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MILITARY STANDARD

GLOSSARY OF TERMS AND DEFINITIONS FOR RADIOGRAPHIC TESTING

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DEPARTMENT OF DEFENSE
WASHINGTON, DC 20301

MIL-STD-369
Glossary of Terms and Definitions For Radiographic Testing

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FOREWORD

This standard prescribes terminology for use with radiographic methods and procedures.

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1. SCOPE

1.1 Purpose. The terminology in this standard for radiographic methods and procedures is intended for use on drawings, and in specifications, standards, and technical documents.

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2. REFERENCED DOCUMENTS

2.1 Government documents. Not applicable.

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3. DEFINITIONS

absorbed dose - the amount of energy imparted by ionizing radiation per unit mass of irradiated matter. Symbol: D. Special unit: rad. One rad is equal to 0.01 joules per kilogram. SI (international System) unit: gray. One gray is equal to one joule per kilogram.

absorbed dose rate - the absorbed dose per unit time. Special unit: rads per second. SI unit: grays per second.

absorption - the process whereby the incident particles or photons of radiation are reduced in number or energy as they pass through matter.

absorption edge - see critical absorption wavelength

accelerator - a device used to impart kinetic energy to charged atomic particles. The beam of particles may be made to impinge on a heavy-metal target to produce x-rays or high-energy photon radiation. Examples of accelerators are the linear accelerator, betatron, Van de Graaff accelerator, and the x-ray machine.

activation - the process by which substances are made radioactive by irradiation (bombardment by atomic particles or gamma rays).

activity - the rate at which spontaneous nuclear transitions occur in an amount of radioactive material at a given time. Symbol: A. Special unit: curie. SI unit: becquerel.

acute radiation syndrome - the immediate effects of short-term, whole-body overexposure of a person to ionizing radiation. These effects include nausea and vomiting, malaise, increased temperature, and blood changes.

added filter - any filter used to achieve filtration in excess of the inherent filtration.

additive, absorptive - see contrast agent.

aerial image - the representation (in relief) of the distribution of the intensity of the radiation in the plane of the radiograph (plane of the film).

afterglow - the persistence of light emission from an intensifying screen or fluorescent screen after an exposure. It is also called phosphorescence radiation.

air-cooled tube - an x-ray tube for which the principal method of cooling is dissipation of heat into surrounding air.

air scatter - ionizing radiation that, because of a scattering interaction with air, arrives at a point by way of an indirect route instead of arriving directly from the source.

alkali - the alkaline constituent (e.g., sodium carbonate) which is normally added to the developer to bring the solution to, and maintain it at, the desired level of chemical activity.

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alpha particle - a positively charged particle emitted by certain radionuclides. It consists of two protons and two neutrons, and is identical to the nucleus of a helium atom.

alpha ray - a beam of alpha particles that has a small cross-sectional area, or a single particle of such a beam.

aluminum equivalent - the thickness of aluminum (with specified purity) affording the same attenuation, under specified conditions as the material in question.

anode - the positive electrode, usually including the target, in an x-ray tube.

anode current - the current passing from the cathode to the anode in an x-ray tube. It is often referred to as the tube current.

anode stem - the metallic rod on which the target is mounted, and which is sealed to the envelope of the x-ray tube.

anti-scatter grid - an array of x-ray opaque and transparent sections of materials placed between the specimen and the film to minimize the effect of scattered radiation on the radiographic image. The grid may be stationary (e.g., Lysholm grid) or moving (e.g., Potter-Bucky diaphragm) during the exposure.

area monitoring - the continued measurement of ionizing radiation exposure or dose levels in an area for the purpose of radiation protection.

area of interest - the specific portion of the specimen image on the radiograph that is to be evaluated.

artifact - a spurious indication on a radiograph caused by faults in the manufacture, handling, storing, exposing, or processing of a film.

atomic number - the number of protons in a given atomic nucleus. Symbol: Z.

atomic weight (atomic mass) - the mass of an atom. The basis of the physical scale of atomic weights is the carbon atom, and the isotope carbon-12 has arbitrarily been assigned an atomic weight of exactly 12 atomic mass units. Hence the atomic mass unit is 1/12 the weight of carbon-12, or roughly the mass of the proton or neutron. The atomic weight of an element, therefore, is approximately equal to the total number of protons and neutrons in its nucleus. One atomic mass unit = 1.66×10^{-24} gram.

attenuation - reduction in the intensity of a beam of ionizing radiation due to passage through matter.

attenuation coefficient - the average fraction of photons or uncharged ionizing particles that interact per unit pathlength in an absorbing material.

Auger electron - an orbital electron emitted by an atom, instead of a photon of characteristic radiation, when a vacancy in an inner electron shell is filled.

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autoradiograph - the image of an object obtained on a photographic emulsion by means of radiation emitted by the object itself.

autoradiography - the process by which the image of an object is obtained on a photographic emulsion by means of radiation emitted by the object itself.

autotransformer - a transformer in which the output voltage can be easily varied.

average gradient - the slope of a straight line joining two specified densities on a characteristic curve.

average life (mean life) - the arithmetic mean value of the lives of the atoms of a radioactive nuclide. It is the reciprocal of the decay constant. Symbol: τ

background count - the number of counts recorded by a counting system over a period of time due to background radiation and electronic noise in the counting system.

background counting rate - the number of background counts per unit time.

background radiation - the radiation in man's natural environment, consisting of that which comes from cosmic rays and the naturally radioactive elements of the earth.

back-scattered radiation - radiation that was scattered at angles greater than 90^{o} with respect to its direction of incidence.

barium clay - a clay containing barium that is used to eliminate or reduce the amount of scattered or secondary radiation reaching a radiographic film.

barium concrete - concrete containing a high proportion of barium compounds, used for radiation protection purposes.

barium plaster - plaster containing a high proportion of barium compounds, used for radiation protection purposes.

barn - a unit used to express atomic or nuclear cross section ($1 \text{ barn} = 10^{-24} \text{ cm}^2$).

beam - a directed flow of energy into space or matter, in which the directions of propagation of individual particles or photons are nearly parallel, but will diverge according to the inverse square law for radiation intensity.

beam angle - the smallest angle between the central axis of the radiation beam and the plane of the (radiographic) film.

beam divergence - the solid angle of the beam of radiation as it emerges from the x-ray tube or gamma-ray exposure device.

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beam quality - an expression used to describe the penetrating power (energy spectrum) of a beam of radiation. The quality of an x-ray beam is usually expressed in terms of half-value layer of some reference material, such as aluminum or copper.

becquerel - the SI (international system) unit of activity. One becquerel equals one nuclear transition per second. Abbreviation: Bq. ($1\ Ci = 3.7 \times 10^{10}$ Bq.).

beta decay - the nuclear transition process characterized by the emission of a beta particle. The parent atom involved is called a beta emitter.

beta particle - an elementary particle emitted from a nucleus during nuclear transition. It has an electrical charge of 1.602×10^{-19} coulomb and a mass equal to 1/1836 that of a proton. A negatively charged beta particle is physically identical to the electron.

beta ray - a beam of beta particles that has a small cross-sectional area, or a single particle of such a beam.

betatron - an accelerator in which charged particles are accelerated by an electric field inside a hollow circular tube shaped like a doughnut. A changing magnetic field induces this electric field (as in the secondary winding of a transformer) and also guides the particles into a circular orbit inside the doughnut. The betatron can accelerate electrons to energies of 10^6 to 10^8 electron volts, which can be used directly or can be deflected onto a heavy metal target to produce high-energy x-rays.

blocking - surrounding specimens or partially covering them with radiation-absorbing material to reduce the amount of scattered radiation reaching the film.

blocking medium - material of appropriate radiation opacity for applying to an object, either around the edges or as a filling for holes, to reduce the effect of scattered radiation and to shield portions of the film which would otherwise be over-exposed (e.g., radiographic putty).

blur- see unsharpness.

body burden - the amount of radioactive material present in the body of a human or an animal.

boundary wavelength (quantum limit) - the shortest wavelength present in a continuous x-ray spectrum. It is inversely proportional to the peak voltage applied to the x-ray tube.

branching - the occurrence of competing radioactive decay processes (branches) in the disintegration scheme of a particular nuclide.

branching fraction - that fraction of the total number of atoms involved which follows a particular branch of the disintegration scheme. It is usually expressed as a percentage.

branching ratio - the ratio of two specified branching fractions. The term is also commonly used as a synonym of branching fraction.

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bremsstrahlung - electromagnetic radiation emitted by charged particles when they are slowed down by electric fields in their passage through matter. Literally "braking radiation" in German.

brightness amplifier - see image intensifier.

broad beam - an uncollimated beam containing scattered radiation as well as the primary beam.

broad-beam absorption - absorption measured under conditions in which scattered radiation is not excluded from the measuring apparatus.

build-up - an increase in a specified radiation quantity due to the contribution from scattered and secondary radiation.

build-up factor - in the passage of radiation through a medium, the ratio of the total value of a specified radiation quantity at any point to the contribution to that value from radiation reaching the point without having undergone a collision.

