight, measure or accessories of metrological instruments.
- Importer means the people who are authorized to import metrological equipment.
- Initial Verification means the verification of new or repaired metrological instruments before putting in service.
- Subsequent (in-service) verification means the periodic verification of metrological instruments which have been subject to initial verification and have been in service.
- Measuring Instruments mean metrological instruments used for determining the volume, length, pressure, sound, light, energy etc.

-Pattern approval means the approval of any specific model of a metrological instrument for its use after testing of one or more instruments in accordance with the prescribed requirements.

-Prescribed mark of verification means a mark prescribed by the Minister under this law.

-Determined Laboratory means the National Laboratory or Laboratory of any country or any international laboratory specified by the Minister.

-Trade means relationship, contract or agreement, sale, purchase referred to in article 19 of this law and includes the pre-packaging of products in the Kingdom of Cambodia.

-Metrology standard means the standard equipment in the field of metrology.

-National standard means National primary standard in which high accuracy is calibrated and recognized by any laboratory specified by the Minister.

-Secondary standard means the second-class standard in which accuracy is calibrated by the National primary standard or a higher standard.

-Working standard means the third standard in which accuracy is calibrated by the secondary standard or a higher standard.

-Individual means legal person or physical person.

-Trade mark means the mark used for services called metrology service mark.

Chapter 2

Competent Authority for Management of Metrology

Article 5-

There shall be established an entity to be known as the National Metrology Center written in short N.M.C for managing all activities and services related to metrology such as scientific metrology, industrial metrology and legal metrology under National policy. NMC operates under the Ministry In Charge of Industry, having the level of a general department and its own specific stamp.

The duty and functioning of the NMC is specified by the sub-decree issued by the Royal government of Cambodia.

Chapter 3

National system of legal units of metrology

Article 6-

The national system of legal units of metrology within the Kingdom of Cambodia are determined and specified in annex 1 and annex 2 of this law.

The use of any unit system other from annex 1 and annex 2 shall be prescribed by Prakas of equivalence issued by the Minister.

Chapter 4 Standard of the units of metrology

- Article 7-
Standards of the units of metrology in the Kingdom of Cambodia shall be classified as follows:
-National Primary standards
-Secondary Standards
-Working Standards.
- Article 8-
Under this law the National Standard Meter and National Standard Kilogram are national basic units of metrology. At any time, as necessary, the Minister shall authorize the Standard for other units of metrology as standard national base units.
- Article 9-
Every kind of standards specified in article 7 of this law and referred to multiply or sub-multiply of any such unit of metrology shall follow the specific requirements in the materials and technical rules of production, avoiding mechanical shock, environmental contamination and other sources of error.
- Article 10-
A National Standard specified in article 7 and article 8 of this law shall be calibrated and recognized by any specified laboratory before use in the Kingdom of Cambodia.
- Article 11-
A National Primary Standard shall be determined by Royal Decree and published in the Royal Gazette.
A National Primary Standard shall be deposited in the National Metrology Center.
- Article 12-
The Minister shall cause to have calibrated the National Primary Standard at least once every 10 (ten) years in any specified laboratory.
During the period that any National Primary Standard is sent out for calibration, the Minister shall designate any Secondary Standard to be National Primary Standard and deposited in NMC.
This Secondary Standard will be considered temporarily as the National Primary Standard.
- Article 13-
According to the provision of this law, copies shall made of the National Primary Standard. These copies shall have the same technical characteristic, materials, and shape as the National Primary Standard.
The Secondary Standards shall be determined and recognized by the Prakas issued by the Minister In Charge Of Industry.

- Article 14-
A Secondary Standard shall be kept in the NMC or its branches and shall be calibrated at least once every 5 (five) years with the National Primary Standard.
- Article 15-
If shown that the Secondary Standard does not comply with article 13 of this law, the Minister may amend and cancel the use of this Standard and publish his decision in the Royal Gazette.
- Article 16-
A Working Standard shall be determined and recognized by the certificate of the president of NMC.
A Working Standard shall be copied and have the specific characteristics, material and form as the Secondary Standard.
- Article 17-
A Working Standard shall have the technical characteristics, materials, and shape as specified in article 16 of this law.
- Article 18-
The President shall assign the Verification Officer to keep and protect the Working Standards and to calibrate them with the Secondary Standard every 2 (two) years.

Chapter 5 Use of authorized units of Metrology

- Article 19-
Every contract, agreement or trade relationship related to the goods or other things that are to be done, purchased, sold, hired, delivered, carried, transported, weighed, measured, computed, or paid for in the Kingdom of Cambodia shall be made in terms of the authorized units of metrology specified in article 6 of this law.
- Article 20-
All taxes, fees, duties and services related to the metrology field that are charged or collected in the Kingdom of Cambodia shall be based on the authorized units of metrology specified in the article 6 of this law.
- Article 21-
All goods produced or packed in the Kingdom of Cambodia for sale shall be done so in authorized units of metrology specified in article 6 of this law.
The importation of goods produced and pre-packaged goods which may not comply with this law shall be allowed in the case of goods transferring through export only.

Chapter 6 Use of metrological instruments

Article 22-

All metrological instruments for trade use and other fields in the Kingdom of Cambodia shall be in the authorized national system of legal units of metrology as specified in annex 1 and annex 2.

Article 23-

All metrological equipment in use or in possession for the purpose of trade activities should be accurate and equivalent to the authorized national units of metrology specified in annex 1 and annex 2 of this law, and indelibly marked on the top or side thereof in legible figures and letters except in the case of small size metrological instruments where labeling is impractical.

Article 24-

Metrological instruments permitted to be used or in possession for the use in trade activities and other fields must indicate capacity, maximum and minimum weights or measures on this equipment.

Article 25-

Metrological instruments may be sold or exposed for sale when these instruments have a Trade Mark and a certification of initial verification by a Verification Officer of the NMC.

