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**Glossary**

**15% rule** Rule stating that changing the kilovoltage peak by 15% has the same effect on image receptor exposure as doubling or halving the mAs.

**absorbed dose** The transfer of radiation energy into matter (e.g., tissue).

**absorption** As the energy of the primary x-ray beam is deposited within the atoms comprising the tissue, some x-ray photons are completely absorbed. Complete absorption of the incoming x-ray photon occurs when it has enough energy to remove (eject) an inner-shell electron.

**actual focal spot size** The size of the area on the anode target that is exposed to electrons from the tube current. Actual focal spot size depends on the size of the filament producing the electron stream.

**added filtration** The filtration that is added to the port of the x-ray tube.

**air gap technique** Based on the simple concept that much of the scatter will miss the image receptor if there is an increased distance between the patient and the image receptor (increased OID).

**air kerma** The amount of energy deposited in a unit mass of air.

**ambient lighting** The level of light in the room while viewing images.

**ALARA** As Low As Reasonably Achievable.

**anatomically programmed techniques** A radiographic system that allows the radiographer to select a particular button on the control panel that represents an anatomic area; a preprogrammed set of exposure factors is displayed and selected for use.

**anode** A positively charged electrode within the x-ray tube composed of molybdenum, copper, tungsten, and graphite. It consists of a target and, in rotating anode tubes, a stator and rotor.

**anode heel effect** The x-ray beam has greater intensity (number of x-rays) on the cathode side of the tube, with the intensity diminishing toward the anode side. The heel effect occurs because of the angle of the target.

**aperture diaphragm** A flat piece of lead (diaphragm) containing a hole (aperture) for beam restriction.

**artifact** Any unwanted image on a radiograph.

**attenuation** Reduction in the energy or number of the primary x-ray beam as it passes through anatomic tissue.

**automatic brightness control (ABC)** A function of the fluoroscopic unit that maintains the overall appearance of the fluoroscopic image (contrast and density) by automatically adjusting the kilovoltage peak (kVp) or milliamperage (mA) or both. (AERC)

**automatic collimator/positive beam-limiting device** Automatically limits the size and shape of the primary beam to the size and shape of the image receptor.

**automatic exposure control (AEC)** A system used to consistently control the amount of radiation reaching the image receptor by terminating the length of exposure.

**automatic rescaling** Occurs during histogram analysis and is employed to maintain consistent image brightness despite overexposure or underexposure of the digital image receptor.

**average gradient** The slope of the straight-line region of a film’s sensitometric curve.

**backup time** The maximum length of time for which the x-ray exposure continues when using an AEC system.

the tint added to its base and any slight amount of fog added during processing.

**beam-restricting device** Changes the shape and size of the primary beam, located just below the x-ray tube housing.

**beam restriction/collimation** Interchangeably used terms that refer to a decrease in the size of the projected radiation field.

**bit** 0 or 1 that refers to the computer’s basic unit of information.

**bit depth** Number of bits.

**body habitus** Refers to the general form or build of the body, including size. The four types of body habitus are *sthenic*, *hyposthenic*, *hypersthenic*, and *asthenic*.

**bremsstrahlung interactions** Occur when a projectile electron completely avoids the orbital electrons of the tungsten atom and travels very close to its nucleus. The very strong electrostatic force of the nucleus causes the electron suddenly to “slow down.” As the electron loses energy, it suddenly changes its direction and the energy loss reappears as an x-ray photon.

**brightness** The amount of luminance (light emission) of a display monitor.

**brightness gain** The product of both flux gain and minification gain; this results in a brighter image on the output phosphor.

**Bucky** Located directly below the radiographic tabletop, the grid is found just above the tray that holds the image receptor. More accurately called the *Potter-Bucky diaphragm*.

**Bucky factor/grid conversion factor** Used to determine the adjustment in mAs needed when changing from using a grid to nongrid (or vice versa) or when changing to grids with different grid ratios.

**byte** 8 bits combined.

**caliper** A device that measures part thickness.

**camera tube** A device used to convert the light emitted from the output phosphor to an electrical signal sent to the television monitor.

**cathode** A negatively charged electrode (within the x-ray tube). It comprises a **319**filament and a focusing cup.

**characteristic interactions** Produced when a projectile electron interacts with an electron from the inner (K) shell of the tungsten atom and ejects it. An outer-shell electron drops into vacancy and the energy difference is emitted as an x-ray photon.

**charge-coupled device (CCD)** A light-sensitive semiconducting device that generates an electrical charge when stimulated by light and stores this charge in a capacitor.

**coherent scattering** An interaction that occurs with low-energy x-rays, typically below the diagnostic range. The incoming photon interacts with the atom, causing it to become excited. The x-ray does not lose energy but changes direction.