Bunsen-Roscoe reciprocity law - see reciprocity law.

byproduct material, radioactive - any radioactive material (except source or fissionable material) obtained in the process of producing or using source or fissionable material. Includes fission products and many other radionuclides produced in nuclear reactors.

calcium tungstate - a fluorescent chemical compound which emits primarily blue-violet light when activated by either x or gamma radiation or charged particles..

calibration - see instrument calibration or source calibration.

cannon tube shield - a tube shield in the form of a long cylinder, generally supported in cantilever fashion. The x-ray beam emerges through an aperture in the lead-lined wall of the cylinder, at right angles to its axis.

capacity, gamma-ray source - the maximum activity in curies (becquerels) specified for a given radionuclide that may be contained in an exposure device.

cascade tube - a high-voltage x-ray tube of cylindrical form divided into sections, the potential difference across each of which is a fraction of the voltage applied to the whole tube. The electron stream is accelerated to its maximum energy in stages.

cassette - a light-tight container for holding a radiographic film, paper or plate with or without screens during exposure, the front face of which is relatively transparent to x and gamma rays.

cathode - the negatively-biased electrode of an x-ray tube.

cathode ray - a stream of electrons emitted by a heated filament (or by a cold structure under the influence of an electric field of high intensity) and accelerated in the form of a beam by means of an electric field or a changing magnetic field.

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certified density - see step-wedge calibration film.

cesium-137 - a radioactive nuclide of the element cesium having a half-life of 30 years, and a gamma-ray energy of 662 keV (which is 0.662 MeV).

characteristic curve - for a particular type of film, a curve showing the relation between the common logarithm of exposure (frequently expressed in arbitrary units) and the photographic density, under specified conditions of exposure and processing.

characteristic radiation - x-radiation consisting of discrete wavelengths which are characteristic of the emitting material.

chemical fog (aerial fog) - see fog.

cine-fluorography - cine-radiography of images produced on a fluorescent screen.

cine-radiography - the production of a series of radiographs which can be viewed rapidly in sequence, thus creating an illusion of continuity.

clearing time - the time required for the first stage of fixing during which the whiteness (opaqueness) of the film disappears.

clockwork timer - a timer controlled by a clockwork mechanism.

cobalt-60 - a radionuclide of the element cobalt, emitting gamma rays with energies of 1.33 and 1.17 MeV, with a half-life of 5.3 years.

coincidence loss - loss of counts due to the occurrence of ionizing events at intervals less than the resolving time of the counting system.

collimator - a device used to limit the size, shape, and direction of the primary radiation beam.

combination screens - a pair of intensifying screens in which the front screen (to be placed on the tube side of the film) is usually thinner than the back screen.

compensator - a device placed in a radiation beam to achieve more uniform radiation intensity over the plane perpendicular to the direction of propagation.

composite filter - a filter of two or more materials chosen so that the longer wavelengths of a beam are strongly absorbed, and within this range anomalous transmission is avoided. The materials are usually arranged so that the second material filters secondary radiation produced in the first material and so on. A particular example is the "Thoraeus filter" which consists of 0.44 mm of tin, 0.25 mm of copper and 1 mm of aluminum in this order in the beam of radiation.

Compton absorption (Compton effect) - the reduction of the energy of an incident photon by its interaction with an electron. Part of the photon energy is transferred to the electron (Compton electron or recoil electron) and part is redirected as a photon of reduced energy.

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Compton scattering - a process in which an incident photon transfers a portion of its energy to an electron in matter and a lower energy photon is scattered at an angle to the original photon path.

computed tomography - a method by which a radiograph of a predetermined interior plane of a thick material is obtained through the use of a computer. The images resulting from a series of exposures at different angles are stored and reconstructed into a single image by the computer.

condenser ionization chamber - an ionization chamber which, having been charged to a certain potential, can be irradiated and subsequently attached to an electrometer to measure the residual charge, whereby the exposure is determined.

cone - see localizing cone

constant-potential circuit - a circuit which is so arranged to apply and maintain a substantially constant potential across an x-ray tube.

constant voltage (constant potential) - a unidirectional voltage of essentially constant magnitude.

container, gamma-ray source - a device for housing radionuclides and giving a required degree of protection against radiation. (This may take the form of an exposure device or a storage container).

contamination - the presence of unwanted radioactive matter, or the "soiling" of objects or materials with "radioactive dirt".

continuous spectrum - an array of the relative number of particles or photons that have a specified wavelength, frequency, or energy in a beam of radiation; for the case when the wavelengths, frequencies, or energies cover an unbroken range of values.

continuous wedge - a wedge, the thickness of which varies continuously.

contrast - the relative brightness of two adjacent areas in a radiograph, photographic reproduction, or fluorescent-screen image.

contrast agent - any suitable substance, solid, liquid, or gas, applied to a material being radiographed, to enhance its contrast in total or in part.

contrast, film - the property of a film to record differences in density in relation to radiation intensity. It depends on the slope (gradient) of the characteristic curve at a given density.

contrast, radiographic - differences in density from one area to another on a radiograph.

contrast ratio - the relative amount of light emitted or reflected as between an indication and its background.

contrast, subject - see subject contrast.

controlled area - any area to which access is controlled for radiation protection purposes.

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control panel - a console or unit that contains the controls necessary to operate a radiation source and any auxiliary equipment used for radiography.

Coolidge tube - an x-ray tube in which the source of the bombarding electrons is a heated filament in the cathode.

corpuscular radiation - see particulate radiation.

count - a pulse that is recorded by a counter and which has been initiated in a detector by an ionizing event.

counter - a device that reacts to signals produced by individual ionizing events, thus enabling them to be summed over a specified period of time.

counting rate - the average rate at which counts are recorded.

counting-rate meter - an instrument that indicates counting rate.

critical absorption wavelength (absorption edge) - the wavelength, characteristic of a given electron energy-level in an atom of a specified element, at which an absorption discontinuity occurs.

cross section - a measure of the probability for an atomic or nuclear interaction. It is usually expressed in barns (1 barn = 10^{-24} cm^2). It can be considered as the effective target area presented by an atom, subatomic particle, or photon for a particular process, e.g., scattering, absorption, or total.

cumulative dose, biological - the total dose resulting from repeated exposure to radiation of the same part or of the whole body.

curie - (Ci) the special unit of activity. One curie equals 3.7×10^{10} spontaneous nuclear transitions per second exactly, or by popular usage, the quantity of any radioactive material having an activity of one curie.

cyclotron - a particle accelerator in which the charged particles are accelerated in an orbit that is approximately a spiral between the ends of a huge magnet, gaining energy with each rotation. The cyclotron is normally used for nuclear research but the particles can be made to collide with a target to produce x-rays.

deadman switch - a switch so constructed that a circuit-closing contact can only be maintained by continuous pressure by the operator.

dead time - the minimum amount of time following the detection of an event by a counting system before another event can be detected. The minimum time may be set by the detector itself, or by the associated electronics.

decay - the decrease in the activity of a radioactive source, the rate of which is controlled by its half-life.

decay constant - the probability that a given nucleus will undergo a spontaneous nuclear transition from a particular energy state in a unit of time. Symbol: λ

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decay curve - the activity of a radioactive source, measured in curies (becquerels), plotted against time.

decontamination - the removal of radioactive contaminants from surfaces, as by cleaning and washing with chemicals.

decontamination factor - the ratio of the amount of radioactive contaminant initially present to the amount remaining after a suitable processing step has been completed. A factor referring to the reduction of the gross measurable radioactivity.

defect detection sensitivity - see sensitivity, defect.

definition - a general and qualitative term that refers to the degree of distinctness of image details in a radiograph, photographic reproduction, or viewing-screen image.

densitometer - an instrument used for optical density measurements either by reflection or by transmission of light.

density (film density; optical density; photographic density) - the quantitative measure of film blackening:

$$D = \log (I_{o/I})$$

where:

D = density,
I_o = light intensity incident on the film, and
I = light intensity transmitted.

density comparison strip - alternative term for step-wedge comparison film.

density gradient - the change in density of a radiographic film (at a particular film density) per unit change in the logarithm of the exposure received by the film.

desensitization - an effect on a radiographic film caused by pressure exerted on the emulsion prior to exposure. It is characterized by low density in the affected area of the radiograph.

detector - a device that determines the presence of ionizing radiation.

developer, photographic - a chemical solution that reduces exposed silver halide crystals to metallic silver, thereby producing a visible image.

developing agent - the constituent of a developer that reduces sufficiently exposed silver halide grains to metallic silver at a greater rate than unexposed or insufficiently exposed grains.

development - the conversion of a latent image into a visible image by treatment of the film emulsion with a suitable chemical solution (developer).

dichroic fog - see fog

differential mottling - minor irregularities in the distribution of density over the whole of the radiograph.

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diffraction - the scattering of incident radiation from the regularly spaced atoms in crystals or complex molecules such that interference between the scattered waves results in a pattern of maxima and minima in the intensity of the scattered radiation.

diffraction mottle - a superimposed mottle or pattern on an image due to diffraction of certain wavelengths in the incident beam, caused by the size and orientation of the crystals of the material through which they have passed.

direct film - see non-screen film.

discharge tube - a tube usually exhausted to a low gas pressure and commonly provided with electrodes for the passage of electricity.

discontinuity - a term generally referring to any kind of flaw, defect, or lack of continuity in a material.

disintegration, nuclear - a spontaneous nuclear transition characterized by the emission of energy and/or mass from the nucleus.

disintegration scheme - the modes of decay of a radioactive nuclide, generally expressed in the form of a diagram which normally includes details of the corpuscular emission and of such subsequent radiations as gamma rays or characteristic x-rays.

distortion - the amount of geometrical departure of an image from the true reproduction of the object.

dose - a general term denoting the quantity of energy absorbed from radiation.

dose, absorbed - see absorbed dose.

dose-effect relation - the relationship between the dose absorbed and the effect produced.

dose equivalent - the product of D, Q, and N at the point of interest in tissue where D is the absorbed dose, Q is the quality factor, and N is the product of all other modifying factors. Symbol: H. Special unit: rem. SI unit: sievert.

$$H = DQN$$

dose equivalent rate - the dose equivalent per unit time. Special unit: rems per second. SI unit: sieverts per second.

dose rate - the radiation dose absorbed per unit time and measured, for instance, in rads (grays) per hour.

dose rate meter - an instrument for measuring dose rate.

dosimeter - a device that measures radiation dose.

double-focus tube - an x-ray tube having a cathode provided with two filaments, only one of which is used at a time, and which generally give two different sizes of focal spot.