Article 26-

Weighing and measuring of goods or products shall be implemented as follows:

a- In any shop, warehouse, market place or public area such goods must be weighed or measured in front of the customers except for goods and products which are bought or sold under other conditions.

b-The provision of paragraph a- of this article shall not apply to pre-packaged goods except upon requests from the customers.

Chapter 7 Verification and stamping of metrological instruments

Article 27-

All metrological instruments for use in trade activities and other fields prescribed in article 28 of this law shall be:

a- Subject to pattern approval as specified in article 32 of this law.

b- Subject to initial verification prescribed by Prakas of the Minister.

c- Subject to subsequent (in-service) verification prescribed by Prakas of the Minister.

d- Subject to verification after repair or modification.

Article 28-

Metrological instruments for the use in the following fields shall be subjected to the provisions of article 27 of this law:

a- Specific metrological instruments prescribed for use in the field of public health.
b- Specific metrological instruments prescribed for use in postal services.
c- Specific metrological instruments prescribed for use in the field of electricity, gas and water.

d- Specific metrological instruments prescribed for use in industry, engineering or any other field.

Article 29-

The verification and service of metrological instruments shall be implemented as follows:

a-The NMC shall fix the time and the place for the examination and verification.

b-The NMC shall give a public announcement before verification.

c- Verification officer shall use a Working Standard for verification at the time and place fixed according to Prakas or Regulation prescribed by the Minister.

d-The fees for verification and services of metrological instruments provided for in this article shall be fixed by a joint-Prakas of the Minister in charge of Industry and the Minister in charge of Economy and Finance.

Article 30-

The Stamping of the verification mark shall be implemented as follows:

a- According to article 29, upon the finding of the compliance of any metrological instrument with the Prakas and Regulations specified by the Minister, Verification Officer shall stamp such metrological instruments in the prescribed manner with the prescribed mark of verification.

b- Verification officer shall not stamp with a mark of verification on any metrological instruments which are not correct or which do not comply with Prakas and Regulation.

c- Verification officer shall stamp any metrological instruments with a mark of verification:

1- Such metrological instruments are under authorization.

2- Have been verified by comparison with a working standard or a higher standard.

Article 31-

Metrological instruments which have been stamped by a Verification Officer under this law may be used any place in the Kingdom of Cambodia.

Article 32-

Pattern approval of metrological instruments shall be respected under the following conditions:

a- Metrological instruments specified in article 27 and article 28 of this law shall be subject to pattern approval by the President of NMC in accordance with the types and limits of errors specified by regulations under this law. The fee to be charge for any such pattern examinations and approval shall be fixed in a joint-Prakas of the Minister in charge of Industry and the Minister in charge of Economy and Finance.

b- Where upon a subsequent examination of any metrological instruments which have been approved earlier by the President of NMC and later found to be defective, the President shall have the power to cancel such earlier approval and give a written notification to the owner of such instruments of the cancellation. During 30 (thirty) days after notification, the owner of equipment may file a complaint. After the notification

period expires the cancellation of the pattern approval shall be true and valid in a legal condition.

Chapter 8 Pre-packaged goods conditions

Article 33-

All pre-packaged goods for sale within the Kingdom of Cambodia shall respect the main conditions as follows:

- a- Specify the Net quantity and assure the correctness of weight and measure marked on the packaging materials.
- b- Respect the authorized national legal units of metrology as defined in annex 1 and annex 2 of this law.
- c- Implement and prepare in accordance with pattern approval the weight and measure.
- d- Certify the name and address of the manufacturer, packer or the trade mark.

A detailed condition of pre-packaged goods relating to metrology shall be prescribed by Prakas of the Minister.

Chapter 9 Manufacture and Repair of metrological instruments

Article 34 -

The prescribed modality of manufacturing and repairs shall be implemented as follows:

- a- The manufacture and repair of metrological instruments shall require a license issued by the President of NMC.
- b- A license shall be in the prescribed modality and conditions and should be valid.
- c- The prescribed modality and conditions for issuing the license shall be prescribed by Prakas of the Minister.
- d- A prescribed fee fixed by a joint-Prakas of the Minister in charge of Industry and the Minister in charge of Economy and Finance shall be charged for every license.

Article 35-

The manufacturer of any metrological instruments shall:

- a- Demonstrate their capacity or the capacity of the persons employed by him to manufacture the metrological instruments which he intends to manufacture.
- b- Certify the tools, equipment and other facilities required for the manufacture of such metrological instruments.
- c- Submit to the President of NMC the required technical drawings and samples of such metrological instruments which he intends to manufacture for a pattern approval.

Article 36-

The repairer of any metrological instruments shall:

- a- Demonstrate his capacity or the capacity of the persons employed by him to repair the metrological instruments which he intends to repair.

- b- Confirm such tools, equipment and other facilities required for the proper execution of such repair.

Article 37-

Verification Officers shall use any Working Standard specified in article 16 and article 18 of this law for the testing.

During the job, the Verification Officers shall respect the regulations and conditions as follows:

- a- Not to derive any personal profit from his duty.
- b- Not to repair, change weights and measures or adjust the metrological instruments. The adjustment of weights and measures and the metrological instruments should be made at any place authorized by the President of NMC.

Article 38 -

Verification Officer of the NMC shall keep the list monitoring verification in the prescribed form in which he will register all activities related to the performance of his duties under this law.

Chapter 10 Penalties

Article 39-

Any person who uses or has in his possession for use in trade activities the metrological instruments which do not have the trade mark, shall be warned or shall be subject to a transitional penalty of each equipment from 10,000 (Ten thousands) riels to 500,000 (five hundred thousands) riels.

If this violation is continued this person shall be subject to a transitional double penalty.

Article 40-

Any person who sells or exposes for sale and distribution or for hiring of metrological instruments which do not have a trade mark shall be subject to a transitional penalty for each equipment from 50,000 (fifty thousands) riels to 1,000,000 (one million) riels.

