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IS 1885-63 (1985): Electrotechnical vocabulary, Part 63: Nuclear instrumentation [LITD 8: Electronic Measuring Instruments, Systems and Accessories]

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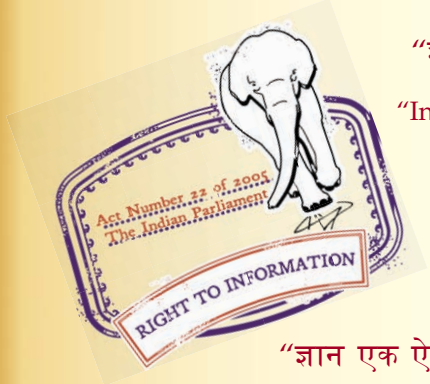

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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IS : 1885 (Part 63) - 1985
IEC Pub 50 (391) (1975) &
IEC Pub 50 (392) (1976)

(Reaffirmed 2001)

Indian Standard

ELECTROTECHNICAL VOCABULARY

PART 63 NUCLEAR INSTRUMENTATION

(IEC Title : International Electrotechnical Vocabulary
Chapter 391 : Detection and Measurement of
Ionizing Radiation by Electrical Means
Chapter 392 : Nuclear Instrumentation)

UDC 621.039:537.56/58:621.317.39:001.4

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Gr 12

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Indian Standard

ELECTROTECHNICAL VOCABULARY

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Chapter 391 : Detection and Measurement of
Ionizing Radiation by Electrical Means
Chapter 392 : Nuclear Instrumentation)

Nuclear Instrumentation Sectional Committee, LTDC 26 [Ref : Doc : LTDC 26 (945)]

National Foreword

This Indian Standard (Part 63), which is identical with IEC Pub 50 'International Electrotechnical Vocabulary', Chapter 391 (1975) 'Detection and measurement of ionizing radiation by electrical means', and Chapter 392 (1976) 'Nuclear instrumentation' Supplement to Chapter 391, issued by the International Electrotechnical Commission, was adopted by the Indian Standards Institution on the recommendation of the Basic Standard on Electronics and Telecommunication Sectional Committee in consultation with the Nuclear Instrumentation Sectional Committee and on the approval of the Electronics and Telecommunication Division Council.

Wherever the words 'International Standard' appear referring to this standard, it should be read as 'Indian Standard'. Similarly reference to 'IEV Chapter 391' should be read as a reference to chapter 391 of this standard.

In this Indian Standard, the 'ICRU Report 19' is referred to; the Sectional Committee responsible for the preparation of this standard has reviewed the provisions of this Report and has decided that they are acceptable for use in conjunction with this standard.

Only the English language text of the International Standards has been retained while adopting them as Indian standard.

Adopted 13 November 1985 | | Gr 12

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CONTENTS

CHAPTER 391: DETECTION AND MEASUREMENT OF IONIZING RADIATION BY ELECTRIC MEANS

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SUPPLEMENT TO CHAPTER 391

EXPLANATORY NOTES

Significance of the words "suitably small".

Terms 391-03-01 — 391-03-09 — 391-03-11 — 391-03-17 — 391-03-19 — 391-03-20 — 391-03-21 — 391-03-23 — 391-03-24 of Section 391-03 "Quantities and units" have been accurately defined by the International Commission on Radiation Units and Measurements (ICRU) by means of mathematical formulae.

In its "Nuclear Energy Glossary", ISO translated these mathematical formulae into plain language, using the words "suitably small" with a peculiar significance.

As far as the definitions of these terms are concerned, it was decided to use the definitions of ISO, and to complete them with possibly the indications of the formulae of ICRU in which the symbols have the meaning specified in ICRU Report 19.

In these definitions, the peculiar significance of the words "suitably small" is as follows:

A "suitably small element of volume" must be understood as a volume that is, in the actual conditions in which the specified quantity is evaluated:

— on one hand, so small that a further reduction in its size would not appreciably change the measured value of this quantity,

— and on the other hand, still large enough to be traversed by many particles and to contain many interactions between particles and matter.

In the same way, a "suitably small interval of time" must be understood as an interval of time that is, in the actual conditions in which the specified quantity is evaluated:

— on one hand, so short that a further reduction in this interval would not appreciably change the measured value of this quantity,

— and on the other hand, still long enough that, during this interval, the element of volume referred to in the definition is traversed by many particles and contains many interactions between particles and matter.

Terms printed in italics

In the text of definitions, a number of words or expressions are printed in italics. They are those terms which are defined elsewhere in Chapter 391 or Chapter 392 and for which the knowledge of the definition was judged useful for a correct understanding of the definitions in which they appear.

CHAPTER 391: DETECTION AND MEASUREMENT OF IONIZING RADIATION BY ELECTRIC MEANS

Sections 391-01 to 391-04 — Ionizing radiation

SECTION 391-01 — PARTICLES

391-01-01

proton

A stable elementary particle having a positive charge of $1.60219 \times \times 10^{-19}$ C and a rest mass of 1.67261×10^{-27} kg.

391-01-02

neutron

An elementary particle having no electric charge, a rest mass of 1.67492×10^{-27} kg, and a *mean life* of about 1000 s.

391-01-03

nucleon

Name given to the constituents of the atomic nuclei: *proton* or *neutron*.

391-01-04

electron

A stable elementary particle having an electric charge of $\pm 1.60219 \times \times 10^{-19}$ C and a rest mass of 9.10956×10^{-31} kg.

Note. — When used without specification, the term means the negatively charged electron, which is also called the negatron or negaton. Its antiparticle is the positively charged electron, which is called the positron or positon.

391-01-05

photon

A stable elementary particle, quantum of electromagnetic radiation.

391-01-06

meson

A general term applied to various elementary very short-lived particles, with or without charge, with zero spin, with mass between that of the *electron* and that of the *proton* and which are produced in high-energy nuclear reactions

391-01-07

muon

An elementary short-lived charged particle, of spin $^1/_2$, of mass between that of the *electron* and that of the *proton*.

391-01-08

hyperon

A general term applied to various elementary very short-lived particles, with or without charge, of spin $^1/_2$ or $^3/_2$, of mass greater than that of the *neutron*.

391-01-09

neutrino

A stable elementary particle with zero charge, of spin $^1/_2$, of rest mass less than one-thousandth that of the *electron*.

Note. — So far two kinds of neutrino have been established, one associated with the emission of electrons and one with *muons*.

391-01-10

alpha particle

A stable particle having the same bound configuration of 2 *protons* and 2 *neutrons* as a helium-4 nucleus and emitted during a nuclear disintegration.

391-01-11

beta particle

An *electron*, of either positive or negative charge, which has been emitted by an atomic nucleus during a nuclear transformation or which results from the disintegration of a neutron or of an instable particle.

391-01-12

directly ionizing particle

Charged particle (*electron*, *proton*, *alpha particle*, etc.), having sufficient kinetic energy to produce *ionization* by collision.

391-01-13

indirectly ionizing particle

Uncharged particle (*neutron*, *photon*, etc.), which can liberate *directly ionizing particles* or can initiate a nuclear transformation.

391-01-14

time-of-flight (of a particle)

Time taken by a particle to move between two specified points.

391-01-15

mobility (of a charged particle)

The ratio of the average drift velocity to field strength for a charged particle in a specified medium.

SECTION 391-02 — TYPES AND SOURCES OF IONIZING RADIATION

391-02-01

ionizing radiation

Radiation consisting of *directly* or *indirectly ionizing particles* or a mixture of both.

391-02-02

alpha radiation

Radiation composed of *alpha particles*.

391-02-03

beta radiation

Radiation composed of *beta particles*.

391-02-04

gamma radiation

Radiation consisting of *photons* emitted in the process of nuclear transition or particle *annihilation*.

391-02-05

X radiation

Radiation consisting of *photons*, other than annihilation radiation, originating in the extranuclear part of the atom and having wavelengths much shorter than those of visible light.

391-02-06

bremsstrahlung

The *X radiation* produced by the deceleration or the acceleration of charged particles, upon passage through the electric field of nuclei or of other charged particles.

391-02-07

cosmic radiation

Radiation comprising very high energy primary particles of extra terrestrial origin and the secondary particles generated by interaction of these particles with high layers of the atmosphere.

391-02-08

radiation source

An apparatus or a material emitting or capable of emitting *ionizing radiation*.

391-02-09

radionuclide

A radioactive nuclide.

391-02-10

α [β] [γ] [X] emitter

Radionuclide which disintegrates with emission of *alpha* [*beta*] [*gamma*] [*X*] *radiation*.

SECTION 391-03 — QUANTITIES AND UNITS

391-03-01

activity

For a given quantity of radioactive material, the number dN of spontaneous nuclear disintegrations occurring in a given quantity of material during a suitably small time interval dt divided by that time interval.
Symbol: A

$$A = \frac{dN}{dt}$$

391-03-02

curie

The unit of *activity*, expressed in disintegrations per second.
Symbol: *Ci*
By definition, $1\ Ci = 3.7 \times 10^{10}$ disintegrations per second.

Note. — Sometimes it is used incorrectly to designate a quantity of a radionuclide.

391-03-03

specific activity

Activity per unit mass

391-03-04

volume activity
activity concentration

Activity per unit volume.

391-03-05

surface activity

Activity per unit surface.

391-03-06

decay constant
disintegration constant

For a radionuclide, the probability for the spontaneous decay of one of its nuclei within a unit time. It is given by:

$$\lambda = -\frac{1}{N}\frac{dN}{dt}$$

in which N is the number of nuclei of concern existing at time t.

391-03-07

radioactive half-life

For a single radioactive decay process, the time required for the *activity* to decrease to half its value.

Note. — For a radionuclide, the radioactive half-life T is related to the *decay constant* λ by the expression

$$T = \frac{L_n 2}{\lambda} = \frac{0.693}{\lambda}$$

391-03-08

mean life

The average lifetime of an atomic or nuclear system in a specified state.

For an exponentially decaying system, it is the average time for the number of atoms or nuclei in a specified state to be divided by a factor e (2.718 ...).