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d/t ratio - the ratio of the source-to-specimen distance (d) and the specimen thickness (t).

duplitized film - radiographic film which consists of photosensitive emulsion coated on both sides of the film base.

elastic scattering - scattering in which the total kinetic energy of the incident radiation and the scatterer remains unchanged.

electromagnetic radiation - radiation consisting of electric and magnetic waves that travel at the speed of light. Examples: light, radio waves, gamma rays, x-rays.

electron - an elementary particle with a negative electrical charge of 1.602×10^{-19} coulomb and a mass equal to 9.1×10^{-28} gram.

electron capture - a mode of radioactive decay in which a bound electron is captured by the nucleus of the same atom, producing a vacancy in an inner electron shell. Subsequent filling of the vacancy results in the emission of characteristic x-rays or Auger electrons.

electron focus - the surface of the intersection of the electron beam and the anode of the x-ray tube.

electron gun - a device in which electrons (usually liberated from a hot filament) are focused and accelerated, and from which they are emitted as a narrow beam.

electron pair - an electron and a positron arising from pair production.

electron radiography - the process whereby a photographic image of an object is produced by electron radiation that has penetrated through the object.

electron volt - a unit of energy equal to the kinetic energy acquired by an electron when it is accelerated through a potential difference of one volt in vacuum. ($1 \text{ eV} = 1.602 \times 10^{-19}$ joule approximately).

elementary particle - originally a term applied to any particle that could not be further subdivided; now usually applied only to protons, electrons, neutrons, and their antiparticles, but not to alpha particles.

emulsion - a photosensitive layer of a gelatin and silver halide crystal mixture coated onto a film base.

encapsulation - the process of sealing a radioactive material in a capsule to prevent its dispersion during use as a radiation source. This term is also used to describe the type, thickness, and number of layers of material used to construct the capsule.

end-window detector - a detector designed to be irradiated from one end. This end may have a very thin window to permit the detection of alpha rays or beta rays.

energy, radiation - see radiation energy.

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equalizing filter - a filter used to equalize the intensity of a primary radiation beam over its effective area.

equi-opaque substance - a material having radiation absorption similar to that of the specimen, applied along its edges or in its cavities in order to obtain homogeneous absorption and thereby avoid local overexposure of film.

equivalent penetrameter sensitivity (equivalent IQI sensitivity) - that thickness of penetrameter (image quality indicator), expressed as a percentage of section thickness radiographed, in which a 2T hole would be visible under the same radiographic conditions.

exposure (radiation quantity) - the absolute value of the total charge of the ions of one sign produced in a unit mass of air when all the electrons liberated by photons are completely stopped by the air. Symbol: X. The special unit of exposure is the roentgen.

exposure, radiographic - the subjection of a recording medium to radiation for the purpose of producing an image. Radiographic exposure is the product of radiation intensity and time, and is commonly expressed in terms of milliampere-seconds (for x-rays) or millicurie-hours (for sealed sources) for a known source-to-film distance.

exposure chart - a chart indicating the radiographic exposures appropriate for different thicknesses of a specified material, given a specified radiation energy and other fixed conditions.

exposure device - a shield in the form of a package designed to contain and allow the controlled use of one or more sealed sources for the purpose of making radiographic exposures.

exposure factor - the product of current and time divided by the distance squared for x-rays, and the product of curies and time divided by the distance squared for gamma rays.

exposure head - a device that locates the sealed source at the desired focal position. It may be a separable unit or an integral part of a source guide tube.

exposure latitude. - the range of thickness of a specified material that correponds to the range of useful film densities.

exposure meter - an instrument for measuring exposure (radiation quantity).

exposure rate (radiation quantity) - the exposure per unit time. Special unit: roentgens per second.

exposure rate meter - an instrument for measuring exposure rate (radiation quantity).

exposure table - a table giving the radiographic exposures suitable for the different thicknesses of a specified material.

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fail-safe design - one in which all failures of indicator or safety components that can reasonably be anticipated cause the equipment to fail in a mode such that personnel are safe from exposure to radiation. For example:(a) if a light indicating "x-rays on" fails, the production of x-rays shall be prevented, and (b) if a shutter status indicator fails, the shutter shall close.

field emission (auto-electronic emission; cold cathode emission) - the emission of electrons in vacuo from the surface of an unheated cathode due to an intense electric field.

filament - the source of electrons in a hot-cathode tube. It is usually a heated wire.

filament transformer - a transformer supplying power to heat the filament of a hot cathode. The primary and secondary windings must be sufficiently insulated to withstand the peak potential difference between the cathode and earth.

film badge. - a package of photographic film which may be worn like a badge to measure exposure of an individual to ionizing radiation. The absorbed dose or dose equivalent can be calculated from the degree of film darkening caused by the irradiation.

film base - a flexible, transparent, or translucent material that is coated with a photosensitive emulsion.

film clearing time - see clearing time.

film contrast - see contrast, film.

film density - see density.

film holder - a light-tight carrier for films and screens (see cassette).

film illuminator - a device incorporating a suitable source of illumination for viewing radiographs or other transparencies.

film processing - see processing, film.

film, radiographic - a photographic film that is usually coated on both sides with an emulsion designed for use with x-rays and gamma rays.

film ring - a film badge worn as a ring to measure the exposure of the fingers to ionizing radiation.

film speed - a measure of the exposure required to produce a given density on a photographic emulsion under any given set of conditions. Fast films require less exposure than do slow films to produce the same density.

film unsharpness - see unsharpness.

film viewer - see film illuminator.

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filter - material placed in the beam of radiation for the purpose of absorbing selectively that radiation which is within a certain range of wavelengths or energies.

filtration - the use of a filter to alter the characteristics of a radiation beam.

filtration, inherent - the filtration of an x-ray beam by any parts of the tube or tube shield, including insulating and cooling fluids, through which it must pass.

fixer (for film) - a chemical solution that dissolves unexposed silver halide crystals from developed film emulsions.

fixing - the chemical removal of unexposed silver halides from an emulsion after development.

flash radiography - a technique of producing radiographs, with an extremely short exposure time, useful for examining transient effects.

flash tube - an x-ray tube designed for use in flash radiography.

flaw sensitivity - see sensitivity, defect.

fluence, particle - the number of particles incident on a sphere of unit cross-sectional area. Symbol: Φ .

fluence rate, particle - the fluence per unit time. Symbol: ρ .

Note: The term particle flux density is also used as the name for this quantity. As the word density has several connotations, the term particle fluence rate is preferable.

fluorescence - luminescence of a substance as the result of the absorption of electromagnetic or particulate radiation. Fluorescence is characterized by the fact that it occurs only so long as the stimulus responsible for it is maintained.

fluorescent screen - see intensifying screen.

fluorography - the use of photography to record fluoroscopic images on film.

fluorometallic screen - see intensifying screen.

fluoroscopy - the visual observation of an image of an object produced on a fluorescent screen by radiation that has penetrated through the object.

flux, particle - the number of particles emitted, transferred, or received in a unit time interval.

focal-film distance (ffd or FFD or SFD) - see focus-to-film distance.

focal spot (focus) - the area of the target on which the electron stream impinges and from which x-rays are emitted.

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focal spot size (focus size) - the apparent dimensions, as viewed along the x-ray beam axis, of that portion of the target from which x-rays are emitted.

focusing - concentration or convergence of energy into a narrow beam.

focus-to-film distance - the distance from the focal spot of an x-ray tube to a film set up for radiographic exposure. Abbreviation: ffd.

fog - a general term used to denote any increase in the optical density of a processed film caused by anything other than the direct action of image-forming radiation. It can be of any of the forms defined below:

ageing fog - fog arising from long-term storage of film prior to use.

chemical fog - fog arising from unwanted chemical reactions during processing of a film.

dichroic fog - fog arising from the deposition of a very thin layer of finely divided silver on an emulsion, which when examined in white light, appears in two colors, red by transmission and green by reflection.

exposure fog - fog arising from any unwanted exposure of a film to ionizing radiation or light, at any time between manufacture and final fixing.

inherent fog - see ageing fog.

oxidation fog - fog caused by exposure of a film to air during development.

photographic fog - fog arising solely from the properties of an emulsion and the processing conditions, i.e., the total effect of inherent fog and chemical fog.

fog density - see fog.

fog threshold - the minimum uniform density inherent in a processed emulsion without prior exposure.

forward scatter - that part of the scattered radiation which has a scattering angle of less than 90°.

4-2T radiography - see radiographic quality level.

frequency - the number of repetitions of a periodic process in a unit of time, such as the number of complete oscillations of an electromagnetic wave per second.

frilling - the loosening of an emulsion from its base, commencing at the edges. It is usually caused by prolonged immersion in a liquid at too high a temperature or of unsuitable chemical composition.

full-wave rectification - rectification that allows current to flow through an x-ray tube, in the same direction, during each half-cycle of an alternating supply.