If this violation is continued this person shall be subject to a transitional double penalty.

Article 41-

Any person who uses or has in his possession for use in any trade activities or exposes for sale or distribution any metrological instruments which have not been stamped by a Verification Officer, shall be warned or shall be subject to a transitional penalty for each equipment from 10,000 (ten thousands) riels to 500,000 (five hundred thousands) riels.

If this violation is continued this person shall be subject to a transitional double penalty.

Article 42-

Shall be subject a transitional penalty from 1,000,000 (one million) riels to 5,000,000 (five millions) riels for any person:

- a- who imports and/or produces any metrological instruments not complying with the approved model of weights and measures or not having the pattern approval or
- b- Who produces and/or repairs any metrological instrument without license issued by the president of NMC or
- c- Who holds the license, but violates the conditions prescribing the license.

If this violation is continued this person shall be subject to a transitional double penalty.

Article 43-

Shall be subject to imprisonment from 6 (six) days to 1 (one) month or shall be subject to a fine penalty from 1,000,000 (one million) riels to 5,000,000 (five millions) riels for any person who imports and/or produces any metrological instruments by using counterfeit trade mark.

If this violation is continued this person shall be subject to imprisonment and / or shall be subject to a double penalty.

Article 44-

Shall be subject to a transitional penalty from 1,000,000 (one million) riels to 5,000,000 (five millions) riels for any person:

- a- Who uses or has in his possession for use in any trade activities or sells or exposes for sales or distribution any metrological instruments with the trade mark which he knows to be counterfeit trade mark or
- b- Who removes or changes any verification mark which has been stamped by the verification officer on any metrological instruments and inserts such verification mark on any other metrological instruments.

If this violation is continued this person shall be subject to imprisonment and / or shall be subject to a double penalty.

Article 45-

Shall be subject to imprisonment from 6 (six) days to 1 (one) month and / or shall be subject to a fine penalty from 1,000,000 (one million) riels to 5,000,000 (five millions) riels for any person:

- a- Who increases, diminishes or forges a weight or measure of metrological instruments which has been stamped or
- b- Who uses or has in his possession for use in any trade activities or sells exposes for sales or distribution metrological instruments which he knows to be increased, diminished or forged.

If this violation is continued this person shall be subject to imprisonment and / or shall be subject to a double penalty.

Article 46-

Shall be subject to imprisonment from 6 (six) days to 1 (one) month and / or shall be subject to penalty from 1,000,000 (one million) riels to 5,000,000 (five millions) riels for any person:

a- Who makes the certification by forging the number, quantity, measure or the computation of the cost of services which he has rendered following the agreed weights and measures.

b- Who sells or delivers goods to purchaser by quantity or measure less than agreed quantity.

If this violation continued this person shall be subject to imprisonment and / or shall be subject to a double penalty.

Article 47-

Any person who supplies, sells or exposes for sale any pre-packaged goods having any deceptive characters of any weight or measure shall be subject to imprisonment from 6 (six) days to 1 (one) month and / or shall be subject to a penalty from 1,000,000 (one million) riels to 5,000,000 (five millions) riels.

If this violation continued this person shall be subject to imprisonment and / or shall be subject to a double penalty.

Article 48-

Any importer or any manufacturer of pre-packaged goods:

a- Who imports or packs pre-packaged goods in contravention of the requirement of the paragraph a of article 33 of this law or

b- Fails to mark, using authorized units, the net weight or measure of contents on any pre-packaged material.

c- Fails to indicate the name and address of manufacturer or importer or a mark for determining the identification of such name and address.

Shall be subject to a transitional penalty from 1,000,000 (one million) riels to 5,000,000 (five millions) riels.

If this violation continued this person shall be subject to a transitional double penalty and withdraw the goods for evidence.

Article 49-

Any person who sells or exposes for sale pre-packaged goods: without marking the number, the net weight or measure unit on the pre-package as specified in the annex 1 and annex 2 shall be warned or shall be subject to a transitional penalty from 10,000 (ten thousands) riels to 500,000 (five hundred thousands) riels.

If this violation continued this person shall be subject to a transitional double penalty.

Article 50-

Any person who obstructs or refuses a Verification Officer in the implementation of the power conferred up on him in the operation which is specified in this law shall be warned or shall be subject to a transitional penalty from 1,000,000 (one million) riels to 5,000,000 (five millions) riels.

If this violation continued this person shall be subject to a transitional double penalty.

Article 51-

Any Verification Officer who breaches of any article of this law such as regulation relating to the verification services of metrological instruments shall be subject

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to disciplining punishment in accordance with law on joint article of the civil servant of the Kingdom of Cambodia.
This disciplining punishment is not an obstacle for the filing of a complaint if any violation has been committed.

Article 52-

According to the provision of this law when any violation has been committed by any trade agency or trader, this violation shall be deemed to have been committed by manufacturer or trader unless he proved that such violation was committed without his knowledge or his participation.

Article 53-

According to the provision of this law, any offence shall be deemed to have been committed by the legal person, if the employee, agent, staff of the legal person follow his orders to commit an offence as specified in this law, then those actions shall be combined with the legal person too.

But the legal person shall not be deemed to have committed an offense if he can prove that it was committed without his knowledge or his participation.

Article 54-

The Verification Officers shall have the ability to examine an offense as specified in this chapter.

The report made in compliance with the implementation of the above paragraph shall be recognized by the court until the contrary is proved.

The provision which is specified in article 82 of penal code shall be implemented except the point that contrary to the 2nd paragraph of this article.

Article 55-

The warning punishment and the transitional penalty specified in this law shall be implemented by a Verification Officer.

In case the violator has refused to pay the transitional penalty and in the case of withdrawal of goods, the NMC shall refer the case to the competent court.

Chapter 11 Transitional provision

Article 56-

When this law enters into effect, the physical person or legal person who are providing the services of production and/or repairs of metrological instruments shall make formality to receive license within 6 (six) months of this law at the Ministry of Industry , Mines and Energy.