**collimator** Two sets of adjustable lead shutters located 3–7 in below the tube that consist of longitudinal and lateral leaves or blades, each with its own control; this makes the collimator adjustable in terms of its ability to produce projected fields of varying sizes.

**comparative anatomy** Concept stating that different parts of the same size can be radiographed using the same exposure factors, provided the minimum kVp value needed to penetrate the part is used in each case.

**compensating filter** Special filters added to the primary beam to alter its intensity. These types of filters are used to image anatomic areas that are nonuniform in makeup and assist in producing more consistent exposure to the image receptor.

**Compton effect** The loss of energy of the incoming photon when it ejects an outer-shell electron from the atom. The remaining lower-energy x-ray photon changes direction and may leave the anatomic part.

**Compton electron/secondary electron** The ejected electron resulting from the Compton effect interaction.

**cone** An aperture diaphragm that has an extended flange attached to it. The flange can vary in length and is shaped as a cone. The flange can also be made to telescope, increasing its total length.

**continuous fluoroscopy** The x-ray exposure continues without interruption while the exposure pedal/button is activated.

**contrast medium** A substance instilled into the body by injection or ingestion that is used when imaging anatomic tissues that have low subject contrast. Also called *contrast agent*.

**contrast resolution** The ability of the image receptor to distinguish between objects having similar subject contrast.

**contrast-to-noise ratio** A method of describing the contrast resolution with the amount of noise apparent in a digital image.

**convergent line** If points were connected along the length of the grid, they would form an imaginary line.

**convergent point** If imaginary lines were drawn from each of the lead lines in a linear focused grid, these lines would meet to form an imaginary point.

**conversion factor** An expression of the luminance at the output phosphor divided by the input exposure rate; its unit of measurement is candela per square meter per milliroentgen per second.

**crossed/cross-hatched grid** A grid containing lead lines that are perpendicular because they contain more lead strips, oriented in two directions.

**cylinder** An aperture diaphragm that has an extended flange attached to it. The flange can vary in length and is shaped as a cylinder.

**densitometer** A device used to numerically determine the amount of blackness on the radiograph.

**density controls**  Controls that allow the radiographer to adjust the amount of preset radiation detection values. Each control changes the exposure time by a certain predetermined amount or increment.

**detective quantum efficiency (DQE)** A measurement of the efficiency of an image receptor in converting the x-ray exposure it receives to a quality radiographic image.

**detectors** The sensors, cells, or chambers within an AEC device that sense how much radiation has reached the imaging plate in order to terminate the exposure.

**deviation index (DI)** A value that reflects the difference between the desired or target exposure to the image receptor and the actual exposure to the image receptor.

**differential absorption** A process whereby some of the x-ray beam is absorbed in the tissue and some passes through (transmits) the anatomic part.

**digital imaging** Constructing an image from numeric data.

**digital imaging and communications in medicine (DICOM)** A communication standard for information sharing between PACS and imaging modalities.

**distortion** Results from the radiographic misrepresentation of either the size (magnification) or the shape of the anatomic part.

**dose equivalent** Units of radiation exposure used in measuring occupational exposure.

**dosimeter** A device that measures x-ray exposure.

**dynamic range** Refers to the range of exposure intensities an image receptor can accurately detect.

**effective focal spot size** Focal spot size as measured directly under the anode target.

**electromagnetic radiation** Radiation that has both electrical and magnetic properties. All radiations that are electromagnetic make up a spectrum.

**electronic masking** Also known as *shuttering*. A postprocessing function that can remove regions of the digital image.

**electrostatic focusing lenses** Focuses and accelerates the electrons through the image intensifier toward the anode.

**elongation** Refers to images of objects that appear longer than the true objects.

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**exit radiation** When the attenuated x-ray beam leaves the patient, the remaining x-ray beam is composed of both transmitted and scattered radiation.

**exposure** The amount of ionizations or electrical charge in a specified amount of air expressed by Roentgen (R).

**exposure indicator** A numeric value that is displayed on the processed image to indicate the level of x-ray exposure received on the digital image receptor.

**exposure intensity** The amount and energy of the x-rays reaching an area of the image receptor.

**exposure latitude** The range of exposures that produce optical densities within the straight-line region of the sensitometric curve.

**exposure technique charts** Pre-established guidelines used by the radiographer to select standardized manual or AEC exposure factors for each type of radiographic examination.

**exposure time** Determines the length of time that the x-ray tube produces x-rays.

**extrapolated** Mathematically estimated; the mathematical process used to create technique charts.

**filament** A coiled tungsten wire that is the source of electrons during x-ray production.

**filament current** Heats the tungsten filament. This heating of the filament causes thermionic emission.

**fill factor** The percentage of the x-rays reaching the sensitive area of the detector element (DEL).

**fixed kVp/variable mAs technique chart** A type of exposure technique chart that is based on the concept of selecting an optimal kVp value that is required for the radiographic examination and adjusting the mAs for variations in part thickness.