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gamma, film - see gradient.

gamma infinity - the maximum gamma that can be achieved by prolonged development of a photographic film. Symbol: γ_∞.

gamma radiation (gamma rays) - electromagnetic radiation emitted by a radioactive nuclide as the result of a nuclear transition.

gamma radiography - the process whereby a photographic image of an object is produced by gamma radiation that has penetrated through the object.

gamma radiography system - all components necessary to make radiographic exposures with gamma radiation, including the exposure device, source assembly, control, and other components associated with positioning the source such as source guide tubes, exposure head, and collimators, if used.

gamma-ray source - a quantity of a radionuclide that emits gamma radiation suitable for radiography.

gamma-ray source container - see container, gamma-ray source.

gas tube - an x-ray tube that depends on the presence of a small quantity of residual gas for the supply of electrons to be accelerated.

Geiger counter (Geiger-Muller counter) - a radiation-detection instrument that consists of a Geiger-Muller tube, associated electronics for counting output pulses of the tube, and an indicator of the rate at which pulses are counted.

Geiger-Muller tube - a gas-filled radiation detector that uses a high electric field to cause gas multiplication that greatly increases the charge resulting from an ionizing event. The output pulse is of the order of volts.

geometric unsharpness - see unsharpness.

gradient - the slope of a characteristic curve at a specified density. Symbol: G_d. NOTE: The term "gamma" is used for the slope of the approximately straight portion of the curve.

graininess - visible irregular variations in the density of a radiograph that are caused by non-uniform distribution of exposed silver grains in the photographic emulsion.

grain size - the average size of the silver halide particles in a photographic emulsion.

gray - the SI (international system) unit for absorbed dose. Symbol: Gy. One gray is equal to one joule per kilogram. To convert from the special unit, 1 rad = 0.01 Gy.

Grenz tube - an x-ray tube having a window of low absorption permitting the transmission of x-rays produced at low voltages (e.g., below 12 kV).

grid - see anti-scatter grid.

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grid ratio - the ratio of the depth of the opaque strips of a grid, measured in the direction of the primary beam, to the spacing between them.

grid tube - an x-ray tube in which a grid, operated with negative bias, is mounted between the cathode and anode.

H and D curve - see characteristic curve.

halation - see unsharpness, film unsharpness.

half-life, biological - the time required for a biological system, such as a man or animal, to eliminate, by natural processes, half the amount of a substance which has entered it.

half-life, radioactive - the time taken for the activity of an amount of radioactive nuclide to fall to half its initial value. Symbol: $T_{1/2}$.

half-value layer (HVL) - the thickness of a specified substance which, when introduced into the path of a given beam of radiation, reduces the value of a specified radiation quantity upon transmission through the substance by one-half. It is sometimes expressed in terms of mass per unit area.

half-value period - see half-life.

half-wave rectification - rectification that allows current to flow in the same direction through an x-ray tube only during alternate half-cycles of an alternating supply.

hardener - a substance (e.g., chrome alum or formalin) used to harden the gelatine in the photographic emulsion, commonly added to the fixing bath.

hard radiation - a term used to describe qualitatively the more penetrating types of radiation.

health physics - a term in common use for that branch of radiological science dealing with the protection of persons from harmful effects of ionizing radiation.

heterogeneous radiation - radiation consisting of particles or photons that have a broad spectrum of energies.

high radiation area - any area, accessible to personnel, in which there exists radiation at such levels that a major portion of the body could receive in any one hour a dose in excess of 100 millirems.

high-voltage change-over switch - a device whereby the high-voltage supply may be connected to any one of several x-ray tubes.

hooded anode - a type of anode, in medium or high voltage x-ray tubes, in which the target is recessed in a metal hood that intercepts electrons. The hood may also incorporate a filter to absorb unwanted radiation.

hot-cathode tube - an x-ray tube in which the cathode is electrically heated to provide electrons.

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hot cell - a heavily shielded enclosure in which radioactive materials can be handled remotely through the use of manipulators and viewed through shielded windows so that there is no danger to personnel.

image amplifier - a device that enhances a radiographic image for the purpose of decreasing interpretation time or increasing image detail.

image contrast - see contrast.

image definition - see definition.

image intensifier - a device used in fluoroscopy to produce an image brighter than that which would be produced by the unaided action of the x-ray beam on a fluorescent screen.

image quality indicator (IQI) (penetrameter) - a device used to determine, from the appearance of its image in a radiograph, the overall quality of that radiograph.

image quality level - see radiographic quality level.

impulse timer - a synchronous timer that is preset in terms of the number of pulses of current required during an exposure, instead of the duration of the exposure.

induced radioactivity - radioactivity resulting from irradiation of matter

industrial radiology - that branch of radiology covering industrial applications of ionizing radiation.

inelastic scattering - scattering in which the total kinetic energy of the incident radiation and the scatterer is changed.

inherent filtration - see filtration, inherent.

inherent fog - see fog.

inherent unsharpness - see unsharpness.

in-motion radiography - a method in which either the object being radiographed or the source of radiation is in motion during the exposure.

insert tube - an x-ray tube intended to be placed within a tube shield.

instrument calibration - a comparison of the response of the given instrument with the response of a standard instrument when both are exposed to the same radiation source under the same conditions; or the determination of the response of the given instrument when exposed to the output of a standard source under well-defined conditions.

intensifying factor (intensification factor) - for a type of intensifying screen, the ratio of the duration of exposure with the screen to that without the screen, all other conditions (including the film density) remaining the same.

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intensifying screen - a layer of material that, when placed in contact with a photographic film, improves the efficiency of the photographic action of ionizing radiation on the film emulsion. The increased rate of absorption of radiation energy by the emulsion enables reduction of exposure time.

fluorescent screen (salt screen) - a screen consisting of a substance (such as calcium tungstate) that fluoresces when exposed to ionizing radiation.

fluorometallic screen - a screen consisting of a metal foil (usually lead) coated with a material that fluoresces when exposed to ionizing radiation. It combines the properties of the fluorescent and metal screen.

metal screen (lead screen) - a screen consisting of a foil of dense metal (usually lead) that emits secondary electrons when exposed to x or gamma radiation. It also reduces the undesirable effects of scattered radiation.

intensity, radiation - the amount of energy passing per unit time per unit area at a point in a beam of radiation, the area being perpendicular to the direction of propagation.

interaction - any process in which all or part of the energy of incident radiation is transferred to the electrons or nuclei of the atoms that constitute matter, or in which only the direction of the incident particle is altered.

interlock - see radiation safety interlock.

internal conversion - the transfer of nuclear deexcitation energy directly to a bound electron in the same atom, which causes the electron to be ejected from the atom. Subsequent filling of the vacancy thus created results in the emission of characteristic x-rays or Auger electrons.

inverse square law - the relationship between radiation intensity and distance from a point source, namely that the intensity changes inversely with the square of the distance. If the distance from a point source is doubled, the intensity is reduced to one-fourth the original value, and conversely.

inverse voltage - a voltage that may appear across an x-ray tube or rectifier during one half-cycle of an alternating current and that reverses the polarity of the electrodes relative to the previous half-cycle.

ion - an atom or group of atoms that carries a positive or negative electric charge as the result of having lost or gained one or more electrons.

ionization - the process of removing electrons from, or adding electrons to, atoms or groups of atoms, thereby creating ions.

ionization chamber - a gas-filled enclosure in which ion pairs created by incident radiation are collected on electrodes that produce an electric field within the enclosure. The number of collected charges is an indication of the radiation intensity.

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ionizing radiation - any radiation that has sufficient energy to create ions in matter, either through direct or indirect processes of interaction. Examples are alpha, beta, gamma, x, and neutron radiation.

ion pair - a positive ion and a negative ion or electron having charges of the same magnitude, and formed simultaneously from a neutral atom or molecule with energy supplied by radiation or any other suitable source.

ion source (ion gun) - a device by which gaseous ions are produced, focused, and accelerated, and are emitted as a narrow beam.

IQI sensitivity - the sensitivity (quality level) of a radiographic process, as determined by the use of an image quality indicator (IQI). Properly called radiographic sensitivity.

iridium-192 - a radioactive nuclide of the element iridium that has a half-life of 74 days. It emits gamma radiation with photon energies of 468, 316, 308, and 296 keV, plus eight additional photon energies emitted with significantly lower intensities.

irradiation - exposure to radiation.

isomeric transition - the transition of an isomer to a lower energy state. It is accompanied by the emission of gamma radiation that may be internally converted.

isomers - nuclei that have the same mass number and atomic number, but have different energy states and relatively long lives.

isotopes - atoms that have the same atomic number (same chemical characteristics) but have different mass numbers. An equivalent statement is that the nuclei have the same number of protons but different numbers of neutrons. Thus, $^{12}C_6$, $^{13}C_6$, $^{14}C_6$ are isotopes of the element carbon, the subscripts denoting their common atomic number, the superscripts denoting the different mass numbers.

K-electron capture (K-capture) - electron capture of a "K" (innermost) shell electron by its nucleus.

key switch - a device that requires a key for making and breaking electrical connections.

kilovolt - a unit of electromotive force or potential, equal to 1000 volts. Abbreviation: kV.

kilovolt peak - the largest instantaneous value of electromotive force or potential attained by a pulsating source of electric potential, expressed in kilovolts. Abbreviation: kVp.

laminography - a process that enables the production of a radiograph of a thin section of the interior of a thick specimen. It is achieved by synchronous rotation of both the film and the specimen during exposure, so that only the desired section remains in focus. A form of tomography.

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latent image - an invisible image that was produced in a photographic medium by exposure to radiation and that is capable of being converted into a visible image by processing.

latitude - see exposure latitude.

law of reciprocity, photographic - see reciprocity law.