After this law enters into effect, the physical person or legal person who has in his possession metrological instruments for use, hire or distribution shall apply for initial verification and stamping by Verification Officer in the period not exceeding 6 (six) months at the Ministry of Industry, Mines and Energy.

Non observance to this provision shall be subject to a transitional penalty from 50,000 (fifty thousands) riels to 500,000 (five hundred thousands) riels.

Chapter 12 Final provision

Article 57-

All provisions contrary to this law shall be abrogated.

Phnom Penh, August 11, 2009
King's Signature

Have submitted for the King's signature
Prime Minister
Signature

NORODOM SIHAMONI

HUN SEN

Have informed to the prime minister
Minister of Industry, Mines and Energy
Signature

SUY SEM

Annex I

Definition of the International System of Units (SI) of metrology

Type of the international system of units of metrology

1 The system of units (SI) are the international system of units of which the international abbreviation the name is "SI".

2 The system of units (SI) consist of:

- The base unit are determined the definitions and symbols in the point 1-2-1 and 1-2-2 of the annexes 1.
- The derived units are determined the definitions and symbols in the point 2.

3 The base units of the international system of units (SI) are the national system of legal units of metrology as follows:

- Metre has the symbols as m
- Kilogram has the symbols as kg
- Second has the symbol as s
- Ampere has the symbols as A
- Kelvin has the symbols as K
- Mole has the symbols as mol
- Candela has the symbols as cd

4 The definition of the base units of the international system of units of metrology SI shall be examined as the national system of legal units of metrology as follows:

- The metre is the length of the path traveled by light in vacuum during a time interval of $1/299792458$ of a second.
- The kilogram is the units of mass, it is equal to the mass of the international prototype, which keeps in the Bureau of Weight and Measure of the international organization of Legal Metrology.
- The second is the duration of 9192631770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium 133 atom.
- The ampere is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section and placed 1 meter apart in vacuum, would produce between these conductors a force equal to 2×10^{-7} Newton per meter of length.
- The Kelvin, unit of thermodynamic temperature, is the fraction $1/273,16$ of the thermodynamic temperature of the triple point of water.
- The mole is the amount of substance of a system which contains as many elementary entities as there are atoms in 0,012 kilogram of Carbon 12 when the mole is used the elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles, or specified group of such particles.
- The candela is the luminous intensity in a given direction of a source that emits monochromatic radiation of frequency 540×10^{12} hertz and that has a radiant intensity in that direction of 1/683 watt per steradian.

2-Derived units

The derived units are defined in such a way that they are coherent with the base units and should the occasion arise with the supplementary units, that is to say they are defined by algebraic expression in the units with a numerical factor equal to one. Most commonly used derived units are indicated in section A, B, C, D, E and F.

1-Units of space and Time

1-1-1- Plane angle: radian (symbol : rad)

The radian is the plane angle between two radii which cut off on the circumference of a circle an arc equal in length to the radius.

$$1 \text{ rad} = \frac{1\text{m}}{1\text{m}} = 1$$

1-2 solid angle: steradian (symbol: Sr)

The steradian is the solid angle, which having its vertex in the centre of a sphere, cuts off an area of the surface of the sphere equal to that of a square with its side of equal length to the radius of the sphere:

$$1 \text{ sr} = \frac{1\text{m}^2}{1\text{m}^2} = 1$$

1-3 Wave number: 1 per meter (symbol:m⁻¹)

1 per meter is the wave number of a monochromatic radiation whose wave length is equal to 1 meter.

$$1 \text{ m}^{-1} = \frac{1}{1\text{m}}$$

1-4 Surface, Area: the square meter (symbol: m²)

The square meter is the surface of a square having a side of 1 meter (1 m² = 1m x 1 m)

1-5 Volume: the cubic meter (symbol : m³)

The cubic meter is the volume of a cube having a side of 1 meter

$$1 \text{ m}^3 = 1\text{m} \times 1\text{m} \times 1\text{m}$$

1-6 Frequency: the hertz (symbol : Hz)

The hertz is the frequency of periodic phenomenon of which the periodic time is 1 second.

$$1 \text{ Hz} = 1 \text{ s}^{-1} = \frac{1}{1\text{s}}$$

2-1-7 Angular velocity: radian per second (symbol: rad/s or rad. s⁻¹)
The radian per second is the angular velocity of a body which, animated by a uniform rotation around a fixed axis, turns 1 radian in 1 second.

$$1 \text{ rad/s} = \frac{1\text{rad}}{1\text{s}}$$

2-1-8 Angular acceleration: radian per second squared (symbol: rad/ s² or rad. s⁻²)

The radian per second squared is the angular acceleration of a body which is animated by a rotation varying uniformly around a fixed axis, and whose angular velocity varies by 1 radian per second in 1 second.

$$1 \text{ rad/s}^2 = \frac{1\text{rad/s}}{1\text{s}}$$

2-1-9 Speed: meter per second (symbol: m/s or m. s⁻¹)

The meter per second is the speed of a body which, animated by a uniform movement, covers 1 meter in 1 second.

$$1 \text{ m/s} = \frac{1\text{m}}{1\text{s}}$$

2-1-10 Acceleration: meter per second squared (symbol: m/s² or m. s⁻²)

The meter per second squared is the acceleration of a body, animated by a uniformly varied movement whose speed varies in 1 second by 1 meter per second.

$$1 \text{ m/s}^2 = \frac{1\text{m/s}}{1\text{s}}$$

B- Units of Mechanics

2-2-1 Linear density: kilogram per meter (symbol: kg/m or kg. m⁻¹)

The kilogram per meter is the linear density of a homogeneous body of uniform section having a mass of 1 kilogram and a length of 1 meter.

$$1 \text{ kg/m} = \frac{1\text{kg}}{1\text{m}}$$

2-2-2 Surface density: kilogram per square meter (symbol: kg/m² or kg. m⁻²)