Note. — For a radionuclide, the

mean life τ is the reciprocal of the *decay constant* λ:

$$\tau = \frac{1}{\lambda}$$

391-03-09

exposure

For *X-* or *gamma radiation*, the quotient of dQ by dm where dQ is the sum of the electrical charges on all the ions of one sign produced in air when all *electrons* (negative and positive) liberated by *photons* in a suitably small element of volume of air of mass *d*m are completely stopped in air.
Symbol: X

$$X = \frac{dQ}{dm}$$

391-03-10

roentgen

The unit of *exposure* equal to 2.58×10^{-4} C/kg.
Symbol: R.

391-03-11

exposure rate

The increment of *exposure* dX during a suitably small interval of time dt divided by that interval of time.

The exposure rate is expressed in *roentgens* per unit time.

391-03-12

energy imparted (to a matter)
integral absorbed dose (deprecated)

The sum, in a given time:

on the one hand, of the difference between the sum of the energies of all the ionizing particles which have entered a volume and the sum of the energies of all those which have left it, exclusive of rest energies;

on the other hand, of the difference between the sum of all of the energies released and the sum of all the energies expended in any nuclear reactions, transformations and elementary particle processes which have occurred within the volume.
Symbol: ε.

391-03-13

total linear stopping power

Of a medium traversed by charged particles of a specified energy, the average energy loss per particle, along an element of path divided by the length of that element.

391-03-14

linear energy transfer
restricted linear collision stopping power

The mean energy imparted to a medium by a charged particle along a small element of its path, due to collisions with energy transfers less than some specified value, divided by the length of that element..

Note. — Although the definition specifies an energy cut-off and not a range cut-off, the energy losses are sometimes called "energy locally imparted"

391-03-15

average energy expended per ion pair formed (in a material)

The quotient of the initial kinetic energy of a charged particle by the average number of ion pairs formed along its track in a material when that particle is completely stopped by the material.

391-03-16

electron-volt

A unit of energy equal to the change in energy of an *electron* in passing through a potential difference of one volt.
Symbol: eV.
1 eV = 1.60219×10^{-19} J.

391-03-17

absorbed dose

The quotient $\frac{d\varepsilon}{dm}$ where $d\varepsilon$ is the *energy imparted to matter* by *ionizing radiation* in a suitably small element of volume of mass *d*m.
Symbol: D

$$D = \frac{d\varepsilon}{dm}$$

391-03-18

rad

The unit of *absorbed dose* equal to 0.01 J/kg or 100 erg/g.

391-03-19

absorbed dose rate

The increment of *absorbed dose* dD during a suitably small interval of time dt divided by that interval of time.
The absorbed dose rate is expressed in *rad* per unit time.

391-03-20

(particle) **fluence**

At a given point of space, the number dN of particles incident during a given time interval on a suitably small sphere centred at that point divided by the cross-sectional area *d*a of the sphere.

Symbol: Φ

$$\Phi = \frac{dN}{da}$$

391-03-21

(particle) **fluence rate**
(particle **flux density**

Increment of *fluence* $d\Phi$ during a suitably small interval of time dt divided by that interval of time.

Symbol: φ

$$\varphi = \frac{d\Phi}{dt}$$

Note. — Fluence rate is identical to the product of the volume particle density and the average speed.

391-03-22

flux

A deprecated term when meaning:

particle flux density or *particle fluence rate*.

391-03-23

energy fluence

At a given point of space, the sum of energies dE_t exclusive of rest energy, of all the particles incident during a given time interval on a suitably small sphere centered at that point, divided by the cross-sectional area da of that sphere.

Symbol: Ψ

$$\Psi = \frac{dE_t}{da}$$

391-03-24

energy fluence rate
energy flux density

Increment of *energy fluence* $d\Psi$ during a suitably small interval of time dt divided by that interval of time.
Symbol: ψ

$$\psi = \frac{d\Psi}{dt}$$

Note. — Energy fluence rate is identical to the product of the *particle fluence rate* and the average energy of the particles.

391-03-25

specific gamma-ray constant

For a *gamma emitter*, the constant which is equal to the product of *exposure rate*, at a given distance from a point source of that emitter and the square of that distance divided by the *activity* of the source neglecting *attenuation*.
Symbol: Γ

SECTION 391-04 — INTERACTION OF IONIZING RADIATION WITH THE MATTER

391-04-01

Ionization

The formation of ions by the division of molecules or by the addition or removal of *electrons* from atoms or molecules.

391-04-02

linear ionization
specific ionization

The total number of ion pairs, including those created by secondary ionizing processes, produced by a *directly ionizing particle* in traversing an element of its path, divided by the length of that element.

391-04-03

ionizing event

A process in which an ion or a group of ions is produced by interaction of a single particle with matter.

391-04-04

volume [linear] ion density

Number of ion pairs per unit volume [length].

391-04-05

scattering

A process in which a change in direction or energy of an incident particle or incident radiation is caused by a collision with a particle or a system of particles.

391-04-06

elastic scattering

Scattering in which the total kinetic energy is unchanged.

391-04-07

inelastic scattering

Scattering in which the total kinetic energy changes.

391-04-08

radiative inelastic scattering

Inelastic scattering in which some of the kinetic energy of an incident particle goes into excitation of the target nucleus followed by subsequent de-excitation through the emission of one or more photons.

391-04-09

thermal inelastic scattering

Inelastic scattering in which a slow neutron or other particle exchanges energy with a molecule or lattice.

391-04-10

back-scatter

Scattering of particles or radiation by material through angles greater than 90° with respect to their initial direction.

391-04-11

capture

A process by which an atomic or nuclear system acquires an additional particle.

391-04-12

Compton effect

The *elastic scattering* of a *photon* by an *electron* when the electron can be considered to be free and stationary. Part of the energy and momentum of the incident photon is transferred to the electron and the remaining part is carried away by the scattered photon.

391-04-13

(energy) absorption

A phenomenon in which incident radiation transfers to the matter which it traverses some or all of its energy.

Note. — *Scattering* accompanied by energy loss, e.g. the *Compton effect* and neu-

tron slowing down, is considered to be energy absorption.

391-04-14

(particle) absorption

An atomic or nuclear interaction in which an incident particle disappears as a free particle even when one or more of the same or different particles are subsequently emitted.

Note. — *Scattering* is not considered to be particle absorption.

391-04-15

absorption coefficient

Of a substance, for a parallel beam of specified radiation, the quantity μ_{abs} in the expression $\mu_{abs} \cdot dx$ for the fraction of energy absorbed in passing through a thin layer of thickness dx of that substance. It is a function of the energy of radiation.
According as to whether dx is expressed in terms of length, mass per unit area, moles per unit area, or atoms per unit area, μ_{abs} is called the linear, mass, molar or atomic absorption coefficient.

391-04-16

total absorption peak

In *X* or *gamma radiation*, the peak of the spectral response curve corresponding to the total *absorption* in a detecting material, of the *photon* energy.

Note. — This peak differs from the *photoelectric peak* in that it takes into account the total absorption due to *Compton effect* and *pair production* effect.

391-04-17

photoelectric effect

The complete *absorption* of a *photon* by an atom with the emission of an orbital *electron*.

391-04-18

photoelectric peak

In *X* or *gamma radiation*, the peak of the spectral response curve corresponding to the *absorption*, in a detecting material, by a *photoelectric effect*, of the *photon* energy.

Note. — In general, this peak has nearly the same energy as the *total absorption peak*, the only one that can be measured.

391-04-19

(electron) pair production

The simultaneous formation of a positive and a negative *electron* as a result of the interaction of a *photon* of sufficient energy (higher than 1.02 MeV) with the field of an atomic nucleus or other particle.

391-04-20

recombination

Interaction between a negative and a positive charge carrier with resulting neutralization of their charges and conservation of their masses.

391-04-21

annihilation

Interaction between a particle and its antiparticle with resulting disappearance of them and emission of particles different in their nature.

391-04-22

attenuation

The reduction of a radiation quantity upon passage of radiation through matter resulting from all types of interaction with matter. The radiation quantity may be, for example, the *particle flux density* or the *energy flux density*.

Note. — Attenuation usually does not include the geometric reduction of the radiation quantity with distance from the source.

391-04-23

attenuation coefficient

Of a substance, for a parallel beam of specified radiation, the quantity μ in the expression μdx for the fraction of a radiation quantity removed by *attenuation* in passing through a thin layer of thickness dx of that substance. It is a function of the energy of the radiation. According as to whether dx is expressed in terms of length, mass per unit area, moles per unit area or atoms per unit area, μ is called the linear, mass, molar or atomic attenuation coefficient.

391-04-24

charged particle equilibrium

The condition existing at a point within a medium under irradiation, when, for every charged particle leaving a volume element surrounding the point, another charged particle of the same kind and energy enters.

391-04-25

Čerenkov effect

The emission of light which arises when a charged particle moves in a medium with a velocity greater than that of light in the same medium.

Note. — Emitted radiation has a continuous spectrum from visible light (blue) to ultraviolet.

391-04-26

Mössbauer effect

Effect which consists, for some *radionuclides* (such as iridium 191 or iron 57) in the crystalline form, of stimulated emission of resonance *photons*. The recoil energy following this emission is absorbed not only by the emitting nucleus but by the whole crystal so that the emitted photons have a very precise energy which is essentially that of the nuclear transition.

391-04-27

nuclear fission

The division of a heavy nucleus into two (or, rarely, more) parts with masses of equal order of magnitude, usually accompanied by the emission of *neutrons*, *gamma radiation*, and, rarely, small charged nuclear fragments.

391-04-28

fission fragments

Nuclei resulting from *fission* and possessing kinetic energy acquired from that fission.

391-04-29

fission energy

Energy released by *fission* process.

391-04-30

radioactive contamination

A radioactive substance in a material or place where it is undesirable.

Sections 391-05 to 391-07 — Components and constituents of detection sub-assemblies

SECTION 391-05 — GENERAL TERMS

391-05-01

semiconductor

Material whose total conductivity, due to *charge carriers* of both signs (electrons and holes), is normally in the range between that of metals and insulators and in which the charge carrier density can be changed by external means.

391-05-02

intrinsic semiconductor (I-type)

An effectively pure *semiconductor* in which, under conditions of thermal equilibrium, the *charge carrier* densities of each sign are nearly equal.