LD_{50} - see median lethal dose.

lead equivalent - the thickness of lead affording the same attenuation of radiation, under specified conditions, as the material in question.

lead glass - glass containing a high proportion of lead compounds, used as a transparent shielding material.

lead rubber - rubber containing a high proportion of lead compounds. It is used as a flexible shielding material.

lead-rubber gloves (protective gloves) - gloves incorporating lead rubber as a shielding material.

lead screen - see intensifying screen.

leakage - the undesired release of radioactive material from a sealed source.

leakage radiation - radiation other than the useful beam emitted from an x-ray tube assembly or a source housing.

leak test - a method capable of detecting the leakage of radioactive material from a sealed source.

licensed material - source material, special nuclear material, or byproduct material received, possessed, used, or transferred under a general or special license issued by the Nuclear Regulatory Commission or an Agreement State.

Lindemann glass - glass of low x-ray absorption containing lithium, boron, and beryllium.

linear accelerator (linac) - an accelerator in which charged particles are accelerated along a straight line by a radio-frequency field inside a waveguide. Accelerated electrons may be made to impinge on a heavy-metal target to produce high-energy photon radiation.

linear energy transfer (LET) - the energy lost by a charged particle per unit distance of material traversed. It can be expressed as electron volts per meter, or some convenient multiple or submultiple, such as keV per millimeter.

line focus - an elongated, rectangular electron focus so angled that the focal spot size, as viewed along the x-ray beam axis, is smaller and approximately square, thereby permitting increased total area loading of the target for a given focal spot size.

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line focus principle - the process of making the angle between the anode face and the axis of the electron beam such that the focal spot size is small in relation to the size of the electron focus.

line-focus tube - an x-ray tube in which the electron focus is approximately a rectangle and the focal spot size is approximately a square.

localizing cone (collimating cone) - a cone that limits the divergence of a beam of radiation.

luminescence - a phenomenon in which the absorption of radiation by a substance gives rise to the emission of light characteristic of the substance.

mAs - see milliampere-second.

masking - the application of radiation-absorbing material which limits the area of irradiation to that region of the specimen undergoing radiographic examination.

mass attenuation coefficient - the fraction of uncharged ionizing particles that experience interactions in traversing a unit distance in a material of density ρ. Symbol: μ/ρ.

mass number - the total number of neutrons and protons in a nucleus. It is the whole number nearest to the exact atomic weight. Symbol: A.

maximum permissible dose - see maximum permissible dose equivalent.

maximum permissible dose equivalent (MPD) - the maximum dose equivalent that the body of a person or specific parts thereof shall be permitted to receive in a stated period of time.

mean life - the average time during which an atom or other system exists in a particular form.

median lethal dose (LD_{50}) - the whole-body dose, resulting from a single short exposure (minutes or hours), that will cause the death, within a specified period of time, of 50 percent of the individuals irradiated. The dose sufficient to cause death to 50 percent of the individuals within 30 days is indicated as LD_{50}^{30} and is on the order of 300 rads.

metal screen - see intensifying screen.

MeV - one million electron volts.

micro - a prefix that divides a basic unit by one million.

microradiography - a technique used to examine very small objects or thin sections of material through the use of low-voltage x-rays and an ultra-fine grain film emulsion to produce a radiograph that is examined with the aid of optical enlargement.

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milli - a prefix that divides a basic unit by one thousand.

milliamperage - a measure of the current flowing between the cathode and the anode in an x-ray tube. The intensity of the output radiation is directly proportional to this current.

milliampere - a unit of electric current equal to one thousandth of an ampere. Abbreviation: mA.

milliampere-seconds - a term used to quantify radiographic exposures made with x-rays. It is the product of tube current in milliamperes and exposure time in seconds. Abbreviation: mAs.

millicurie-hour - a term used to quantify radiographic exposures made with a gamma-ray source. It is the product of the activity of the source in millicuries and the exposure time in hours.

milliroentgen (mR) - one-thousandth of a roentgen.

miniature-film radiography (mass miniature radiography) - fluorography using miniature photographic film.

monitoring, radiation (for radiation protection) - the continuing collection and assessment of pertinent information to determine the adequacy of radiation protection practices and to alert to potentially significant changes in conditions.

movement unsharpness - see unsharpness.

multiple-film technique - a procedure in which two or more films of the same or different speed are placed in the same film holder and exposed simultaneously.

neighborhood effect - the name given to various effects arising from the diffusion of developer which has become locally exhausted or loaded with oxidation products by its action on a heavily exposed region of an emulsion. Typical examples are developer streaks and abnormal density variations near the edges of regions of high density.

net density - total film density less fog and support (film base) density.

neutron radiography - the process whereby a photographic image of an object is produced by neutron radiation that has penetrated through the object.

non-screen film - x-ray film designed for use with or without metal screens, but not intended for use with salt screens. It may be of relatively high speed and coarse grain (ordinary non-screen film) or of lower speed and finer grain (fine-grain non-screen film).

nuclear activity - see activity.

nuclear reaction - the transformation of an atomic nucleus that results from interaction with a charged particle, neutron, or photon.

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nuclear transition - a change in the energy state or level of an atomic nucleus which may, or may not, result in the emission of radiation.

nucleus - the positively-charged core of an atom. It is only about 1/10,000 the diameter of the atom, but contains nearly all the mass. Except for ordinary hydrogen, all nuclei contain both protons and neutrons.

nuclide - a species of atom characterized by its mass number, atomic number, and nuclear energy state, and that has a measurable mean life.

object-to-film distance - the distance from the tube or source side of the irradiated specimen to the film surface, i.e., inclusive of specimen thickness. Abbreviation: ofd.

occupancy factor - the factor by which the workload should be multiplied to correct for the degree or type of occupancy of the area in question. Symbol: T.

occupational dose - the dose, or dose equivalent, resulting from exposure of an individual to radiation in the course of gainful employment.

oil-cooled tube - an x-ray tube in which the heat produced is dissipated, directly or indirectly, by means of oil.

oil-immersed tube - an x-ray tube designed for operation in oil.

1-1T radiography - see radiographic quality level.

1-2T radiography - see radiographic quality level.

optical density - see density.

orbital electron (shell electron) - an electron that is outside the nucleus of its atom.

over-development - development which is greater than that required to produce the optimum results in a particular radiograph. It may arise from development for too long a time, or at too high a temperature, and may give rise to excessive graininess, fog, and lack of contrast.

overload interlock x-ray unit - an x-ray machine in which the presetting of voltage, current, and time are interlinked in such a way that if their product (i.e., the energy to be applied) exceeds the permissible loading of the x-ray tube, the latter cannot be energized.

oxidation fog - see fog.

pair production - the transformation of a high-energy photon into an electron-positron pair in the field of an atomic nucleus or some other particle. It occurs only if the energy of the incident photon is above 1.02 MeV.

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panoramic exposure - simultaneous exposures made possible by the use of a source that emits radiation over a wide range of directions.

particulate radiation - radiation consisting of charged or uncharged atomic particles.

particle - a minute constituent of matter with a measurable mass, such as an electron, neutron, proton, or meson.

peak voltage - the maximum value achieved by a varying voltage.

penetrameter - an image quality indicator composed of material identical, or radiographically similar, to the specimen being radiographed, and whose thickness is a percentage of the specimen thickness. It may also contain steps, holes, slots, or wires.

penetrameter sensitivity - see sensitivity, radiographic.

penumbra - an area of partial shadow, bordering the area of total shadow (umbra), cast on a film by a specimen exposed to a radiation source. The area of partial shadow is caused primarily by the finite size of the source (each part of the source casts its own shadow) and appears on the radiograph as geometric unsharpness.

personnel monitor - a device designed to be worn or carried by an individual for the purpose of measuring the dose received (e.g., film or TLD badges, pocket chambers, film or TLD rings).

personnel monitoring - the determination, by means of a personnel monitor, of the dose received by an individual.

photoelectric absorption - the complete absorption of a photon by an atom with the ejection of an orbital electron (photoelectron). Also called photo-electric effect.

photographic emulsion - see emulsion.

photographic fog - see fog.

photographic intensification - chemical treatment of a processed emulsion, when under-exposed or under-developed, to increase the overall contrast, or density, or both.

photographic reduction - treatment of a processed emulsion, usually with an oxidizing agent, to lessen the density. There may be a change of contrast, depending on the process used.

photographic transmission density - see density.

photon - a discrete quantity (quantum) of electromagnetic energy. Photons have no electrical charge and no mass, but have momentum. They exhibit the properties of both particles and waves. Includes x and gamma radiation.

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photo-sensitivity - a property of a photographic emulsion by virtue of which electromagnetic or particulate radiation may produce chemical or physical changes in the emulsion.

pinhole - a through hole of small diameter in a sheet of material opaque to radiation.

plate penetrameter (strip penetrameter) - a plate of material similar to the specimen under examination, having a thickness of 1 or 2 percent of the specimen thickness, and having holes of different diameters relating to percents of specimen thickness.

positron - an elementary particle with a mass equal to that of the electron, and a positive charge equal to the negative charge of the electron. It is said to be the antiparticle of the electron.

Potter-Bucky diaphragm - a device incorporating an anti-scatter grid which is kept in motion during the time of a radiographic exposure so as to avoid grid images on the radiograph.

Potter-Bucky grid - see Potter-Bucky diaphragm.

preservative, developer - a constituent (e.g., sodium sulphite) that minimizes the exhaustion of a developer caused by aerial oxidation, and that also serves to remove oxidation products which might otherwise retard development or produce stain.

pressure mark - an effect produced by pressure on a film which after developing results in areas of either increased or decreased density. The crescent-shaped pressure mark due to severe local bending of a film is often called a crimp mark.

primary radiation - radiation coming directly from the source.

processing, film - a series of operations, such as developing, fixing, and washing, associated with the conversion of a latent image into a stable visible image.

processing unit - a series of tanks forming a single unit for holding chemical solutions used during processing.

projector - see exposure device.

protective material - shielding material used for the purpose of radiation protection.

proton - an elementary particle with a single positive electrical charge and a mass approximately 1836 times that of the electron.

pulsating voltage - a voltage that undergoes periodic variations in magnitude, generally at a frequency related to that of the supply. The term is usually confined to unidirectional voltage.

quality, radiation - see beam quality.

