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NATIONAL PETROCHEMICAL COMPANY STANDARDS

ENGINEERING STANDARD

FOR
SYSTEM OF UNITS

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SCOPE

This engineering standard presents International System of Units, "SI", as a legal system in the "NPC" and related companies.

In the case of any conflict between this engineering standard and contractor's standards and/or specifications, NPC shall confirm.

RELATED STANDARDS

This engineering standard is based on and referred to the following international standards and publications.

ISO 31/0 (1981), General principles concerning quantities, units and symbols.

ISO 31/1 (1978), Quantities and units of space and time.

ISO 31/2 (1978), Quantities and units of periodic and related phenomena.

ISO 31/3 (1978), Quantities and units of mechanics.

ISO 31/4 (1978), Quantities and units of heat.

ISO 31/5 (1979), Quantities and units of electricity and magnetism.

ISO 31/6 (1980), Quantities and units of light and related electromagnetic.

ISO 31/7 (1978), Quantities and units of acoustics.

ISO 31/8 (1980), Quantities and units of physical chemistry and molecular physics.

ISO 31/9 (1980), Quantities and units of atomic and nuclear physics.

ISO 31/10 (1980), Quantities and units of nuclear reactions and ionizing radiations.

ISO 31/11 (1978), Mathematical signs and symbols for use in the physical sciences and technology.



ISO 31/12 (1981), Dimensionless parameters.

ISO 31/13 (1981), Quantities and units of solid state physics.

ISO 31(Amendment 1) (1985), Quantities and units.

ISO 1000 (1981), SI units and recommendations for use of their multiples and of certain other units.

OIML NO.2 (1978), Legal units of measurement.

INTERNATIONAL SYSTEM OF UNITS, "SI"

SI is the official international French abbreviation for the International System of Units (Le Systeme International d'Unites). The SI is not the old centimeter-gram-second system, but a modernized version of it.

SI consists of base units, derived units, and units for dimensionless quantities. In addition, there are other units which are not a part of SI, but may be used together with SI units (called allowable non-SI units). The base units of SI by convention are regarded as being dimensionally independent. Derived units of SI are divisions of the SI base units without the introduction of any numerical factors. Thus the SI unit of speed is the SI base unit of length divided by the SI base unit of time, and the SI unit of Kinetic energy is the SI base unit of mass multiplied by the square of the SI base unit of length divided by the square of the SI base unit of time. Such a system of units is called "coherent".

In any coherent system of units there is one, and only one unit for each quantity.

SI prefixes are used to form decimal multiples and submultiples of the SI units.



3.1 BASE UNITS

The base units of SI by convention are regarded as being dimensionally independent. The names and symbols of these units are respectively meter (symbol:m), Kilogram (symbol:kg), second (symbol:s), Ampere (symbol:A), Kelvin (symbol:K), mole (symbol:mol), and candela (symbol:cd).

As it is seen in the following definitions, all base units of SI except kilogram have been related to natural phenomena and considered unvarying and capable of being measured very accurately.

3.1.1 Meter(m)

Meter is the unit of length; it is the length equal to 1,650,763.73 wavelengths in vacuum of the radiation corresponding to the transition between the levels $2p^{10}$ and $5d_5$ of the, krypton-86 atom.

3.1.2 Kilogram(kg)

Kilogram is the unit of mass; it is equal to the mass of a certain platinum-iridium cylinder kept at the International Bureau of Weights and Measures at Sevre, near Paris, France.

3.1.3 Second (s)

Second is the unit of time; it is the duration of 9,192,631,770 periods of radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium-133 atom.

3.1.4 Ampere (A)

Ampere is the unit of electrical current; it is a constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed one meter apart in vacuum, a force equal to 2×10^{-7} Newton per meter of length would produce.

3.1.5 Kelvin (k)

Kelvin is the unit of thermodynamic temperature; it is $1/273.15$ of the thermodynamic temperature of the triple point of water.



In addition to the thermodynamic temperature (symbol: T), expressed in kelvin, use is also made of Celsius temperature (symbol: t) defined by the equation:

$t = T - T_0$, where, $T_0 = 273.15\text{K}$.

The unit "degree Celsius" is a special name instead of "kelvin" to express Celsius temperature. An interval of Celsius temperature, may be expressed either in degree Celsius or in kelvin.

3.1.6 Mole (mol)

Mole is the unit for amount of substance; it is the **amount** of substance of a **system**, which contains as **many** as elementary, entities as there are atoms in 0.012 kilogram of carbon 12 in the ground state.

When mole is used, the elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles.

3.1.7 Candela(cd)

Candela is the unit of luminous intensity; it is luminous intensity in the perpendicular direction of a surface of $1/600.000$ square meter of a black body at the temperature of freezing platinum under a pressure of 101,325 Newton per square meter.

3.2 DIMENSIONLESS QUANTITIES' UNITS

In addition to the base units, which are described in sub-clause 3.1 and there under, the SI have two, purely geometrical units which are called units for dimensionless quantities. The names and symbols of these units are:

Radian(symbol: rad) and Steradian(symbol: sr).

3.2.1 Radian(rad)

The radian, used for plane angle, is the plane angle between two radii which cuts off on the circumference of a circle and are equal in length to the radius:

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



3.2.2

Steradian(sr)

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

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

3.3

DERIVED UNITS

Derived units are expressed algebraically in terms of base units and/or units of dimensionless quantities. Their symbols are obtained by means of mathematical signs of multiplication and divisions. For example, the unit for velocity is (m/s) and for angular velocity is (rad/s).

For some of the derived units, special names and symbols exist, which are included in table I.