Note. — By extension, this term is incorrectly used to designate *compensated semiconductors.*

391-05-03

compensated semiconductor

A *semiconductor* in which the effects of the impurities of a given type on the *charge carrier* density partially or completely cancel those of the other type. Such a semiconductor has properties which are similar to those of an *intrinsic semiconductor.*

391-05-04

extrinsic semiconductor

A *semiconductor* having impurities or other imperfections and in which the *charge carrier* densities of each sign are different.

391-05-05

N-type semiconductor

Extrinsic semiconductor in which the conduction *electron* density exceeds the mobile *hole* density.

391-05-06

P-type semiconductor

Extrinsic semiconductor in which the mobile *hole* density exceeds the conduction *electron* density.

391-05-07

scintillating material

A material able to emit, by means of *scintillation*, a luminous radiation in response to *ionizing radiation.*

391-05-08

activator

An impurity, or displaced atom, which increases the luminescence efficiency of a material to be used as a *scintillating material.*

391-05-09

wavelength shifter

A photofluorescent compound used with a *scintillating material* to absorb *photons* and emit photons of a longer wavelength, with the purpose of causing more efficient use of the photons by a *photomultiplier tube* or photocell.

SECTION 391-06 — TYPES OF COMPONENTS AND CONSTITUENTS

a) *Of ionization chambers and counter tubes*

391-06-01

collecting electrode

The electrode of an *ionization chamber* or a *counter tube* which is intended to collect electrons or ions produced by ionizing radiation.

391-06-02

guard ring

An auxiliary electrode which is intended to reduce the flow of leakage current between *collecting electrode* and other electrodes of an *ionization chamber* or a *counter tube* and/or to define the potential gradients and *sensitive volume.*

391-06-03

sensitive material (of a neutron detector)

The material used in certain neutron detectors, either for example in a lining or a filling gas, which is intended to produce *directly ionizing particles* from the neutrons by nuclear reaction.

Note. — The word "particle" is used here in a general sense and includes *fission fragments.*

391-06-04

sensitive lining (of a neutron detector)

Sensitive material applied as a lining.

391-06-05

quenching circuit

A circuit which achieves *quenching*

by reducing suppressing or reversing the potential applied to a *Geiger-Müller counter tube*.

391-06-06

quenching gas

A component of the gas mixture filling of a *Geiger-Müller counter tube* which is intended to ensure self-quenching of the discharge.

b) *Of scintillation detectors*

391-06-07

scintillator

The element sensitive to *ionizing radiation* in a *scintillation detector*. It consists of a defined quantity of *scintillating material*, in a suitable form.

391-06-08

electron multiplier

A group of electrodes, called dynodes, subjected to increasing voltages in a vacuum and used to amplify an electron current by a cascade process by means of secondary emission.

391-06-09

photomultiplier tube
multiplier phototube (U.S.A.)

A vacuum tube intended to convert light into an electrical signal and which essentially contains a photocathode and an *electron multiplier*.

391-06-10

windowless photomultiplier tube
windowless multiplier phototube (U.S.A.)

A *photomultiplier tube* in which no material is interposed between the source of photons and the target used as photocathode. A particular application is the detection of ultraviolet radiation of short wavelength.

391-06-11

light guide

Optical device which is intended to transmit light without significant loss and may be placed for instance between a *scintillator* and a *photomultiplier tube*.

SECTION 391-07 — PARAMETERS AND MISCELLANEOUS TERMS

391-07-01

scintillation (of a scintillator)

Luminescence of short duration (of the order of a few microseconds or less) caused by an ionizing particle.

391-07-02

scintillation duration

The time between the instant at which 10% and the instant at which 90% of the *photons* of the *scintillation* have been emitted.

391-07-03

scintillation rise time

The time required for the rate of the emission of *photons* after a single excitation to rise from 10% to 90% of its maximum value.

391-07-04

scintillation fall time

The time required for the rate of the emission of *photons* after a single excitation to decrease from 90% to 10% of its maximum value.

391-07-05

scintillation decay time

The time required for the rate of the emission of *photons* after a single excitation to fall to $1/e$ of its initial value ($e = 2.718...$).

391-07-06

emission spectrum
(of a scintillator)

A curve representing the distribution of the number of emitted *photons* as a function of their wavelength or energy.

391-07-07

emission band (of a scintillator)

That part of the *emission spectrum* corresponding to energies (or wavelengths) for which the probability of emission of *photons* is greatest.

391-07-08

absorption band (of a scintillator)

That part of the absorption spectrum corresponding to energies (or wavelengths) for which the probability of absorption of *photons* is greatest.

391-07-09

photon emission curve (of a scintillator)

The curve representing the variation with time of the *photon* emission rate corresponding to a single excitation of a scintillator.

391-07-10

energy conversion efficiency
(of a scintillator)

The ratio of the total energy of the *photons* emitted by a scintillator to the incident energy absorbed by it.

391-07-11

conversion quantum efficiency
(of a photocathode)

The ratio of the number of *electrons* emitted by the photocathode to the number of incident *photons*.

391-07-12

spectral response curve
(of a photocathode)

The curve which shows the varia-

tion of *conversion quantum efficiency* with wavelength of the incident radiation.

391-07-13

photocathode sensitivity

The quotient of the intensity of the photoelectric emission current from the photocathode by the incident luminous flux under specified conditions of illumination.

391-07-14

transit time (in a photomultiplier tube)

The time between the arrival at the photocathode of a light pulse having a finite flux and infinitesimal duration, and the occurrence of a stated point (peak amplitude for instance) on the output current pulse.

391-07-15

transit time jitter (in a photomultiplier tube)

The variation in the *transit times* corresponding to different light pulses having a finite flux and infinitesimal duration, each giving rise to not more than a single photoelectron.

391-07-16

response pulse duration (of a photomultiplier tube)

The time duration corresponding to the *full width at half maximum* in the curve representative of the output current pulse when the photocathode receives a light pulse having a finite flux and infinitesimal duration giving rise to a large number of photoelectrons.

391-07-17

dark current (of a photomultiplier tube)

The current flowing in the anode circuit of a photomultiplier tube in the absence of light.

391-07-18

gain (of an electron multiplier in a photomultiplier tube)

The number of *electrons* reaching, under specified working conditions, the output electrode of the photomultiplier tube for each electron received by the first dynode.

391-07-19

gain (of a photomultiplier tube)

The ratio of the anode signal current to the current emitted by the photocathode at stated electrode voltages.

391-07-20

collection efficiency (of a photomultiplier tube)

The ratio of the number of **useful** *electrons* reaching the first dynode to the number of electrons **emitted** by the photocathode.

Sections 391-08 to 391-10 — Detection sub-assemblies

SECTION 391-08 — GENERAL TERMS

391-08-01

radiation detector

An apparatus, generally sub-assembly, or substance which, in the presence of radiation, provides by either direct or indirect means a signal or other indication suitable for use in measuring one or more quantities of the incident radiation.

391-08-02

linear detector

A *radiation detector* in which the output signal of interest is directly proportional to a quantity related to the radiation, generally the energy lost in the *sensitive volume* of the detector by the incident radiation.

391-08-03

non-linear detector

A *radiation detector* in which the output signal of interest is not directly proportional to a quantity related to the radiation.

391-08-04

analogue detector

A *radiation detector* providing the information in an analogue form.

391-08-05

pulse detector

A *radiation detector* providing the information in the form of pulses.

391-08-06

ionization detector

A *radiation detector* based on the use of *ionization* in the *sensitive volume* of the detector.

391-08-07

ionization chamber

An *ionization detector* consisting of a chamber filled with a suitable gas, in which an electric field, insufficient to induce *gas multiplication*, is provided for the collection at the electrodes of charges associated with the ions and the electrons produced in the *sensitive volume* of the detector by the *ionizing radiation*.

391-08-08

counter tube

A *pulse ionization detector* consisting of a tube filled with a suitable gas, in which an electric field, sufficient to induce *gas multiplication*, is provided for the collection at the electrodes of charges associated with the ions and the electrons produced in the *sensitive volume* of the detector by the *ionizing radiation*.

391-08-09

track chamber

A chamber which makes visible the paths of ionizing particles passing through it or formed in it.

391-08-10

scintillation detector

A *radiation detector* consisting of a *scintillator* optically coupled to a photosensitive device (for example one or more *photomultiplier tubes*), either directly or through *light guides*.

391-08-11

thermoluminescence detector

A *radiation detector* using a thermoluminescent medium which, by thermal stimulation, emits a luminous radiation, the magnitude of which is a function of the energy stored in the detector during its exposure to ionizing radiation.

391-08-12

(U.V.) photoluminescence detector

A *radiation detector* using a photoluminescent medium (for instance silver phosphate glass) which, receiving radiation of certain wavelengths (ultra-violet radiation for silver phosphate), emits a luminous radiation of a different wavelength, generally in the visible spectrum, the magnitude of which is a function of the energy stored in the detector during its exposure to the ionizing radiation.

391-08-13

semiconductor detector

An *ionization detector* using a *semiconductor* medium in which an electric field is provided for the collection at the electrodes of the excess *charge carriers* produced by *ionizing radiation*.

391-08-14

spark detector

A *radiation detector* in which the passage of a strongly ionizing particle produces, between electrodes, a spark which generates an electric pulse of measurable amplitude.

391-08-15

Rosenblum detector

A particular type of *spark detector*.

391-08-16

Čerenkov detector

A *radiation detector* intended to detect relativistic particles, using a medium in which the *Čerenkov effect* is produced. It is optically coupled to a photosensitive device (for example one or more *photomultiplier tubes*), either directly or through *light guides*.

391-08-17

charge emission detector

A *radiation detector* in the form of an electric capacitor between the plates of which the potential difference changes due to the transfer, from one plate to the other, of

charged particles produced under the influence of radiation.

391-08-18

collectron
self-powered neutron detector

A *neutron* detector in which an electric current is produced without the application of an external power source through the emission of *beta particles* or *electrons* by a part of the detector called the emitter. This emission is caused by neutron interaction.

391-08-19

secondary emission detector

A *radiation detector* with a confined evacuated volume in which a current is produced as a result of charged particles being ejected from the walls and collected with a suitable applied potential.

391-08-20

neutron thermopile

A *neutron* detector in which the hot junctions of thermocouples are in thermal contact with a material which is heated by *absorption* of particles resulting from neutron-induced reactions.