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quality factor - the linear-energy-transfer-dependent factor by which absorbed doses are to be multiplied to obtain, for radiation protection purposes, a quantity (i.e., dose equivalent) that expresses on a common scale for all ionizing radiations the irradiation incurred by exposed persons. The quality factor weights the absorbed dose for the biological effectiveness of the particular type of radiation producing the absorbed dose. Symbol: Q.

quality level - see radiographic quality level.

quantum - a discrete amount of radiation energy. The quantum energy is $E = h$, where is the frequency of the radiation and h is Planck's constant.

rad - the special unit of absorbed dose. 1 rad is 10^{-2} joule per kilogram.

radiation - energy transmitted through space or a medium in the form of particles (electrons, neutrons, protons, etc.) or electromagnetic waves.

radiation area - any area, accessible to personnel, in which there exists radiation at such levels that a major portion of the body could receive in any one hour a dose in excess of 5 millirems, or in any 5 consecutive days a dose in excess of 100 millirems.

radiation burn - a burn caused by overexposure to radiant energy.

radiation damage - the undesired alteration of the properties of a material arising from exposure to radiation.

radiation detector - see detector.

radiation energy - a property of radiation which determines its penetrating ability. X-ray energy is determined by the magnitude of the voltage applied to the tube anode. Gamma-ray energy is a characteristic of the emitting radionuclide. The unit of radiation energy is the electron volt.

radiation hazard - a situation or condition that represents potential danger to health as the result of exposure to ionizing radiation.

radiation indicator - a device used for the purpose of indicating, audibly or visually, the presence of ionizing radiation.

radiation maze - an indirect route of access to a room that contains a radiation source. It is designed to allow easy access when the source is turned off or is fully shielded, and to reduce radiation intensity outside the room to acceptable levels when the source is turned on or exposed. Reduction of radiation intensity is achieved through multiple scattering from walls and application of the inverse-square law.

radiation meter - an instrument consisting of one or more radiation detectors, associated electronics, and an indicator of the magnitude of the measured radiation quantity.

radiation monitor - a radiation meter that is designed and used to keep track of radiation levels in a specific area, and to record those levels, or to provide an audible or visual signal when a predetermined level is exceeded.

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radiation protection - a branch of the physical, biological, and chemical sciences applying to the prevention of the risks presented by exposure of persons to ionizing radiations.

Radiation Protection Guide - recommended upper bounds of occupational dose resulting from exposure to ionizing radiation under ordinary circumstances. This guidance is approved by the President as recommendations to Federal agencies for their implementation. It is developed cooperatively by concerned Federal agencies.

radiation protection survey - evaluation of the radiation hazards in and around an area where a radiation source is used or stored. It customarily includes an examination of the arrangement and use of the source and related equipment, and measurements of exposure rates under expected operating conditions.

radiation quality - see beam quality.

radiation safety interlock - a device for precluding access to an area of radiation hazard either by preventing entry or by automatically removing the hazard.

radiation safety officer - an individual responsible for applied radiation protection.

radiation sickness - see acute radiation syndrome.

radiation source - a machine or a material emitting, or capable of emitting, ionizing radiation.

radiation survey - see radiation protection survey.

radiation trap - see radiation maze.

radioactive - exhibiting radioactivity.

radioactive contamination - the presence of unwanted radioactive material, particularly in circumstances which may be hazardous to health or which may interfere with the normal use of measuring equipment.

radioactive decay - see decay.

radioactive half-life - see half-life, radioactive.

radioactive material - any material that exhibits the property of radioactivity.

radioactive series - a sequence of radionuclides formed by successive nuclear transitions until a stable (non-radioactive) nuclide, the end product, is reached.

radioactive source - a radiation source consisting of radioactive material.

radioactive waste - equipment and materials (from nuclear operations) that are radioactive and for which there is no further use.

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radioactivity - the property possessed by some nuclides of emitting particulate or electromagnetic radiation as the result of spontaneous nuclear transition.

radiobiology - the study of the scientific principles, mechanisms, and effects of the interaction of ionizing radiation with living matter.

radiograph - a photographic image of an object that was produced by radiation that penetrated through the object.

radiographer - an individual who performs or personally supervises radiographic operations and who is responsible for assuring compliance with the requirements of pertinent regulations and conditions of licenses.

radiographer's assistant - any individual who, under the personal supervision of a radiographer, uses radiation sources, related handling tools, or survey instruments in radiography.

radiographic code - a code for specifying minimum standards related to radiographic practices.

radiographic contrast - see contrast, radiographic.

radiographic equivalence factor - that factor by which the thickness of a specific material must be multiplied in order to determine what thickness of a "standard" material (often steel) will have the same absorption.

radiographic exposure - exposure, radiographic.

radiographic exposure device - see exposure device.

radiographic film - see film, radiographic.

radiographic inspection - the use of radiography to detect discontinuities in material, and to present their images on a recording medium.

radiographic interpretation - the determination of the cause and significance of subsurface discontinuities indicated on the radiograph. The evaluation as to the acceptability or rejectability of the material is based upon the judicious application of the radiographic specifications and standards governing the material.

radiographic paper - white paper coated on one side with emulsion, suitable for some purposes as an alternative to x-ray film.

radiographic projection method - a method whereby image magnification is achieved by projection.

radiographic quality level - an expression of the quality (sensitivity) of a radiograph in terms of an image quality indicator (penetrameter). When a standard hole-type penetrameter is used, quality level is stated as a-bT, where a is the penetrameter thickness, expressed as a percentage of the maximum thickness of the specimen, and b is the diameter of the smallest discernible penetrameter hole, expressed as a multiple of penetrameter thickness, T. For example, the 3-2T quality level means that the penetrameter

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thickness equals 3 percent of the maximum specimen thickness, and the smallest discernible penetrameter hole has a diameter equal to twice the penetrameter thickness.

radiographic range - see exposure latitude.

radiographic screen - see intensifying screen.

radiographic sensitivity - see sensitivity, radiographic.

radiographic stereometry - the process of finding the position and dimensions of details within a specimen by measurements made on radiographs taken from different directions.

radiographic technique - the selection of those radiographic factors such as kilovoltage, milliamperage, type of film and screens, distances, and calculated exposure time to produce the desired radiographic sensitivity.

radiography - the process whereby a photographic image of an object is produced by ionizing radiation that has penetrated through the object.

radioisotope - a radioactive isotope of an element.

radiology - the science and application of x-rays, gamma rays, and other penetrating ionizing radiations.

radionuclide - a radioactive nuclide.

radium - a radioactive element with the atomic number 88 and mass number 226. In nature, radium is found with uranium, which decays to radium by a series of alpha and beta emissions. Radium is used as a radiation source, emitting photons with a broad range of energies. It has a half-life of 1600 years.

range - of an ionizing particle. The maximum thickness of a given medium that can be penetrated by such a particle. It may be either the total path length (integrated range) of the rectilinear distance between the ends of the path (practical range).

range of correct exposure - the difference between the two extremes of correct exposure. These are set on the one hand by the minimum acceptable gradient and on the other hand by the maximum readable density.

ratemeter - an instrument for measuring and indicating counting rate, exposure rate, or dose rate.

ray - a beam of energy of small cross section; a stream of particles traveling in the same line.

RBE - see relative biological effectiveness.

real-time radiography - a type of radiography in which an image is not produced photographically, but is instead produced on a fluorescent screen viewed by a video camera. The image may be intensified or enhanced before display on a television monitor. This enables radiographic interpretation

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concurrent with irradiation of a specimen, and lends itself to remote rapid inspection of items on an assembly line. A videorecorder may be used to record the image.

reciprocity failure - departure from the reciprocity law for a photochemical reaction, possibly due to a change of radiation intensity by a factor of 4 or more, or exposure to light (from a fluorescent intensifying screen).

reciprocity law (Bunsen-Roscoe law) - states that the extent of a photochemical reaction is dependent only on the product of the radiation intensity (I) and the duration of the exposure (t), and is independent of absolute values of either quantity. This implies that the resultant density of a film depends only on the product of the radiation intensity reaching the film and the exposure time.

recording medium - a photographic film or other material that converts radiation energy into a permanent visible image.

rectification - any method by which a unidirectional current can be obtained from an alternating supply.

rectifier - a device that converts alternating current into direct current by allowing current to flow in only one direction.

reduction factor - the exposure rate without a shield divided by the exposure rate with a shield interposed between a radiation source and the point at which radiation is measured.

reflection density - the common logarithm of the ratio of the brightness of a non-absorbing perfect diffuser to that of the sample, both being illuminated at an angle of 45° to the surface, the direction of measurement being normal to the surface.

relative abundance - the proportion of a given nuclide in a particular sample of an element, usually expressed as a percentage.

relative biological effectiveness (RBE) - a factor used to compare the biological effectiveness of absorbed radiation doses due to different types of ionizing radiation. It is the experimentally determined ratio of an absorbed dose of a radiation under consideration to the absorbed dose of a reference radiation required to produce the same degree of a stipulated biological effect in a particular experimental organism or tissue. The RBE is not equivalent to the quality factor and should not be used in radiation protection.

relative exposure - exposure expressed relative to a standard exposure which is arbitrarily assigned the value of 1.0.

relative speed - the speed of a radiographic film relative to a reference film that is arbitrarily assigned a value of 100. A film that requires only half the exposure to achieve the same density as the reference film will have a relative speed of 200.