The kilogram per square meter is the density of a homogeneous body having a mass of 1 kilogram and a surface of 1 square meter.

$$1 \text{ kg/m}^2 = \frac{1\text{kg}}{1\text{m}^2}$$

2-2-9 Power, Energy flow rate, Heat flow rate: watt (symbol: W)
The watt is the power which gives rise to a production of energy equal to 1 joule per second.

$$1 \text{ W} = \frac{1 \text{ J}}{1 \text{ s}}$$

2-2-10 Volume flow rate: cubic meter per second (symbol: m^3/s or $\text{m}^3 \cdot \text{s}^{-1}$)
The cubic meter per second is the volume flow rate of a uniform flow such that a substance having a volume of 1 cubic meter passes through the cross section considered in 1 second.

$$1 \text{ m}^3 / \text{s} = \frac{1 \text{ m}^3}{1 \text{ s}}$$

2-2-11 Mass flow rate: kilogram per second (symbol: kg/s or $\text{kg} \cdot \text{s}^{-1}$)
The kilogram per second is the mass flow rate of uniform flow such that a substance having a mass of 1 kilogram passes through the cross section considered in 1 second.

$$1 \text{ kg}/\text{s} = \frac{1 \text{ kg}}{1 \text{ s}}$$

C-Units of Heat

3-1 Entropy: joule per Kelvin (symbol: J/K or $\text{J} \cdot \text{K}^{-1}$)
The joule per Kelvin is the increase in the entropy of a system receiving a quantity of heat of 1 joule at the constant thermodynamic temperature of 1 Kelvin, provided that no irreversible change takes place in the system.

$$1 \text{ J}/\text{K} = \frac{1 \text{ J}}{1 \text{ K}}$$

3-2 Specific heat capacity: joule per kilogram Kelvin (symbol: $\text{J}/(\text{kg} \cdot \text{K})$ or $\text{J} \cdot \text{kg}^{-1} \cdot \text{K}^{-1}$)
The joule per kilogram Kelvin is the specific heat capacity of a homogeneous body having a mass of 1 kilogram in which the addition of a quantity of heat of 1 joule produces a rise in temperature of 1 Kelvin.

$$1 \text{ J}/(\text{kg} \times \text{K}) = \frac{1 \text{ J}}{1 \text{ kg} \times 1 \text{ K}}$$

3-3 Thermal conductivity: watt per meter Kelvin (symbol: $\text{W}/(\text{m} \cdot \text{K})$ or $\text{W} \cdot \text{m}^{-1} \cdot \text{K}^{-1}$)
The watt per meter Kelvin is the thermal conductivity of a homogeneous body in which a difference of temperature of 1 Kelvin between two parallel planes having a surface of 1 square meter and which is 1 meter apart produces between these planes a heat flow rate of 1 watt.

$$1 \text{ W}/(\text{m} \times \text{K}) = \frac{1 \text{ W}/\text{m}^2}{1 \text{ K}/1 \text{ m}}$$

2-2-3 Density (mass density): kilogram per cubic meter (symbol: kg/m^3 or $\text{kg} \cdot \text{m}^{-3}$)
The kilogram per cubic meter is the density of a homogeneous body having a mass of 1 kilogram and a volume of 1 cubic meter.

$$1 \text{ kg}/\text{m}^3 = \frac{1 \text{ kg}}{1 \text{ m}^3}$$

2-2-4 Force: Newton (symbol: N)
The Newton is the force which, when applied to a body having a mass of 1 kilogram, gives it an acceleration of 1 meter per second squared.

$$1 \text{ N} = 1 \text{ kg} \times \text{m}/\text{s}^2$$

2-2-5 Pressure, Stress: Pascal (symbol: Pa)
The Pascal is the uniform pressure which, when acting on a plane surface of 1 square meter, exercises perpendicularly to that surface a total force of 1 Newton. It is also uniform stress which, when acting on a plane surface of 1 square meter, exercises on that surface a total force of 1 Newton.

$$1 \text{ Pa} = \frac{1 \text{ N}}{1 \text{ m}^2}$$

2-6 Dynamic viscosity: Pascal second (symbol: $\text{Pa} \cdot \text{s}$)
The Pascal second is the dynamic viscosity of a homogeneous fluid in which the uniform linear movement of the plane surface of 1 square meter leads to a retarding force of 1 Newton, when there is a difference in velocity of 1 meter per second between two parallel planes separated by a distance of 1 meter.

$$1 \text{ Pa} \times \text{s} = \frac{1 \text{ Pa} \times 1 \text{ m}}{1 \text{ m}/\text{s}}$$

2-7 Kinematics viscosity: meter squared per second (symbol: m^2/s or $\text{m}^2 \cdot \text{s}^{-1}$)
The meter squared per second is the kinematics viscosity of a fluid whose dynamic viscosity is 1 Pascal second and whose density is 1 kilogram per cubic meter.

$$1 \text{ m}^2 / \text{s} = \frac{1 \text{ Pa} \times \text{s}}{1 \text{ kg}/\text{m}^3}$$

2-8 Work, Energy, Quantity of heat: joule (symbol: J)

The joule is the work done when the point of application of force of 1 Newton is displaced through a distance of 1 meter in the direction of the force.

$$1 \text{ J} = 1 \text{ N} \times 1 \text{ m}$$

1-Units of Electricity and Magnetism

4-1 Quantity of electricity, Electric charge: coulomb (symbol: C)

The coulomb is the quantity of electricity carried in 1 second by a current of 1 ampere.

$$1 \text{ C} = 1 \text{ A} \times 1 \text{ s} = 1 \text{ A} \times \text{s}$$

4-2 Electric potential, electric tension, Electromotive force: volt (symbol: V)

The volt is the difference of electric potential between two points of a conducting wire carrying a constant current of 1 ampere, when the power dissipated between these two points is equal to 1 watt.