SECTION 391-09 — TYPES OF DETECTION SUB-ASSEMBLIES

a) *Gas ionization detectors*

i *Pulse detectors*

391-09-01

pulse ionization chamber

An *ionization chamber* acting as a *pulse detector* and producing a useful pulse for each detected ionizing particle.

391-09-02

electron collection pulse chamber

A *pulse ionization chamber* in which the output signal is due principally to the collection of *electrons*, taking advantage of their high mobility, far greater than that of ions.

391-09-03

ion collection pulse chamber

A *pulse ionization chamber* in which the output signal is due to the total collection of ions and *electrons*.

391-09-04

grid ionization chamber

A *pulse ionization chamber*, generally used to measure the energy of *alpha particles* or *fission fragments*. It contains flat electrodes and an additional electrode (Frisch grid), which is held at an intermediate potential, to reduce the influence of heavy ions.

391-09-05

boron trifluoride ionization chamber

An *ionization chamber* intended to detect *neutrons* and containing for this purpose boron trifluoride. *Ionization* is initiated by *alpha particles* and lithium nuclei produced by nuclear reaction of neutrons with boron.

391-09-06

boron-lined ionization chamber

An *ionization chamber* intended to detect *neutrons* and containing for that purpose boron *sensitive lining* on its walls or on conveniently shaped electrodes. *Ionization* is initiated by *alpha particles* and lithium nuclei produced by nuclear reaction of neutrons with boron in the lining.

391-09-07

fission ionization chamber

An *ionization chamber* intended to detect *neutrons* and containing for that purpose a *sensitive lining* of fissile materials. *Ionization* is initiated mainly by *fission fragments* produced by nuclear reaction of neutrons with the fissile material.

391-09-08

proportional counter tube

A *counter tube* operating in the *proportional region*.

391-09-09

boron trifluoride counter tube

A *counter tube* intended to detect *neutrons* and containing for this purpose boron trifluoride. The initial *ionization* is caused by *alpha particles* and lithium nuclei produced by nuclear reaction of neutrons with boron.

391-09-10

boron-lined counter tube

A *counter tube* intended to detect *neutrons* and containing for this purpose a boron *sensitive lining* on its walls or on conveniently shaped electrodes. The initial *ionization* is caused by *alpha particles* and lithium nuclei produced by nuclear reaction of neutrons with boron in the lining.

391-09-11

helium counter tube

A *counter tube* intended to detect *neutrons* and containing for this purpose helium-3. The initial *ionization* is caused by *protons* and tritium nuclei produced by nuclear reaction of neutrons on helium.

391-09-12

recoil proton counter tube

A *counter tube* intended to detect fast *neutrons* and containing for this purpose hydrogenous atoms. The initial *ionization* is caused mainly by recoil *protons* resulting from the collision of fast neutrons with the nuclei of these hydrogenous atoms.

391-09-13

Geiger-Müller counter tube

A *counter tube* operating in the *Geiger-Müller region.*

391-09-14

self-quenched counter tube

A *Geiger-Müller counter tube* in which the filling gas is such that the *quenching* is obtained in the absence of any other device.

391-09-15

halogen-quenched counter tube

A *self-quenched counter tube* in which the filling gas contains a halogen gas.

391-09-16

organic-quenched counter tube

A *self-quenched counter tube* in which the filling gas contains a small amount of organic vapour (e.g. methanol).

391-09-17

thin wall counter tube

A *counter tube* with an envelope of such low absorption as to permit the detection of low penetrating power radiation.

391-09-18

window counter tube

A *counter tube* with a portion of its envelope, called the window, of such low absorption as to permit the detection of low penetrating power radiation.

391-09-19

end window counter tube

A *window counter tube* with the *window* situated perpendicular to the axis of the tube.

391-09-20

external cathode counter tube

A *counter tube*, the envelope of which is generally of glass, and the cathode of which is a carbon or metal coating on the external surface of this envelope.

391-09-21

liquid sample counter tube

A *counter tube* intended to measure the *activity* of a liquid. Typically, the unit consists of a cylindrical counter tube surrounded by a coaxial cylindrical cup, which may be either fixed or removable. The liquid is introduced into the annular space between the cup and the counter tube.

391-09-22

dip counter tube

A *counter tube* specially designed to be dipped into the liquid whose *activity* is to be measured.

391-09-23

corona counter tube

A *counter tube* in which a corona discharge is maintained and a sharp current change is caused by a passing ionizing particle.

391-09-24

fission counter tube

A *counter tube* intended to detect *neutrons* and containing, for that purpose, a *sensitive lining* of fissile materials. The initial *ionization* is caused by *fission fragments* produced by nuclear reaction of neutrons with the fissile materials.

391-09-25

cloud chamber

A *track chamber* containing supersaturated vapour in which ions produced along the paths act as centres for condensation.

391-09-26

diffusion chamber

A *cloud chamber* in which supersaturation of the vapour is produced by continuous diffusion of saturated vapour, this diffusion being due to a temperature difference between the chamber walls.

391-09-27

Wilson cloud chamber
expansion cloud chamber

A *cloud chamber* in which supersaturation of the vapour is produced for a short time by a rapid expansion.

391-09-28

spark chamber

A *track chamber* in which the paths of ionizing particles are indicated by a succession of sparks occurring between successive electrodes at different potentials.

ii *Analogue detectors*

391-09-29

integrating ionization chamber

An *ionization chamber* designed to measure the accumulated charge caused by individual *ionizing events* occurring during some interval of time.

391-09-30

current ionization chamber

An *ionization chamber* used for measurement of the *ionization current* produced by *ionizing radiation.*

391-09-31

free air ionization chamber

An *ionization chamber* open to the air and mainly used for the absolute measurement of *exposures*. It is so designed that the volume of air which is taken as the basis for the

calculation of the exposure is well defined and neither the beam of radiation nor a significant number of the secondary electrons produced strike the electrodes.

391-09-32

Bragg-Gray cavity ionization chamber

An *ionization chamber* used for determining the *absorbed dose* (e.g. of X or gamma rays) in a medium. Its characteristics (*sensitive volume*, gas pressure, nature and thickness of the walls) are such that the conditions defining the *Bragg-Gray cavity* are met in practice.

391-09-33

air-wall ionization chamber

An *ionization chamber* in which the filling gas and the materials of the wall have the same effective atomic number as air. This condition allows some relaxation of the *Bragg-Gray cavity* conditions so that the cavity size may be large compared with the range of the secondary particles. It may be used to determine the *absorbed dose* in air or to measure *exposure* when it is calibrated against a *free-air ionization chamber*.

391-09-34

tissue equivalent ionization chamber

An *ionization chamber* intended to determine the *absorbed dose* in tissue and in which the materials of the walls have the same effective atomic number as tissue. This condition allows some relaxation of the *Bragg-Gray cavity* conditions so that the cavity size may be large compared with the range of the secondary particles.

391-09-35

difference ionization chamber

An *ionization chamber* composed of two sections arranged in such a manner that the resulting output current corresponds to the difference between the *ionization currents* of the two sections.

391-09-36

compensated ionization chamber

A *difference ionization chamber* designed in such a manner as to practically eliminate the effect of another radiation superimposed on the radiation which it is desired to measure.

391-09-37

extrapolation ionization chamber

An *ionization chamber* in which one of the characteristics can be varied — normally the spacing between electrodes — in order to extrapolate the readings to zero chamber volume.

391-09-38

recoil proton ionization chamber

An *ionization chamber* intended to detect fast *neutrons* and in which the filling gas contains for this purpose hydrogenous atoms. *Ionization* is initiated mainly by recoil *protons* resulting from the collision of fast neutrons with the nuclei of these hydrogenous atoms.

391-09-39

capacitor ionization chamber

An *ionization chamber* whose electrodes form a capacitor of known capacitance so that when previously charged the radiation *exposure* can be calculated from the decrease in potential.

391-09-40

thimble ionization chamber

An *ionization chamber* in which the outer electrode has shape and dimension similar to those of a thimble.

b) *Liquid ionization detectors*

391-09-41

bubble chamber

A *track chamber* containing a superheated liquid and in which the ions produced along the paths of particles act as centres for the formation of bubbles.

c) *Solid-state ionization detectors*

391-09-42

surface barrier semiconductor detector

A *semiconductor detector* in which the potential barrier due to the *junction* results from a superficial *inversion layer*.

391-09-43

diffused junction semiconductor detector

A *semiconductor detector* in which the *P-N* or *N-P junction* is produced by diffusion of an impurity of one type into a *semiconductor* of opposite type.

Note. — The first letter P or N designates the type of the diffused impurities.

391-09-44

compensated semiconductor detector

A *semiconductor detector* consisting of a region of *compensated semiconductor* between a P type region and a N type region.

391-09-45

lithium drifted semiconductor detector

A *compensated semiconductor detector* in which the compensated region is obtained by causing lithium ions to move through a P-type crystal under an applied electric field in such a way as to compensate the charge of the bound impurities.

391-09-46

amplifying semiconductor detector

A *semiconductor detector* in which charge multiplication is produced by a secondary process such as an *avalanche*.

391-09-47

transmission semiconductor detector

A *semiconductor detector* whose thickness, including its entrance and exit *windows*, is sufficiently small to permit the radiation to pass completely through the detector.

391-09-48

differential dE/dx semiconductor detector

A *transmission semiconductor detector* in which the thickness of the *depletion layer* is small compared to the range of the incident particles in the *semiconductor* material.

391-09-49

totally depleted semiconductor detector

A *semiconductor detector* in which the thickness of the *depletion layer* is essentially equal to the thickness of the *semiconductor* material.

391-09-50

boron [lithium] coated semiconductor detector

A *semiconductor detector* intended to detect *neutrons* and containing for that purpose boron-10 [lithium-6] in the form of a coating on its surface. *Ionization* is initiated by *alpha particles* produced by nuclear reactions of neutrons in the coating.

391-09-51

fission semiconductor detector

A *semiconductor detector* intended to detect *neutrons* and containing for that purpose a coating of fissile material. *Ionization* is initiated by *fission fragments* resulting from nuclear reactions of neutrons with the fissile material.

391-09-52

crystal conduction detector

An *ionization detector* which is made of a *semiconductor* of homogeneous crystalline structure.

d) *Miscellaneous detectors*

391-09-53

2π [4π] radiation detector

A *detector* intended to detect the radiation over 2π [4π] steradians from a *radiation source*.