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rem - the special unit of dose equivalent. The dose equivalent in rems is numerically equal to the absorbed dose in rads multiplied by the quality factor, and any other necessary factors. (rem is an acronym for roentgen equivalent man).

replenisher - a modified form of the original developer which, when added to partially exhausted developer, restores its efficiency.

resolution - the smallest distance between adjacent distinguishable images on a radiograph or viewing screen. It may be expressed as the number of lines (or line pairs) per millimeter which can be seen as discrete images.

resolving time - the minimum amount of time that must separate two events in a counting system so they will be recorded as two separate pulses. The limiting time may be set by the detector itself, or by the associated electronics.

restrainer - the constituent (e.g., potassium bromide) that reduces the activity of the developing agent but enhances its preferential action by reducing the rate of development of unexposed grains to a greater extent than it does that of exposed grains. It thus tends to reduce chemical fog.

restricted area - any area to which access is controlled for the purposes of radiation protection.

reticulation - a net-like structure appearing in the emulsion of a photographic film as a result of damage due to differences in temperatures between processing baths, or rinsing water.

reversal - the decrease of radiographic density due to increase of the exposure beyond that required to attain maximum density. In the extreme case, a positive instead of a negative image may be produced in an emulsion.

Rhm - see roentgens per hour at one meter.

ripple - the periodic variation in the potential difference between the cathode and anode of an x-ray tube, resulting from rectification of an alternating current. As the ripple is decreased by the use of filtering circuits, a constant potential is more nearly approached.

R-meter - an ionization-type instrument designed to measure radiation exposure.

rod-anode tube - a special type of x-ray tube in which the target is situated at the outer end of a long tubular anode. It usually produces panoramic radiation.

roentgen - the special unit of exposure. One roentgen equals 2.58×10^{-4} coulumb per kilogram of air. Symbol: R.

roentgens per hour at one meter - a specification of the output of a source of x or gamma radiation in terms of the exposure rate, in roentgens per hour, measured in air at a distance of one meter from the source. Abbreviation: Rhm.

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rotating-anode tube - an x-ray tube in which the anode can rotate. The axis of rotation is offset from the axis of the electron beam, so that the focus lies on a circle on the rotating surface.

safelight - a special lamp used in darkrooms to provide working visibility without significantly affecting the photosensitive emulsion of the radiographic film.

salt screen - see intensifying screen.

scatter - see scattered radiation.

scattered radiation - radiation that, as the result of interaction with matter, has had its direction changed and, for some interactions, its energy decreased.

scattering - a change of direction, and possibly reduction of energy, of an incident particle or photon as the result of interaction with an atom, nucleus, or other particle.

scattering angle - the angle between the directions of propagation of the incident and scattered radiation.

scatter unsharpness - see unsharpness.

Schwarzschild exponent - a mathematical index that may be applied to one of the variables in order to correct for the failure of the reciprocity law over a limited range.

scintillation - a localized flash of light caused by a particle or photon of ionizing radiation incident on a fluorescent material.

scintillation counter - an instrument that detects and counts the number of scintillations occurring over a specified period of time.

scintillator - a substance that emits a localized flash of light when excited by an incident particle or photon of ionizing radiation.

screen - alternative term for intensifying screen.

screen, intensifying - see intensifying screen.

screen, radiographic - see intensifying screen.

screen-type film - a radiographic film produced specially to be used with fluorescent screens. This type of film has high sensitivity to the fluorescent light emitted by such screens under the effect of ionizing radiations. (Improperly called screen film).

screen unsharpness - see unsharpness.

sealed source - a radioactive source that is bonded or encapsulated to prevent dispersion of the radioactive material under the conditions of use for which it was designed.

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secondary radiation - radiation other than primary radiation emerging from irradiated matter.

self absorption - reduction of the emission rate of a radioactive source due to absorption of radiation in the radioactive material itself, or in any non-radioactive material with which it may be mixed.

self-rectifying tube - any hot-cathode x-ray tube that permits current to flow only from the cathode to the anode, when the anode is kept cool.

sensitivity - a general term used as an indication of the ability to detect small differences.

sensitivity, defect - the minimum dimension of a discontinuity, considered to be a defect, that can be detected in a radiograph under specified conditions.

sensitivity, equivalent penetrameter - see equivalent penetrameter sensitivity.

sensitivity, IQI - see IQI sensitivity.

sensitivity, radiographic - the ratio of the smallest difference in thickness that is detectable on the radiograph to the thickness of the specimen. It may be expressed as a percentage, and is an indication of ability to detect a small discontinuity. In practice, it is determined by the use of an image quality indicator (penetrameter).

sensitivity, spectral - the variation in radiographic exposure, as a function of x-ray energy, required to produce a given film density.

sensitometric curve - see characteristic curve.

sensitometry - characterization of the properties of emulsions by measurement of the changes in photographic density produced under different conditions of exposure and processing.

sequestering agent - a constituent (e.g., sodium hexametaphosphate) which is sometimes added to a developer to prevent the formation of scum from hard water.

sharpness - see definition.

shield - a layer or mass of material used to reduce the intensity of ionizing radiation, primarily for the purpose of radiation protection.

shielding barrier - see shield.

shock-proof - a term applied to those components of the high-voltage circuit of x-ray equipment which are entirely surrounded by grounded metal enclosures, e.g., shock-proof tube, shock-proof cable.

shock-proof tube - an x-ray tube surrounded by a grounded conducting enclosure.

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shutter - a device that incorporates a movable shield used to block the useful beam emitted from an x-ray tube assembly or source housing.

sievert - the SI (international system) unit for dose equivalent. Symbol: Sv. One sievert is equal to one joule per kilogram. To convert from the traditional unit, 1 rem = 0.01 Sv.

silver halide - a compound of silver with one of the halogen elements, e.g., silver bromide.

soft radiation - a qualitative term used to describe the relatively less penetrating types of ionizing radiation.

soft x-rays - a qualitative term used to describe the relatively less penetrating types of x-rays, i.e., those with lower photon energies (longer wavelengths).

solarization - the diminution in (photographic) density produced by exposure additional to that required to give maximum density. This may result in reversal.

source - see radiation source.

source assembly - a component of a gamma radiography exposure device to which the sealed source is affixed or in which the sealed source is contained. The source assembly includes the sealed source.

source calibration - the determination of the output of a radiation source by comparison with the output of a standard source, or by the response of a standard instrument to the output of the source.

source capsule - the immediate container that, along with the contained radioactive material, constitutes a sealed source of ionizing radiation.

source changer - a shielded enclosure that is designed specifically for use in the replacement of the sealed source contained in an exposure device.

source container - see container, gamma-ray source.

source guide tube (conduit) - a flexible or rigid tube for guiding the sealed source from the exposure device to the exposure head.

source housing - an enclosure for a sealed source which provides attenuation of the radiation emitted by the source. The enclosure may have an aperture through which the useful beam is emitted or through which the source is extracted.

source material - any material, except special nuclear material, which contains 0.05% or more of uranium, thorium, or any combination of the two.

source-shift radiography - a method involving two offset exposures, each for half the normal time. Used for determining the depth of a discontinuity.

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source size, effective - the apparent dimensions, as viewed along the beam axis, of that portion of the source from which ionizing radiations are emitted. For the purpose of calculating geometric unsharpness, the effective dimensions must always be used.

source-to-film distance - the distance between the radiation source and the plane of the film in position for a radiographic exposure. (Abbreviation: sfd).

source-to-object distance - the distance between the radiation source and the irradiated specimen. Abbreviation: sod.

special nuclear material - plutonium, uranium-233, uranium containing more than the natural abundance of uranium-235, or any material artificially enriched by any of these substances, not including source material.

specific activity - the activity per unit mass of a radioactive material (expressed in curies per gram or becquerels per gram).

spectrum - an orderly array of the components of a beam of radiation according, for example, to their wavelengths, frequencies, or energies.

speed, film - for a particular film, the reciprocal of the exposure required to achieve a certain density.

stabilizer - a device that automatically compensates for variation of main voltage and/or frequency in an electric circuit. An example is the stabilization of filament heating current, and therefore the anode current, in an x-ray tube.

stable isotope - a non-radioactive nuclide of a particular element.

stationary grid - a grid in which the opaque strips are so thin and so close together that it can remain stationary during exposure without causing images of the strips that would interfere with interpretation of the radiograph (e.g., Lysholm grid).

step wedge - a block of material in the form of a series of steps in thickness, used for the preparation of exposure charts.

step-wedge calibration film - a step-wedge comparison film, the densities of which are traceable to a nationally recognized standardizing body. It is used for reference when determining the density or densities of a radiograph.

step-wedge comparison film - a strip of processed film carrying a stepwise array of increasing photographic density.

step-wedge penetrameter (step penetrameter) - a penetrameter of similar material to the specimen under examination, having steps ranging usually from 1 to 5 percent of the specimen thickness. Each step may contain one or more drilled holes for the assessment of definition.

stereofluoroscopy - a fluoroscopic technique that enables screen images to be viewed three-dimensionally.