$$1 \text{ V} = \frac{1 \text{ W}}{1 \text{ A}}$$

4-3 Electric field strength: volt per meter (symbol: V/m)

The volt per meter is the strength of the electric field which exercises a force of 1 Newton on a body charged with a quantity of electricity of 1 coulomb.

$$1 \text{ V/m} = \frac{1 \text{ N}}{1 \text{ C}}$$

4-4 Electric resistance: ohm (symbol: Ω)

The ohm is the electric resistance between two points of a conductor when a constant potential difference of 1 volt, applied to these points, produces in the conductor a current of 1 ampere, the conductor not being the seat of any electromotive force.

$$1 \Omega = \frac{1 \text{ V}}{1 \text{ A}}$$

4-5 Conductance: siemens (symbol: S)

The siemens is the conductance of a conductor having an electric resistance of 1 ohm.

$$1 \text{ S} = 1 \Omega^{-1} = \frac{1}{1 \Omega}$$

4-6 Electric capacitance: farad (symbol: F)

The farad is the capacitance of a capacitor between the plates of which there appears a difference of electric potential of 1 volt, when it is charged by a quantity of electricity of 1 coulomb.

$$1 \text{ F} = \frac{1 \text{ C}}{1 \text{ V}}$$

2-4-7 Inductance: Henry (symbol: H)

The Henry is the electric inductance of a closed circuit in which an electromotive force of 1 volt is produced when the electric current in the circuit varies uniformly at the rate of 1 ampere per second.

$$1 \text{ H} = \frac{1 \text{ V} \times 1 \text{ s}}{1 \text{ A}}$$

2-4-8 Magnetic flux, magnetic induction flux: Weber (symbol: Wb)

The Weber is the magnetic flux which, linking a circuit of 1 turn, would produce in it an electromotive force of 1 volt, if it were reduced to zero at a uniform rate in 1 second.

$$1 \text{ Wb} = 1 \text{ V} \times 1 \text{ s}$$

2-4-9 Magnetic induction, magnetic, flux density: tesla (symbol: T)

The tesla is the uniform magnetic induction, which, distributed normally over a surface of 1 square meter, produces across the surface a total magnetic flux of 1 Weber.

$$1 \text{ T} = \frac{1 \text{ Wb}}{1 \text{ m}^2}$$

2-4-10 Magnetic motive force: ampere (symbol: A)

The ampere is the magnetomotive force along any closed curve which surrounds once only an electric conductor through which an electric current of 1 ampere passes.

2-4-11 Magnetic field strength: ampere per meter (symbol: A/m or $\text{A} \cdot \text{m}^{-1}$)

The ampere per meter is the strength of the magnetic field produced in vacuum along the circumference of a circle of 1 meter circumference, by an electric current of 1 ampere, maintained in a straight conductor of infinite length, of negligible circular cross section, forming the axis of the circle mentioned.

$$1 \text{ A/m} = \frac{1 \text{ A}}{1 \text{ m}}$$

2-Units of Radiation and Light

2-5-1 Radiant intensity: watt per steradian (symbol: W/sr or $\text{W} \cdot \text{sr}^{-1}$)

The watt per steradian is the radiant intensity of a point source emitting a uniform radiant flux of 1 watt in a solid angle of 1 steradian.

$$1 \text{ W/sr} = \frac{1 \text{ W}}{1 \text{ sr}}$$

3-Decimal Multiples and sub-multiples of SI Units

3-1 The decimal multiples and sub-multiples of SI units are formed by means of the decimal numerical factors set out in paragraph 3.2 by which the SI unit concerned is multiplied.

3-2 The names of the decimal multiples and sub-multiples of the SI units are formed by means of SI prefixes designating the decimal numerical factors.

Factors	SI Prefix	Symbol
1 000 000 000 000 000 000 = 10 ¹⁸	exa	E
1 000 000 000 000 000 = 10 ¹⁵	peta	P
1 000 000 000 000 000 = 10 ¹²	tera	T
1 000 000 000 000 = 10 ⁹	giga	G
1 000 000 000 = 10 ⁶	mega	M
1 000 000 = 10 ³	kilo	k
100 = 10 ²	hecto	h
10 = 10 ¹	deca	da
0.1 = 10 ⁻¹	deci	d
0.01 = 10 ⁻²	centi	c
0.001 = 10 ⁻³	milli	m
0.000 001 = 10 ⁻⁶	micro	μ
0.000 000 001 = 10 ⁻⁹	nano	n
0.000 000 000 001 = 10 ⁻¹²	pico	p
0.000 000 000 000 001 = 10 ⁻¹⁵	femto	f
0.000 000 000 000 000 001 = 10 ⁻¹⁸	atto	a

3-3 A prefix shall be considered to be combined with the name of the unit to which it is directly attached.

3-4 The symbol of the prefix shall be placed before the symbol of the unit without intermediate space, the whole forms the symbol of the multiple of the unit. The symbol of the prefix is therefore considered to be combined with the symbol of the unit, to which it is directly attached, forming with it a new unit symbol which can be raised to a positive or negative power and which can be combined with other unit symbols to form the symbol or compound units.

3-5 Compound prefixes formed by the juxtaposition of several SI prefixes, are not permitted.

3-6 The names and symbols of the decimal multiples and sub-multiples of the unit of mass are formed by the addition of the SI prefixes to the word "gram" (symbol: g) 1g = 0.001 kg = 10⁻³ kg

3-7 To designate the decimal multiples and sub-multiples of a derived unit which is expressed in the form of a fraction, a prefix can be attached indifferently the units which appear either in the numerator, or in the denominator, or in both of these terms.