391-09-54

internal gas detector

An *ionization detector* designed to measure the *activity* of the gas which is used wholly or partly as the filling gas.

391-09-55

well-type ionization chamber

An *ionization chamber* designed for measuring the *activity* of beta, X or gamma *emitters* of appreciable volume within a solid angle of nearly 4π steradians. It comprises a central cylindrical well in which the sources to be measured are placed.

391-09-56

gas-flow detector

A *radiation detector* (*counter tube*, *ionization chamber*, etc.) in which an appropriate atmosphere is maintained by means of a low rate of flow of a suitable gas.

SECTION 391-10 — PARAMETERS AND MISCELLANEOUS TERMS

a) *General terms related to detectors*

391-10-01

detector efficiency

The ratio of the number of detected particles to the number of particles of the same type which are incident on the detector in the same time interval.

391-10-02

detection efficiency

Under stated conditions of detection, the ratio of the number of detected particles to the number of particles of the same type emitted by the radiation source in the same time interval.

391-10-03

photofraction

For a given *photon* energy, the ratio of the number of photons detected in the *total absorption peak* to the total number of photons detected in the same time interval.

391-10-04

total absorption detector efficiency

For a given *photon* energy, the ratio of the number of photons detected in the *total absorption peak* to the number of photons which are incident on the detector in the same time interval. It is equal to the product of the *photofraction* and the *detector efficiency*.

391-10-05

total absorption detection efficiency

For a given detection assembly and *photon* energy, the ratio of the number of photons detected in the *total absorption peak* to the total number of photons emitted by the radiation source in the same time interval. It is equal to the product of the *photofraction* and the *detection efficiency*.

391-10-06

selectivity (of a detector)

The ratio of (1) the *sensitivity* of the detector to the *ionizing radiation* to be measured to (2) the sensitivity of the same detector to the *concomitant radiation*.

391-10-07

sensitive volume (of a detector)

That part of a detector which is sensitive to radiation and used for detection.

391-10-08

window (of a detector)

That portion of a detector which is designed to facilitate the penetration of the required radiation.

391-10-09

wall effect

Effect on the result of the measurement due to the presence of the wall of the detector and which depends on its nature and its thickness.

391-10-10

useful life (of a detector)

Operational life, under irradiation and environmental conditions restricted within specified limits, after which the detector characteristics exceed the specified tolerances. Useful life can be expressed in incident particle *fluence*, number of produced pulses, etc.

391-10-11

burn-up life (of a neutron detector)

An estimated *fluence* of *neutrons* of a given energy distribution after which the *sensitive material* will be consumed to such an extent that the detector characteristics exceed the specified tolerances for a specified purpose.

391-10-12

Ionization current

The electric current resulting from the motion under the influence of an electric field and collection of ions and electrons produced in an ionized medium.

391-10-13

residual current

The current which continues to be produced by a detector after it is no longer exposed to external radiation, and which is due to activation of the component materials of the detector, to their contamination and to the poor quality of its insulation.

391-10-14

leakage current

The total detector current flowing at the operating bias in the absence of radiation.

b) *Terms related to ionization chambers*

391-10-15

electron [ion] collection time

The time interval between the formation of ion pairs at a given point by *ionizing radiation* and the collection of the corresponding *electrons* [ions] on the *collecting electrode*.

391-10-16

burst (in an ionization chamber)

Sudden appearance for a short period of time of a large number of ion pairs due to one or more particles of high energy incident on the filling gas or the walls.

391-10-17

saturation current (of an ionization chamber)

Under a given irradiation, the *ionization current* obtained when the applied voltage is sufficiently high for essentially all the ions to be collected (without the *gas multiplication* region being reached).

391-10-18

saturation voltage (of an ionizatior chamber)

Under a given irradiation, the minimum voltage necessary to obtain *saturation current* in an ionization chamber.

Note. — By extension, terms such as "95% [90%] saturation voltage" are used in practice to design the voltage necessary to obtain 95% [90%] saturation current.

391-10-19

saturation curve (of a current ionization chamber)

Under a given irradiation, a curve characteristic of the variation of output current with applied voltage, which permits the determination of *saturation current* and *voltage*.

391-10-20

Bragg-Gray cavity

An ideal cavity containing gas within a solid medium, the cavity being sufficiently small not to disturb the distribution of either primary or secondary radiation in the medium.

391-10-21

compensation factor (of a compensated ionization chamber)

The ratio of (1) the *sensitivity* to undesired radiation of the compensated ionization chamber to (2) the sensitivity to the same undesired radiation of the same chamber, if it were not compensated.

391-10-22

compensation ratio (of a compensated ionization chamber)

The inverse of the *compensation factor*. It is used as an index of performance of a *compensated ionization chamber*.

c) *Terms related to counter tubes*

391-10-23

gas multiplication

The process whereby in a sufficiently intense electric field the ion pairs produced in a gas by incident radiation generate additional ion pairs.

391-10-24

Townsend avalanche

A *gas multiplication* chain process in which a charged particle rapidly gives rise by collision to a large number of charged particles.

391-10-25

critical field (of a counter tube)

The minimum electric field necessary for *gas multiplication* to be initiated.

391-10-26

gas multiplication factor

The factor by which the initial number of ion pairs is multiplied as a result of the *gas multiplication* process, under stated conditions.

391-10-27

end effect (of a counter tube)

An effect due to distortion of the electric field near the ends of the *collecting electrode* of a counter tube and consisting of a *counting loss* or degradation of the measured spectrum.

391-10-28

proportional region

The range of applied voltage of a *counter tube* in which the *gas multiplication factor* is greater than one and practically independent of the total number of ion pairs initially produced in the *sensitive volume* as a result of an *ionizing event*, the pulse amplitude being proportional to this number.

391-10-29

region of limited proportionality

The range of applied voltage of a *counter tube*, between the *Geiger-Müller region* and the *proportional region*, in which the *gas multiplication factor* is dependent on the total number of ion pairs initially produced in the *sensitive volume* as a result of an *ionizing event*, and on the applied voltage.

391-10-30

Geiger-Müller region

The range of applied voltage of a *counter tube* in which the *gas multiplication factor* is much greater than one, the pulse amplitude being substantially independent of the total number of ion pairs initially produced in the *sensitive volume* as a result of an *ionizing event*.

391-10-31

Geiger-Müller threshold

Under specified conditions, the minimum applied voltage for a *counter tube* to operate in the *Geiger-Müller region*.

391-10-32

temperature coefficient of the Geiger-Müller threshold

Coefficient representing the variation of the *Geiger-Müller threshold* as a function of temperature, between specified temperature limits. It is expressed in volts per degree Celsius or in percentage of a given threshold per degree Celsius.

391-10-33

overvoltage (of a Geiger-Müller counter tube)

The difference between the operating voltage and the *Geiger-Müller threshold*.

391-10-34

characteristic curve (of a Geiger-Müller counter tube)

A curve showing the *counting rate* as a function of the voltage applied to a *Geiger-Müller counter tube* with all other parameters constant.

391-10-35

plateau

That portion of the *characteristic curve* of any *Geiger-Müller counter tube* over which the *counting rate* is substantially independent of the applied voltage.

391-10-36

plateau relative slope

The slope of the *plateau* expressed as the percentage change in *counting rate* per one hundred volts change in applied voltage.

391-10-37

quenching

The process of terminating continuous or multiple discharges following a single *ionizing event* in a *Geiger-Müller counter tube*.

391-10-38

dead time (of a Geiger-Müller counter tube)

The time interval after the initiation of a pulse caused by an *ionizing event*, during which a *Geiger-Müller counter tube* cannot respond to a further ionizing event.

391-10-39

maximum counting rate (of a Geiger-Müller counter tube)

The maximum in a curve of measured *counting rate* as a function of radiation *fluence rate*.

d) *Terms related to track chambers*

391-10-40

ionization track

A part of the path of an ionizing particle which is visible in a *track chamber*, a nuclear emulsion, etc.

391-10-41

sensitive time (of a track chamber)

Duration of the sensitive state suitable for *ionization track* formation in certain *track chambers* as *Wilson chambers* or *bubble chambers*.

e) *Terms related to semiconductor detectors*

391-10-42

junction

A transition layer between semiconductor regions of different electrical properties, or between a *semiconductor* and a superficial layer of different type.
This layer is characterized by a potential barrier impeding the movement of *charge carriers* from one region to the other.

391-10-43

PN junction

A *junction* between P and N type semiconductor regions.

391-10-44

forward direction (of a junction)

The direction of continuous (direct) current flow in which a *junction* has its lowest resistance and the current is mainly due to movement of majority *charge carriers*.

391-10-45

forward voltage (of a junction)

Applied voltage such that the current flows in the *forward direction*.

391-10-46

forward current (of a junction)

Current which flows in the *forward direction*

391-10-47

reverse direction (of a junction)

The direction of continuous (direct) current flow in which a *junction* has its highest resistance and the current is mainly due to movement of minority *charge carriers*.

391-10-48

reverse voltage (of a junction)

Applied voltage such that the current flows in the *reverse direction*.

391-10-49

reverse current (of a junction)

Current which flows in the *reverse direction*.

391-10-50

breakdown (of a reverse-biased junction)

Transition from a state of high dynamic resistance to a state of substantially lower dynamic resistance for increasing magnitude of *reverse voltage*.

391-10-51

avalanche breakdown (of a junction)

A *breakdown* caused by the cumulative multiplication of *charge carriers* in a *semiconductor* under the action of a strong electric field which causes some charge carriers to gain enough energy to liberate new hole-electron pairs (field-induced impact ionization).

391-10-52

avalanche voltage

The applied *reverse voltage* at which *avalanche breakdown* occurs.

391-10-53

charge carrier (abbreviation: carrier)

In a *semiconductor*, a free conduction *electron* or a mobile *hole*.

391-10-54

hole

A transient vacancy due to the ejection of an *electron* from the atomic structure of an insulator or a *semiconductor* and having the same behaviour as a carrier with charge equal and opposite to that of the electron.

391-10-55

dead layer (of a semiconductor detector)

A layer of a *semiconductor detector* in which no significant part of the energy lost by particles can contribute to the resulting signal.

391-10-56

depletion layer (in a semiconductor detector)

A layer of a *semiconductor detector* which constitutes its *sensitive volume*. Most of the energy lost by the particles in this region can contribute to the resulting signal.