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stereograticule - a scale which enables direct measurements in the direction of viewing to be made during stereoscopic examination.

stereoradiography - the production of a pair of radiographs suitable for stereoscopic viewing.

stereoscopic - a type of viewing that employs an optical instrument (stereoscope) to combine the images of two radiographs taken from slightly different angles, thus achieving a three-dimensional effect.

stereoscopy - the three-dimensional visual effect resulting from binocular vision.

stop bath - a mildly acid bath used to arrest development and to neutralize alkaline developer in an emulsion before transfer to the fixing bath.

stray radiation - radiation other than the useful beam. It includes leakage, secondary, and scattered radiation.

stripping emulsion - a photographic emulsion, for use in autoradiography, which can be removed from its base and placed in contact with a specimen containing radioactive material.

subject contrast - the ratio (or the logarithm of the ratio) of the radiation intensities transmitted by selected portions of the specimen.

subjective contrast - a qualitative estimate of the contrast in a radiograph or fluorescent screen reproduction.

subject range - the range of thickness or radiation opacity of material in a specimen.

surface irregularity - an image on a radiograph that corresponds to an irregularity visible on the surface of a specimen.

surge suppressor - a device that automatically reduces abnormally high voltage or current transients to acceptable levels.

survey - see radiation protection survey.

survey meter - a hand-carried instrument that provides a prompt indication of exposure rate or other radiation quantity of interest for radiation protection purposes.

synchronous timer - a timer that is operated by a synchronous motor.

target - the area on the anode of an x-ray tube on which the electron stream impinges and from which the primary beam of x-rays is emitted.

technique chart - see exposure chart.

tenth-value layer (TVL) - the thickness of the layer of a specified substance which, when introduced into the path of a given narrow beam of radiation, reduces the intensity of this radiation to one-tenth the original value.

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thermal focus - that part of the anode of an x-ray tube submitted to direct heating by the electron beam.

thermionic emission - the emission of electrons from the surface of a heated material by virtue of their thermal energy.

thermoluminescence - the property, possessed by certain crystals, of emitting light when heated after having been exposed to ionizing radiation.

thermoluminescence dosimeter (TLD) - a dosimeter, commonly used as a personnel monitor, that uses thermoluminescent material. The total amount of light emitted upon heating of the material is proportional to the amount of radiation energy absorbed.

3-2T radiography - see radiographic quality level.

threshold dose - the minimum absorbed dose or dose equivalent that will produce a specified effect.

timer - a time-measuring device designed to automatically make or break electrical connections at the end of a preset time interval.

tomograph - a radiograph of a specified plane of a deep structure.

tomography - the radiography of a predetermined interior plane of a thick material. In one method the x-ray tube and the film are moved simultaneously in opposite directions about a pivotal point in the plane of the layer.

transmission target - a relatively thin target so arranged that the x-ray beam emerges from the surface opposite that on which the electron stream is incident.

tube current - the current, measured in milliamperes, flowing between the cathode and anode during the operation of an x-ray tube.

tube diaphragm - an adjustable device, normally attached to a tube housing, that limits the cross section of the emergent x-ray beam.

tube filter - a filter that can be attached to the x-ray tube housing.

tube housing - an enclosure that contains an x-ray tube and has a port through which the useful beam is emitted. The tube housing may also contain transformers and other appropriate components.

tube rating - the maximum electrical power (in watts) that can be safely applied to an x-ray tube for a specified period.

tube shield - the housing of an x-ray tube which normally provides protection against electric shock and affords a degree of protection against radiation.

tube-shift radiography - a technique requiring two exposures at slightly different angles for determining the depth of an imperfection, but using the same focus-to-film or source-to-film distance.

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tube shutter - a device attached to a tube housing, generally of lead and usually remotely operated, used to permit or to prevent the emergence of the x-ray beam.

tube stand - a support, often in the form of one or more vertical pillars with adjustable attachments, for holding an x-ray tube in position for use.

tube window - the relatively thin section of the x-ray tube through which the useful beam emerges. (Materials have different absorption properties, and thus some "windows" are designated by their material, e.g., "beryllium window").

tungsten alloy (heavy alloy) - a shielding material containing tungsten, copper, and nickel, and having a density about 50 percent greater than that of lead.

two-film technique - a procedure wherein two films of different relative speeds are used simultaneously to radiograph both the thick and the thin sections of a specimen.

2-1T radiography - see radiographic quality level.

2-2T radiography - see radiographic quality level.

type A packaging - the name given, in the regulations concerning the transport of radioactive materials, to packaging capable of preventing any loss or dispersion of the radioactive contents and of maintaining its function of shielding against radiations in normal transport conditions.

type B packaging - the name given, in the regulations concerning the transport of radioactive materials, to packaging capable of resisting not only normal transport conditions like type A packaging but also a serious accident.

umbra - a region behind an object in a beam of radiation such that a straight line drawn from any point in this region to any point in the source passes through the object. The umbra is sometimes referred to as the region of total shadow.

undercut (scatter)- radiation that has reached the film cassette or screen by passage through a thin portion, or along an edge, of a specimen and is then scattered into the shadow of an adjacent thicker portion. This causes excessive film density along the edges of the thicker portions.

under-development - development which is less than that required to produce the optimum results in a particular radiograph. It may arise from development for too short a time, or at too low a temperature, or from the use of exhausted developer.

unidirectional voltage - a voltage of which the polarity, but not necessarily the magnitude, is constant.

unrestricted area - any area to which access is not controlled for purposes of radiation protection.

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unsharpness (blur) - a general and qualitative term that refers to a lack of distinctness of image details in a radiograph, photographic reproduction, or viewing-screen image.

film unsharpness - image spread (diffusion) caused by scatter of electrons or light through the emulsion grains (also called inherent unsharpness).

geometric unsharpness - unsharpness of the image that is determined by the size of the radiation source, the source-to-specimen distance, and the specimen-to-film distance. Geometric unsharpness is minimized when the source is small, the source-to-specimen distance is large, and the specimen-to-film distance is small. Symbol: UG.

inherent unsharpness - see film unsharpness.

movement unsharpness - unsharpness arising from the relative movement of the source of radiation, irradiated object, or film or screen, during film exposure.

scatter unsharpness - unsharpness due to radiation scattered by an irradiated object or intensifying screen.

screen unsharpness - image blurring caused by the use of an intensifying screen or a fluorescent viewing screen. It may result from the scatter of light by the crystals of the fluorescent layer, or poor contact between screen and film, or both.

use factor - the fraction of the workload during which the useful beam is pointed in the direction under consideration when designing shielding. Symbol: U.

useful beam - all radiation that emerges from a source housing or an x-ray tube assembly through a port, diaphragm, or cone.

useful density range - the range of density over which the gradient is adequate for the recognition of image details. The upper density limit is determined mainly by the brightness available in the film illuminator, and the lower density limit by the sensitivity required.

Van de Graaff accelerator - an accelerator that is based on the principle of transfer of charge from a carrier (a moving belt) to the inside of a hollow conductor. The high potential (several million volts) thus generated is used to accelerate ions or electrons, which can be impacted on a heavy-metal target to produce x-rays.

viewing mask - a device for limiting the field of examination of the radiograph.

voltage regulator - a device that automatically compensates for variations in line-power voltage, thus maintaining a nearly constant voltage on the circuits of an x-ray machine.

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water-cooled tube - an x-ray tube for which the principal method of cooling is dissipation of heat, directly or indirectly, by means of water.

wavelength - the distance, in the direction of propagation of a wave, between two successive crests (or troughs).

wedge - see step wedge.

wedge filter - a filter so constructed that its thickness varies continuously or in steps from one edge to the other. Wedge filters may be used to increase the uniformity of radiation in certain types of exposures.

wetting agent - a substance used in film processing to reduce surface tension. When used in a pre-development bath it promotes the subsequent uniform diffusion of developer into the emulsion. It may also be used in a final bath to assist rapid and uniform drainage of the film and so reduce the occurrence of marks caused by uneven drying (drying marks).

wire penetrameter - an image quality indicator incorporating a series of wires that are graded in diameter and usually of similar material to the specimen under examination.

workload - a measure in suitable units of the amount of use of radiation sources. It is usually expressed in milliampere-minutes per week for x-ray sources and roentgens per week at one meter from the source for gamma-ray sources and high-energy sources (such as linear accelerators, betatrons, etc.).

xero-radiography - a process using the photo-conductive property of amorphous selenium to reproduce a radiological image, instead of photographic film.

x-radiation - see x-rays.

x-radiography - the process of producing radiographs using x-rays.

x-rays - penetrating electromagnetic radiation produced artificially when a beam of charged particles (usually electrons) is made to impact upon a metallic target. X-rays are emitted when the incident particles (1) are slowed down by interactions with nuclei in the target material, and (2) excite electrons in the target material which subsequently release energy.

x-ray film - a film base that is coated (usually on both sides) with an emulsion designed for use with x-rays.

x-ray paper - white paper coated on one side with emulsion for use with or without an intensifying screen. It is suitable for some purposes as an alternative to x-ray film.

x-ray spectrometer - an instrument used to determine the wavelengths of x-rays and the relative intensities of different wavelengths in an x-ray beam.

x-ray spectroscopy - the study of x-ray spectra and their interpretation.

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x-ray tube - a vacuum tube intended for the production of x-rays by bombarding the anode with a beam of electrons accelerated under a difference of potential between anode and cathode.

x-ray tube assembly - a tube housing with the tube installed. It may include high voltage and filament transformers and other appropriate elements when they are contained within the tube housing.

zircon sand - a highly absorptive material used as a blocking or masking medium for drilled holes, slots, and highly irregular geometric parts to reduce or eliminate scattered radiation.

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4. NOTES

4.1 Subject term (key word) listing.

Glossary of NDTI terms	Nondestructive testing
Radiography	Radiographic testing

Custodians:
Army - MR
Navy - AS
Air Force - 20

Review activities:
Army - AT, AR, EA, ME, WV, AV
Air Force - 24, 71, 80, 82, 84, 99

User activities:
Army - MI
Navy - AS

Preparing Activity.
Army - MR

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