-5-2 Luminance: candela per square meter (symbol: Cd/m² or cd . m⁻²)
The candela per square meter is the luminous luminance perpendicular to the plane surface of 1 square meter of a source of which the luminous intensity perpendicular to that surface is 1 candela.

$$1 \text{ cd /m}^2 = \frac{1 \text{ cd}}{1 \text{ m}^2}$$

-5-3 Luminous flux: lumen (symbol: lm)
The lumen is the luminous flux emitted in the unit solid angle (steradian) by a uniform point source having a luminous intensity of 1 candela.

$$1 \text{ lm} = 1 \text{ cd} \times 1 \text{ sr}$$

-5-4 Illuminance: lux (symbol: lx)
The lux is the illuminance of a surface receiving a luminous flux of 1 lumen, uniformly distributed over a square meter of the surface.

$$1 \text{ lx} = \frac{1 \text{ lm}}{1 \text{ m}^2}$$

Units of Ionizing Radiations

5-1 Activity (of a radioactive source): Becquerel (symbol: Bq)
The Becquerel is the activity of radioactive source which one nuclear transformation or transition occurs per second.

$$1 \text{ Bq} = \frac{1}{1 \text{ s}}$$

5-2 Absorbed dose: gray (symbol: Gy)
The gray is the dose absorbed in an element of matter of 1 kilogram mass to which the energy of 1 joule is imparted by ionizing radiations whose energy fluence is constant.

$$1 \text{ Gy} = \frac{1 \text{ W}}{1 \text{ kg}}$$

5-3 Exposure: coulomb per kilogram (symbol: C/kg or C . kg⁻¹)
The coulomb per kilogram is the exposure of a photonic ionizing radiation, which can produce in a quantity of air of 1 kilogram mass, ions of one sign carrying a total electric charge of 1 coulomb, the energy fluence being uniform in the quantity of air considered.

Annex 2

Authorized system of units of metrology for use in production — Trade

Part 1

Multiples and sub-multiples of the international system of units of metrology SI

1-1 Measurement of length

1-1-1 SI units

Kilometer (km) = 1000 meters
 Meter (m) = as defined annex 1
 Millimeter (mm) = 1/1000 meters
 Micrometer (μm) = 1/1000000 meters

1-1-2 Other metric units

Nautical mile = 1852 meters
 Centimeter = 1/100 meters

1-2 Measurement of Area

1-2-1 SI units

Square meter (m^2) = as defined in annex 1
 Square kilometer ($(\text{km})^2$) = 1000000 square meters
 Square millimeter ($(\text{mm})^2$) = 1/1000000 of square meter
 Hectare (ha) = 10000 square meters
 Are (a) = 100 square meters
 Square centimeter ($(\text{cm})^2$) = 1/10000 of a square meter

1-3 Measurement of Plane and Solid angle

1-3-1 Plane angle

Radian (rad) = as defined in annex 1
 Degree ($^\circ$) = $\pi/180$ radians
 Minute ($'$) = $\pi/10800$ radians
 Second ($''$) = $\pi/648000$ radians

1-3-2 Solid angle

steradian (sr) = as defined in annex 1

1-4 Measurement of speed

1-4-1 SI units

Meter per second (m/s) = as defined in annex 1

1-4-2 Other metric units

Kilometer per hour = 10/36 meters per second

1-5 Measurement of sound

1-5-1 The bel (Symbol: B) is the level of a field quantities F when $F/F_0 = 10^{1/2}$, where F_0 is a reference quantities of the same kind.

$$1 \text{ B} = \ln (F/F_0)$$

F_0 = Reference value, F = measure value

The sub-multiple decibel has symbol as (dB) is commonly used.

1-6 Measurement of volume or capacity

1-6-1 SI units

Cubic meter = as defined in annex 1

1-6-2 Other metric units

Hectoliter (hl) = 100 liters
 Liter (l) = 1/1000th of a cubic meter
 Cubic centimeter ($(\text{cm})^3$) = 1/1000000th of meter
 Deciliter (dl) = 1/10th of a liter
 Centiliter (cl) = 1/100th of a liter
 Milliliter (ml) = 1/1000th of a liter

1-7 Measurement of Mass

1-7-1 SI units

Kilogram (kg) = as defined in annex 1
 Gram (g) = 1/1000th of kilogram
 Milligram (mg) = 1/1000000th of a kilogram
 Microgram (μg) = 1/1000000000th of a kilogram

1-7-2 Other metric units

Tone (t) = 1000 kilogram
 Metric carat = 1/5th part of gram

1-8 Measurement of density (mass density)

1-8-1 SI units

Kilogram per cubic meter = as defined in annex 1

1-8-2 Other metric units

Tone per cubic meter = 1000 kilograms per cubic meter

1-9 Measurement of Force

1-9-1 SI units

Mega Newton (MN) = 1000000 new tons
 Kilo Newton (kN) = 1000 new tons
 Newton (N) = as defined in annex 1
 Mill Newton (mN) = 1/1000th of a new ton

1-10 Measurement of pressure and stress

- 1-10-1 SI units
 - Mega Pascal (MPa) = 1 000 000 Pascal
 - Kilopascal (kPa) = 1 000 paschal
 - Pascal (Pa) = as defined in annex 1

1-11 Measurement of linear density of textiles

- 1-11-1 Other metric units
 - tex (tex) = The mass in grams of one kilometer of yarn
 - millitex (mtex) = $1 \text{ g/km} = 10^{-6} \text{ kg/m}$
 - decitex (dtex) = $1/1\,000^{\text{th}}$ of a tex
 - kilotex (ktex) = $1/10^{\text{th}}$ of a tex
 - = 1 000 tex

1-12 Measurement of Time and Frequency

- 1-12-1 Time
 - Minute (min) = 60 seconds
 - Hour (h) = 3600 seconds
 - Day (d) = 86 400 seconds
 - Week = 7 days
 - Month and year of the Gregorian calendar

-12-2 Frequency

- Gigahertz (GHz) = 1 000 000 000 hertz
- Megahertz (MHz) = 1 000 000 hertz
- Kilohertz (kHz) = 1 000 hertz
- Hertz (Hz) = as defined in annex 1.