391-10-57

inversion layer

For a given type of *semiconductor*, a surface layer of the opposite type.

391-10-58

total depletion voltage (of a semiconductor detector)

The *reverse voltage* at which the *depletion layer* extends over essentially the whole thickness of the *semiconductor*.

391-10-59

charge collection time (of a semiconductor detector)

By convention, the time interval for the integrated current due to the charge collected in the *semiconductor detector*, after the passage of an *ionizing particle*, to increase from 10% to 90% of its final value.

Sections 391-11 and 391-12 — Electronic sub-assemblies

SECTION 391-11 — TYPES OF ELECTRONIC SUB-ASSEMBLIES

a) *Amplifiers*

391-11-01

electronic amplifier

An electronic apparatus in which a parameter of the output signal depends in a specified way on a parameter (which may be different) of the input signal and contains greater power or energy.

391-11-02

pulse amplifier

An *electronic amplifier* designed to provide within the limits of its normal operating characteristics a single output pulse for each input pulse.

391-11-03

linear pulse amplifier
proportional amplifier

A *pulse amplifier* the output amplitude of which is proportional to the input pulse amplitude.

391-11-04

logarithmic pulse amplifier

A *pulse amplifier* the output amplitude of which is a logarithmic function of the input pulse amplitude.

391-11-05

biased pulse amplifier

A *pulse amplifier* designed to provide an amplified output pulse only for that portion of an input signal exceeding a predetermined threshold value.

391-11-06

direct current amplifier

An *electronic amplifier* designed to provide, within the limits of its normal operating characteristics, an output quantity which represents the input current (voltage), even when the frequency of this current (voltage) approaches zero.

391-11-07

linear direct current amplifier

A *direct current amplifier* the output quantity of which is a linear function of the input quantity.

391-11-08

logarithmic direct current amplifier

A *direct current amplifier* the output quantity of which is a logarithmic function of the input quantity.

391-11-09

biased direct current amplifier

A *direct current amplifier* designed to provide an amplified output signal only for that portion of an input signal exceeding a predetermined threshold value.

391-11-10

chopper amplifier

A *direct current amplifier* in which the input current (voltage) is transformed into a signal of predetermined frequency, amplified by an alternating current amplifier, and then retransformed into a direct current signal.

391-11-11

vibrating capacitor amplifier

A *chopper amplifier* utilizing a vibrating capacitor for signal transformation prior to amplification.

391-11-12

charge amplifier

An *electronic amplifier* designed to provide an output signal the amplitude of which is proportional to the input charge signal.

391-11-13

preamplifier

An *electronic amplifier* designed to be connected to the *radiation detector* output prior to transmission to the main amplifier (for example, to transform the output characteristics of the detector to match the input of the main amplifier).

b) *Discriminators*

391-11-14

discriminator

A sub-assembly designed to provide an output signal for each input signal of which a specified characteristic (amplitude, rise time, duration, etc.) meets a specified condition.

391-11-15

amplitude discriminator

A *discriminator* designed to provide an output signal for each input signal the amplitude of which exceeds a predetermined threshold value.

391-11-16

direct current amplitude discriminator

An *amplitude discriminator* designed to provide an output signal when the input current (voltage) exceeds a predetermined threshold value even when the frequency of this current (voltage) approaches zero.

391-11-17

time discriminator

A *discriminator* designed to provide an output signal for each input pulse which appears before a specified reference time, or alternatively, after a specified reference time.

391-11-18

pulse duration discriminator

A *discriminator* designed to provide an output signal for each input pulse the duration of which exceeds a predetermined value or alternatively is less than a predetermined value.

391-11-19

pulse fall time [rise time] discriminator

A *discriminator* designed to provide an output signal for each input pulse of which the *fall time* [*rise time*] exceeds or alternatively is less than a given value.

391-11-20

pulse shape discriminator

Deprecated. See: *Pulse shape selector.*

391-11-21

charge discriminator

A *discriminator* designed to provide an output signal when the electrical charge exceeds a predetermined threshold value or, alternatively, is less than a predetermined threshold value within a specified time interval.

391-11-22

window discriminator

Deprecated. See: (Pulse) Selector.

c) *(Pulse) selectors*

391-11-23

(pulse) selector

A sub-assembly designed to provide an output signal for each input pulse of which a specified characteristic (amplitude, rise time, duration, etc.) lies between two specified limits.

391-11-24

(pulse) amplitude selector

A *selector* designed to provide an output pulse for each input pulse the amplitude of which lies between two specified limits.

391-11-25

time selector

A *selector* designed to provide an output signal for each input pulse which appears within a specified time interval.

391-11-26

pulse duration selector

A *selector* designed to provide an output signal for each input pulse the duration of which falls between two specified values.

391-11-27

coincidence selector

A *time selector* with two or more inputs designed to provide an output signal only when specified inputs all receive pulses within a specified time interval.

391-11-28

anticoincidence selector

A *time selector* with two or more inputs and designed to provide within a specified time interval an output signal only when input pulses occur at one or more specified inputs and no input pulse occurs at other specified inputs.

391-11-29

pulse shape selector

A *selector* designed to provide an output signal for each input signal of which a specified characteristic of the shape meets specified conditions.

d) *Analysers*

391-11-30

analyser

A sub-assembly designed to determine the distribution function of a group of signals in terms of one or more of their characteristics (amplitude, duration, etc.).

391-11-31

single-channel analyser

An *analyser* (consisting of a *pulse selector*) used for a point by point determination of a distribution function.

391-11-32

multichannel analyser

An *analyser* with more than one channel, usually containing a sufficient number of channels to determine a distribution function of a group of signals by sorting the pulses into the various channels according to one of their characteristics (amplitude, duration, etc.).

391-11-33

amplitude analyser

An *analyser* designed to determine the distribution function of a group of signals in terms of their amplitude.

391-11-34

time interval analyser

An *analyser* designed to determine the distribution function of intervals of time between events.

391-11-35

time-of-flight analyser

An *analyser* designed to determine the distribution function of the *times-of-flight* of particles in a beam in order to obtain the energy distribution of the particles.

e) *Converters*

391-11-36

analog-to-digital converter

A sub-assembly designed to provide

an output signal which is a digital representation of the analog input signal.

391-11-37

amplitude-to-time converter

A sub-assembly, designed to provide, according to the type of apparatus:
a) an output signal the duration of which is proportional to the amplitude of the input signal;
b) two output signals separated by a time interval proportional to the amplitude of the input signal.

391-11-38

time-to-amplitude converter

A sub-assembly designed to provide, according to the type of apparatus:
a) an output signal the amplitude of which is proportional to the time interval between two input signals;
b) an output signal the amplitude of which is proportional to the duration of the input signal.

391-11-39

digital time converter

A sub-assembly designed to provide an output signal which is a digital representation of the time interval between two input signals.

f) *Counting apparatus*

391-11-40

scaler

A sub-assembly designed for counting electrical pulses and containing one or more *scaling circuits*.

391-11-41

scaling circuit

An electronic circuit designed to provide an output pulse each time a specified number of pulses has been received at its input.

391-11-42

difference scaler

A *scaler* having two inputs, which adds one to its contents for each incoming signal pulse at one input and substracts one from its contents for each incoming signal pulse at the other input.

391-11-43

reversible scaler

A *scaler* having a single input, which, for each incoming signal pulse, adds one to its contents or substracts one from its contents, according to an auxiliary control.

391-11-44

(counting) ratemeter

A sub-assembly designed to provide a continuous indication of the average *counting rate*.

391-11-45

linear ratemeter

A *ratemeter* in which the indication is proportional to the *counting rate*.

391-11-46

logarithmic ratemeter

A *ratemeter* in which the indication is proportional to the logarithm of the *counting rate*.

g) *Miscellaneous*

391-11-47

spectrum stabilizer

A sub-assembly associated with a *radiation spectrometer* and designed to reduce distortion of the spectrum by compensating for the drifts of some elements of this assembly.

SECTION 391-12 — PARAMETERS AND MISCELLANEOUS TERMS

a) *Terms concerning discriminators*

391-12-01

discriminator curve
integral spectrum (deprecated)

A curve showing the *counting rate* as a function of the discriminator threshold.

b) *Terms concerning pulse selectors*

391-12-02

(pulse) coincidence

The occurrence of pulses within a preselected time interval in each of two or more channels, as specified.

391-12-03

true coincidence

A *coincidence* due to the detection of a single particle, or of two or more particles resulting from a single event.

391-12-04

false coincidence

Any *coincidence* which is not a *true coincidence*.

391-12-05

random coincidence

A *false coincidence* due to the detection of unrelated particles that happen to occur within the *coincidence resolving time* as a result of their random time distribution.

391-12-06

coincidence resolving time

The maximum time interval which can elapse between the occurrence of pulses at each of two or more specified inputs of a *coincidence selector* allowing the pulses to be recognized as a *coincidence*.

391-12-07

anticoincidence

A general term referring to an event or a pulse used to prevent a circuit or instrument from providing an output signal corresponding to a signal (or signals) at a specified input (or inputs) within a specified time interval.

c) *Term concerning counting apparatus*

391-12-08

scaling factor

The number of pulses required at the input of a *scaling circuit* in order to produce an output pulse.

Sections 391-13 to 391-15 — Radiation measuring assemblies

SECTION 391-13 — GENERAL TERMS

391-13-01

radiation meter
radiation measuring assembly

An assembly designed to measure quantities concerned with *ionizing radiation* (activity, exposure rate, etc.), and including one or several *radiation detectors* and associated sub-assemblies or basic function units.

391-13-02

(radiation) warning assembly

An assembly intended to give a warning, usually visual or audible, that the quantity connected with *ionizing radiation* exceeds some predetermined value or that the measured value is not within some predetermined limits.

391-13-03

(radiation) indicator

An assembly for quickly giving, by means of the variation of a signal usually visual or audible a coarse estimation of a quantity connected with *ionizing radiation*.

391-13-04

(radiation) monitor

An assembly having the functions of both a *radiation meter* and a *warning assembly*.

391-13-05

probe (of a radiation measuring assembly)

That part of a radiation measuring assembly consisting of an envelope of convenient geometrical form containing a *radiation detector* and possibly a *preamplifier* and certain functional units. Its form and construction are usually such as to permit its operation in places of difficult access, or remote from the associated apparatus, or for scanning of a surface or volume.

SECTION 391-14 — TYPES OF RADIATION MEASURING ASSEMBLIES

a) *Health physics instruments*

391-14-01

exposure meter

A *radiation meter* intended to measure *exposure*.

391-14-02

dosemeter

A *radiation meter* intended to measure the *absorbed dose*.

Note. — In a wider sense this term is also used in *exposure* measurement. This use is deprecated and the term *exposure meter* is more particularly applied to exposure measurement.

391-14-03

personal dosemeter [exposure meter]

Dosemeter [exposure meter] of small size intended to be carried by a person in order to determine the absorbed dose [exposure] received by this person.

391-14-04

pocket dosemeter [exposure meter]

Personal dosemeter [exposure meter] with the form and the dimensions of a fountain-pen.

391-14-05

direct reading pocket dosemeter [exposure meter]

A *pocket dosemeter [exposure meter]* comprising a *capacitor ionization chamber* and an electrometer which may be read directly.

391-14-06

dosemeter [exposure meter] charger

An instrument intended to charge a *direct reading pocket dosemeter [exposure meter]*.

391-14-07

indirect reading pocket dosemeter [exposure meter]

Pocket dosemeter [exposure meter] comprising a *capacitor ionization chamber* which must be read with a separate reader.

391-14-08

dosemeter [exposure meter] charger reader

Instrument intended to charge an *indirect reading pocket dosemeter [exposure meter]* and to allow reading of the dosemeter from the residual charge measurement.

391-14-09

pocket ionization chamber

Personal dosemeter [exposure meter] consisting of a small *capacitor ionization chamber*.

391-14-10

thermoluminescent personal dosemeter [exposure meter]

Personal dosemeter [exposure meter] comprising a *thermoluminescence detector*, a separate reader being used for reading.

391-14-11

reader for thermoluminescent dosemeter [exposure meter]

An instrument intended for reading of a *thermoluminescent personal dosemeter [exposure meter]* by measuring the light emitted by thermal stimulation of the dosemeter [exposure meter] in a predetermined temperature interval.

391-14-12

photoluminescent personal dosemeter [exposure meter]

Personal dosemeter [exposure meter] comprising a *photoluminescence detector*, a separate reader being used for reading.

391-14-13

reader for photoluminescent dosemeter [exposure meter]

An instrument intended for reading of a *photoluminescent personal dosemeter [exposure meter]* by measuring the light emitted by the dosemeter [exposure meter] when receiving radiation of certain wavelength.

391-14-14

exposure ratemeter

A *radiation meter* intended to measure *exposure rate*.

391-14-15

dose ratemeter

A *radiation meter* intended to measure or to permit evaluation of *absorbed dose rate*.

391-14-16

particle fluence ratemeter

A *radiation meter* intended to measure *particle fluence rate*.

391-14-17

surface contamination meter

A *radiation meter* intended to determine the *contamination* of an object by measuring the *activity* of its surface.

391-14-18

contamination monitor

A *monitor* intended to determine whether the *activity* associated with the *contamination* is above or below a predetermined limit.

b) *Activity meters*

391-14-19

activity meter

A *radiation meter* intended to measure the *activity* of a radiation *emitter* and equipped with an indicating or recording instrument.

391-14-20

liquid scintillator activity meter

An *activity meter* intended to measure the *activity* of a solution of a radiation *emitter*, by mixing the solution with a liquid *scintillator* and detecting the scintillations produced.

c) *Radiation spectrometers*

391-14-21

radiation spectrometer

A measuring assembly intended to determine the energy *spectrum* of *ionizing radiation*.

391-14-22

gamma [alpha] [beta] [X] ray spectrometer

A *radiation spectrometer* for gamma [alpha] [beta] [X] radiation.

391-14-23

anti-Compton gamma ray spectrometer

A *gamma ray spectrometer* in which the continuous background due to the *Compton effect* is reduced.

391-14-24

scintillation spectrometer

A *radiation spectrometer* that utilizes a *scintillation detector*.

391-14-25

time-of-flight neutron spectrometer

A *radiation spectrometer* intended to determine the energy *spectrum* of the *neutrons* in a beam, by measuring their *times-of-flight*.

391-14-26

recoil proton spectrometer

A *radiation spectrometer* intended to determine the energy *spectrum* of fast *neutrons* by measuring the energy distribution of the recoil *protons* resulting from elastic scattering of fast neutrons in a detector containing nuclei of hydrogen.

391-14-27

mass spectrometer

An assembly intended to analyse a substance in terms of the relative abundances of its components, separating the components by their "mass to charge" ratios. The detection and the counting of the ions are by electrical means.

391-14-28

mass spectrograph

An assembly intended to analyse a substance in terms of the relative

abundances of its components, separating the components by their "mass to charge" ratios. The detection and the counting of the ions are by photographic means.

d) *Pulse counting assemblies*

391-14-29

(pulse) counting assembly

A *radiation meter* intended to count the pulses produced in its *radiation detector* or detectors.

e) *Prospecting radiation assemblies*

391-14-30

prospecting radiation meter

A *radiation meter* intended to measure *fluence rate* in general, regional or local prospecting or for subsurface and deep survey.

391-14-31

radiometric bore-hole logging assembly

A *prospecting radiation meter* intended to measure the radiation in a bore-hole at various depths. The assembly includes a *probe* that is inserted in the bore-hole and connected to external associated apparatus.

f) *Miscellaneous assemblies*

391-14-32

charge integrator
radiation charge meter

An assembly intended to measure the electric charge by integration of the current provided from a *radiation detector*.

391-14-33

(radiation) multi-parameter analysing assembly

A *radiation measuring assembly* intended to record simultaneously the information delivered by its *radiation detectors*, and to analyse this information as a function of two or more parameters in order to establish correlations. The assembly often includes digital data processing equipment.

SECTION 391-15 — PARAMETERS AND MISCELLANEOUS TERMS

a) *Terms concerning radiation measuring assemblies*

391-15-01

sensitivity (of a measuring assembly)

For a given value of the measured quantity, the ratio of the variation of the observed variable to the corresponding variation of the measured quantity.

391-15-02

background effect (of a radiation meter)

The value indicated by a *radiation meter* in the absence of the source whose radiation is to be measured, when the device is placed under its normal conditions of operation.

391-15-03

concomitant radiation

Radiation which is associated with the radiation to be measured but which is not the object of the measurement, and whose effects on the measurement should preferably be eliminated.

391-15-04

response time (of a measuring assembly)

The time required after a step variation in the measured quantity for the output signal variation to reach for the first time a given percentage of its final value.

391-15-05

settling time

The time required after a step variation in the measured quantity for the output signal to reach and remain within a specified percentage of its final steady-state value.

391-15-06

rise time (of a measuring assembly)

The time for the output quantity to rise from 10% to 90% of its amplitude, for a step function input.

b) *Terms concerning spectrometers*

391-15-07

spectrum (of an ionizing radiation)

Distribution of the values of a specific radiation quantity usually associated with energy, for example emission rate as a function of energy of emitted particles.

391-15-08

full width at half maximum (FWHM)

In a distribution curve comprising a single peak, the distance between the abscissa of two points on the curve whose ordinates are half of the ordinate of the peak.

Note. — If the curve considered comprises several peaks, a full width at half maximum exists for each peak.

391-15-09

energy resolution (of a radiation spectrometer)

A measure, at a given energy, of

the smallest relative difference between the energy of two particles capable of being distinguished by a *radiation spectrometer*.

Note. — In common practice, the energy resolution is expressed by a factor which is the *full width at half maximum* divided by the energy at the peak of the distribution curve for monoenergetic particles.

c) *Terms concerning counting assemblies*

391-15-10

count

A single response of a *counting assembly*.

391-15-11

spurious count

Count caused by any agency other than the radiation to be measured.

391-15-12

counting rate

Number of *counts* per unit time.

391-15-13

counting loss

A reduction of the observed *counting rate* due to the *resolving time* or to losses caused by phenomena such as *pile-up*.

391-15-14

fractional counting loss

Counting loss referred to the number of received data.

391-15-15

pile-up (in a counting assembly)

A phenomenon where a pulse occurs on the tail of the preceding pulse so as to result in an incorrect indication of pulse amplitude. The pile-up can also result in failure to resolve some pulses.

391-15-16

threshold of response (to pulses)

The minimum amplitude of a pulse required for a given circuit associated with the detector to perform its function in response to that pulse.

391-15-17

resolving time

The smallest time interval which must elapse between the occurrence of two consecutive pulses or *ionizing events* and still be recognized as separate pulses or events.

391-15-18

resolving time correction
dead time correction

Correction to be applied to the observed number of pulses in order to take into account the number of pulses lost due to the *resolving time*.

391-15-19

paralysis time

Constant predetermined value imposed on the *resolving time* by a paralysis circuit, usually in order to make the *resolving time correction* more accurate.

391-15-20

recovery time

The minimum time interval from the start of a counted pulse to the instant a succeeding pulse can attain a specified percentage of the maximum amplitude of the counted pulse.

391-15-21

half amplitude recovery time

Recovery time corresponding to 50% amplitude.

391-15-22

latency time

The time which elapses between the arrival of a particle at the detector and the moment when the pulse characteristic quantity reaches the *threshold of response* of the circuit associated with the detector.

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CHAPTER 392: NUCLEAR INSTRUMENTATION

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CHAPTER 392: NUCLEAR INSTRUMENTATION

SUPPLEMENT TO CHAPTER 391

Section 392-01: Detection sub-assemblies

The terms of this section are to be added to Section 391-09 of I. E. V. Chapter 391.

392-01-01

liquid-wall ionization chamber

An *ionization chamber* designed to measure the alpha or beta *activity* of a liquid so situated that its surface constitutes the wall of the chamber.

392-01-02

wall-less ionization chamber

An *ionization chamber* in which the *sensitive volume* is not defined by walls, but by the lines of force of the electrical field determined by the form and arrangement of the electrodes and by the potential difference between electrodes.

392-01-03

flat counter tube

A *counter tube* formed by two metallized plane sheets between which several parallel wires are suspended parallel to these sheets.

Section 392-02: Radiation measuring assemblies

The terms of this section are to be added to Section 391-14 of I. E. V. Chapter 391.