-13 Measurement of Temperature

- 13-1 SI units
 - Kelvin (K) = as defined in annex 1.

-13-2 Other metric units

- Degree Celsius (C°) = one Kelvin (K)
- the Celsius temperature scale is defined by the following equation:

$$t = T - T_0 \text{ where}$$

t - Temperature in degree Celsius,
T - Temperature in Kelvin
T₀ = 273.15 K

14 Measurement of Energy and Power

- 14-1 Energy, Work and Quantity of Heat
 - Joule (J) = as defined in annex 1.
 - Kilojoule (kJ) = 1 000 joules
 - Megajoule (MJ) = 1 000 000 joule and all other multiples and sub-multiples as defined in section 3 of annex 1.
 - Wattour (Wh) = $3.6 \cdot 10^3$ joules
 - kilo wattour (kWh) = 1 000 wattour

Electron volt (ev) = The energy acquired by an electron in passing through a potential difference of 1 volt in vacuum.

All multiple and sub-multiples are determined in point 3 of the annex 1.

1-14-2 Power Energy flow rate and Heat flow rate

- milliwatt (mW) = $1/1\,000$ of a watt
- watt (W) = as defined in annex 1.
- kilowatt (kW) = 1 000 W
- Megawatt (MW) = 1 000 000 watts and all other multiples and sub-multiples as defined in section 3 of annex 1.

All multiple and sub-multiples are determined in point 3 of the annex 1.

1-15 Specific Energy

- 1-15-1 SI units
 - kilojoule per kilogram (kJ/kg) = 1 000 joules per kilogram
 - joule per kilogram (J/kg) = 1 joule per kilogram

1-15-2 Other units

- joule per gram (J/g) = $1/1\,000^{\text{th}}$ joule per kilogram

1-16.1 SI units

- ampere (A) = as defined in annex 1
- milliampere (mA) = $1/1\,000^{\text{th}}$ of ampere
- microampere (μA) = $1/1\,000\,000^{\text{th}}$ of ampere

1-17 Electric current

- 1-17-1 SI units
 - kilovolt (kV) = 1 000 volts
 - volt (V) = as defined in annex 1
 - millivolt (mV) = $1/1\,000^{\text{th}}$ of a volt
 - microvolt (μV) = $1/1\,000\,000^{\text{th}}$ of a volt

1-18 Electric Capacitance

- 1-18-1 SI units
 - henry (H) = as defined in annex 1
 - millihenry (mH) = $1/1\,000^{\text{th}}$ of a henry
 - microhenry (μH) = $1/1\,000\,000^{\text{th}}$ of a henry

1-19 Electric resistance

- 1-19-1 SI units
 - megaohm (M Ω) = 1 000 000 ohms
 - kilo ohm (k Ω) = 1 000 ohms
 - ohm (Ω) = as defined in annex 1
 - Milliohm (m Ω) = $1/1\,000^{\text{th}}$ of an ohm
 - micro ohm ($\mu\Omega$) = $1/1\,000\,000^{\text{th}}$ of an ohm

Annex 2 Part 2

Determination of standard of the international system of units.

1-1 Linear measures

Measures of:

- 500 meters
- 200 meters
- 100 meters
- 50 meters
- 30 meters
- 20 meters
- 10 meters
- 5 meters
- 3 meters
- 2 meters
- 1 meter

- 1 centimeter
- 1 millimeter
- 1 micro meter

1-2 Square Measures

Measures of, or any multiple of 1, 1 square decimeter.

1-3- Cubic measures

Measures of or any multiple of, the cubic decimeter = 0.001 m³

1-4 Capacity measures

Measures of:

- 10 liters or any multiple of 10 liters
- 5 liters
- 2½ liters
- 2 liters
- 1 liter
- 500 milliliters
- 250 milliliters
- 200 milliliters
- 100 milliliters
- 50 milliliters
- 25 milliliters
- 20 milliliters
- 10 milliliters
- 5 milliliters
- 2 milliliters
- 1 milliliter

1-20 quantity of Electricity

- 1-20-1 SI units
 - coulomb (C) = as defined in annex 1
 - millicoulomb (mC) = 1/1 000th of coulomb
 - microcoulomb (μC) = 1/1 000 000th of coulomb
- 1-20-2 Other units
 - amperehour (Ah) = 3600 coulombs

1-21 Luminous intensity

- 1-21-1 SI units
 - candela (cd) = as defined in annex 1

1-22 Illumination

- 1-22-1 SI units
 - lux (lx) = as defined in annex 1

1-23 Luminous fluxes

- 1-23-1 SI units
 - Lumen (lm) = as defined in annex 1

1-24 Activity

- 1-24-1 SI units
 - Becquerel (Bq) = as defined in annex 1
 - Milli Becquerel (mBq) = 1/1 000 of Becquerel

1-25 Absorbed dose

- 1-25-1 SI units
 - gray (Gy) = as defined in annex 1
 - milli gray (mGy) = 1/1 000 of gray

1-26 Exposure

- 1-26-1 SI units
 - Coulomb per kilogram (C/kg) = as defined in annex 1

1-5 Weights
Weights of:

50 kilograms
20 kilograms
10 kilograms

5 kilograms
2 kilograms
1 kilogram

500 grams
200 grams
100 grams
50 grams
20 grams
10 grams
5 grams
2 grams
1 gram

500 milligrams
200 milligrams
100 milligrams
50 milligrams
20 milligrams
10 milligrams
5 milligrams
2 milligrams
1 milligram

1-5-2 Weights of:

500 carats (metric)
200 carats (metric)
100 carats (metric)
50 carats (metric)
20 carats (metric)
10 carats (metric)
5 carats (metric)
2 carats (metric)
1 carat (metric)
0.5 carats (metric)
0.25 carats (metric)
0.2 carats (metric)
0.1 carats (metric)
0.05 carats (metric)
0.02 carats (metric)
0.01 carats (metric).