1 — Health physics instruments

392-02-01

air contamination meter

A *radiation meter* designed to measure the *activity* concentration of aerosols, vapours or gas in air.

392-02-02

radioactive aerosol contamination meter

An *air contamination meter* utilizing aerosol sampling and measuring devices.

392-02-03

air contamination monitor

A *monitor* designed to measure the *activity* concentration of aerosols, vapours or gas in air and to give a warning when it exceeds a predetermined value.

392-02-04

radioactive aerosol contamination monitor

An *air contamination monitor* utilizing aerosol sampling and measuring devices.

392-02-05

air contamination indicator

An *indicator* designed to detect the presence of *contamination* by radioactive aerosols, vapours or gas in air.

392-02-06

criticality monitor

A *monitor* designed to measure a quantity connected with a possible criticality accident and to give a warning when it exceeds a predetermined value.

392-02-07

tissue activity meter

An *activity meter* designed to locate, by means of appropriate probes, fixed radionuclides within tissues.

392-02-08

(body) radiocartograph

An assembly designed to establish the chart of the radioactivity distribution of a part of the human body, after absorption of a suitable radionuclide.

392-02-09

whole-body radiation meter

An assembly which measures the total gamma radiation (including Bremsstrahlung) emitted by the body and uses one or several scintillation detectors heavily shielded against ionizing ambient radiation.

392-02-10

whole-body gamma spectrum analyser

A measuring assembly including a *whole-body radiation meter* and an *amplitude analyser*, designed to identify radionuclides present in the human body and to evaluate their respective *activities*.

Note. — This is commonly referred to as "Whole-body counter".

2 — Prospecting radiation assemblies

392-02-11

prospecting audio-radiation indicator

A portable prospecting *radiation indicator* that provides an audible indication of radiation *flux density*.

392-02-12

radon content meter (for prospecting purposes)

A prospecting assembly used to determine the concentration of radon by measuring the *counting rate* and/or the number of *counts* corresponding to the alpha particle emission rate from radon and its daughters in the air sample.

392-02-13

beryllium prospecting meter (γ, n)

A measuring assembly designed to be used in prospecting for beryllium ores; operation is usually based on the beryllium nuclear reaction (γ, n) due to a gamma radiation source, the neutrons produced being counted after moderation.

392-02-14

ore content meter

A measuring assembly designed to determine the amount of a specified element or material in ore specimens.

392-02-15

uranium content meter (by beta and gamma radioactivity)

An *ore content meter* designed to determine the uranium content of an ore sample by means of the measurement of beta and gamma emission rates of this sample.

392-02-16

beryllium content meter (γ, n)

An *ore content meter* having a gamma radiation source and designed to determine the beryllium content of an ore sample by means of the beryllium nuclear reaction (γ, n).

392-02-17

thorium content meter

An *ore content meter* designed to determine the thorium content of an ore sample by means of a method based on the difference between the *half-lives* of radon and thoron.

3 — Miscellaneous assemblies

392-02-18

radiochromatograph

A measuring assembly designed to draw a representative curve of the *activity* of different components of a mixture, labelled with radionuclides and deposited, by a chromatograph method, on a paper strip moving in front of a radiation detector.

Section 392-03: Assemblies for nuclear reactors

1 — Assemblies involved with protection system

392-03-01

protection system

The system which acts only to prevent the reactor conditions from exceeding specified safe limits or to reduce the consequences of their being exceeded. The protection system may include various subsystems: emergency shut-down system, interlock system, power cutback system, alarm system, containment isolation system, emergency cooling system, etc.

392-03-02

emergency shutdown system; safety shutdown system

That part of the *protection system* which initiates the rapid shutdown of the reactor for safety purposes.

392-03-03

(safety) interlock system

That part of the *protection system* which prevents certain operations which may affect the safety of the reactor unless all prescribed conditions are met.

392-03-04

(safety) power cutback system

That part of the *protection system* which controls or provides for control of a limited decrease of power according to a programme.

392-03-05

(safety) alarm system

That part of the *protection system* which comprises all *safety alarms*.

392-03-06

safety alarm

An alarm which warns the operator to take essential protective action.

392-03-07

(safety) monitoring assembly

A measuring assembly intended to follow the variation of a characteristic concerned with the reactor and comprising a data processing subassembly giving one or more output logic signals.

For example: an assembly comprising a thermocouple, a trip amplifier and an output relay.

Note. — A monitoring assembly generally includes several measuring channels for each characteristic to provide the necessary reliability.

392-03-08

safety logic assembly

An assembly connected to the measuring channels of one or more *safety monitoring assemblies* and intended to perform a decision-making function and give a command signal to one or more *safety actuators*.

392-03-09

safety actuator

Sub-assembly which accepts command signals from one or more *logic assemblies* and directly controls safety action.

For example: safety actuators are used for safety shutdowns, emergency cooling, etc.

392-03-10

alarm indicator

An *indicator* which gives a visible and/or audible warning upon the appearance of one or more faults to advise the reactor operator that his attention is required.

392-03-11

failed fuel element monitor

A *radiation monitor* designed to discover failures in the cladding (or coating) of the fuel elements in a nuclear reactor by measuring the concentration of radioactive materials (generally fission products) present in the reactor coolant.

392-03-12

assembly for failed fuel element localization

An assembly designed to enable localization of failed fuel elements by scanning the different regions of the nuclear reactor.

2 — Servomechanisms

392-03-13

control element drive mecnanism (of a nuclear reactor)

A device used to move a control element of a nuclear reactor.

392-03-14

rotational control electromechanism (for a nuclear reactor)

An electromechanism designed to perform a rotational motion of one or several nuclear reactor control elements.

392-03-15

linear control electromechanism
(for a nuclear reactor)

An electromechanism designed to perform a linear motion of one or several nuclear reactor control elements.

392-03-16

automatic control assembly
(for a nuclear reactor)

An assembly designed to perform the automatic regulation of a quantity which is characteristic of the power of the reactor (such as the neutron flux density or any other quantity for which regulation is desired) and, in certain conditions, to change automatically the value of this quantity.

3 — Miscellaneous assemblies

392-03-17

period meter

An electronic sub-assembly which, in association with one or more detectors, is used to indicate the time constant (period) of a nuclear reactor.

392-03-18

reactivity meter

An electronic sub-assembly which, in association with one or more detectors, gives an indication of the reactivity of a nuclear reactor.

392-03-19

clad temperature computer
(for a nuclear reactor)

A computer that calculates the temperature reached by the hottest cladding inside a nuclear reactor. The calculation is based on the reactor power and temperatures measured at certain points.

Section 392-04: Measuring instruments using a source of ionizing radiation

392-04-01

thickness meter
(ionizing radiation)

A measuring assembly that includes an ionizing radiation source and is designed to measure non-destructively the thickness of a material by means of ionizing radiation.

392-04-02

(ionizing radiation) transmission thickness meter

A *thickness meter* that utilizes the radiation transmitted through the material being measured.

392-04-03

beta [gamma] back-scatter thickness meter

A *thickness meter* that includes a beta [gamma] radiation source and that utilizes the radiation back-scattered by the material being measured. This assembly is frequently used for the measurement of lining or coating thicknesses.

392-04-04

X-ray fluorescence thickness meter

A *thickness meter* that utilizes the X-ray fluorescence excited in the material to be measured or in the supporting material.

392-04-05

density meter (ionizing radiation)

A measuring assembly that includes an ionizing radiation source and is designed to determine either the density of a material or the average specific gravity of a heterogeneous mixture, using the variation, within a defined geometry, of the absorption or diffusion of radiation.

392-04-06

transmission density meter
(ionizing radiation)

A *density meter* that utilizes the radiation transmitted through the material being measured. The assembly is also used to check the homogeneity of a material.

392-04-07

back-scatter density meter
(ionizing radiation)

A *density meter* that utilizes the radiation back-scattered by the material being measured.

392-04-08

level meter
(ionizing radiation)

A measuring assembly that includes an ionizing radiation source and is designed to measure or indicate the level in a container of liquid or granular substances, even when direct access to that level is not possible.

392-04-09

on-off level indicator
(ionizing radiation)

An *indicator* that includes an ionizing radiation source and a detector for determining, in the case of a material contained in an enclosure, the absence or the presence of this material on the path between source and detector.

392-04-10

following level meter
(ionizing radiation)

A level meter including an *on-off level indicator* and in which the source-detector assembly is compelled to follow the level.

392-04-11

static level meter
(ionizing radiation)

A *level meter* for continuous measurement which includes a fixed ionizing radiation source and a detector disposed in such a way that the radiation imparted to the detector is a function of the level value.

392-04-12

content meter (ionizing radiation)

A measuring assembly that includes an ionizing radiation source for determining the amount of a specified element or material that is present in a substance.

392-04-13

coal ash content meter
(ionizing radiation)

A *content meter* designed to determine ash content in coal by measurement of the radiation back-scattered or transmitted by the coal.

329-04-14

sulphur content meter for hydrocarbons (ionizing radiation)

A *content meter* designed to determine the sulphur content of hydrocarbons by measurement of residual radiation after absorption in the hydrocarbons.

392-04-15

X-ray fluorescence content meter; X-ray excitation fluorimeter

A *content meter* designed to determine the content of one or several elements in liquid or solid samples, by measurement of X-ray fluorescence excited by X-rays.

392-04-16

soil moisture meter
(ionizing radiation)

A *content meter* including a fast neutron source and designed to determine soil water content through counting the neutrons moderated by the hydrogen nuclei in the water molecules.

392-04-17

ionized-gas anemometer

An assembly designed to measure the velocity of gas and comprising an ionizing radiation source included in an *ionization chamber* through which the gas studied is flowing, the value of the velocity being determined from the electric current flowing through the chamber.

392-04-18

vacuum meter with alpha emitter

A vacuum meter designed to measure low pressures and comprising an alpha radiation source in an *ionization chamber* communicating with an enclosure, the vacuum of which is to be determined. The gas of the chamber is thus at the same pressure as the gas in the enclosure and the electric current flowing through the chamber provides the measure of this pressure.

392-04-19

proximity indicator (ionizing radiation)

An *indicator* including an ionizing radiation source and a radiation detector, designed to give an estimate of the relative proximity of two objects, by using the direct or scattered radiation.

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