**flat-panel detectors (FPD)** Solid-state image receptors using a large-area active matrix array of electronic components ranging in sizes from 43 × 35 cm to 43 × 43 cm.

**fluorescence** The ability of phosphors to emit visible light only while exposed to x-rays (with little or no afterglow).

**fluoroscopy** Allows imaging of the movement of internal structures. It differs from film-screen imaging in that it uses a continuous beam of x-rays to create images of moving internal structures that can be viewed on a television monitor.

**flux gain** The increase in light intensities at the output phosphor by accelerating the electrons.

**focal distance** The distance between the grid and the convergent line or point, sometimes referred to as *grid radius*.

**focal range** The recommended range of SIDs that can be used with a focused grid. The convergent line or point always falls within the focal range.

**focused grid** Grid that has lead lines that are angled, or canted, to approximately match the angle of divergence of the primary beam.

**focusing cup** Made of nickel and nearly surrounds the filament. It is open at one end to allow electrons to flow freely across the tube from cathode to anode. It has a negative charge, which keeps the cloud of electrons emitted from the filament from spreading apart. Its purpose is to focus the stream of electrons.

**fog** Scatter radiation (Compton interactions) that reach the image receptor and creates unwanted exposure on the radiographic image.

**foreshortening** Refers to images that appear shorter than the true objects.

**frequency** The number of waves passing a given point per given unit of time. Frequency is represented by a lowercase *f* or by the Greek letter *nu (ν)*, and values are given in Hertz (Hz).

**gray scale** The number of different shades of gray that can be stored and displayed by a computer system.

**grid** A device that has very thin lead strips with radiolucent interspaces, intended to absorb scatter radiation emitted from the patient.

**grid cap** Contains a permanently mounted grid and allows the image receptor to slide in behind it.

**grid cassette** An image receptor that has a grid permanently mounted to its front surface.

**grid cutoff** A decrease in the number of transmitted photons that reach the image receptor because of some misalignment of the grid.

**grid focus** The orientation of the lead lines to one another.

**grid frequency** Expresses the number of lead lines per unit length, in inches or centimeters or both. Grid frequencies can range from 25 to 45 lines/cm (60 to 110 lines/in).

**grid pattern** The linear pattern of the lead lines of a grid. The two types of grid pattern are linear and crossed or cross-hatched.

**grid ratio** The ratio of the height of the lead strips to the distance between them.

**half-value layer (HVL)** The amount of filtration that reduces the intensity of the x-ray beam to one-half of its original value is considered the best method for describing x-ray quality. The HVL also can be used as an indirect measure of the total filtration in the path of the x-ray beam. It is expressed in millimeters of aluminum (mm-Al).

**health level seven standard (HL7)** A communication standard for medical information.

**heat unit (HU)** The amount of heat produced from any given exposure.

**high contrast** A radiograph with few densities but great differences among them.

**histogram analysis** Graphic display of the distribution of pixel values. Each image has its own histogram, and it is evaluated to determine the adequacy of the image receptor exposure to x-rays.

**illuminator** Device that provides light illumination so that the anatomy, displayed as various shades of optical densities, can be visualized. It is also known as a *viewbox*.

**image intensification** The process whereby the exit radiation from the anatomic area of interest interacts with a light-emitting material (input phosphor) **321**for conversion to visible light to create a brighter image.

**image receptor (IR)** A device that receives the radiation leaving the patient.

**imaging plate (IP)** Located in the CR image receptor, where the photon intensities are absorbed by the phosphor.

**inherent filtration** The filtration that is permanently in the path of the x-ray beam. Three components contribute to inherent filtration: (1) the glass envelope of the tube, (2) the oil that surrounds the tube, and (3) the window in the tube housing.

**input/output phosphor** Phosphors within the image intensifier. The input phosphor converts incoming radiation into visible light energy, and the output phosphor converts the electrons into a brighter image.

**intensity of radiation exposure** The amount and energy of the x-rays reaching an area of the image receptor.

**interspace material** Radiolucent strips between the lead lines of a grid; generally made of aluminum.

**inverse square law** The relationship between distance and x-ray beam intensity, which states that the intensity of the x-ray beam is inversely proportional to the square of the distance from the source.

**invisible image** The latent image not visible within the image receptor.

**ionization** The ability to remove (eject) electrons; a property of x-rays.

**ionization/ion chamber** A hollow cell that contains air and is connected to the AEC timer circuit via an electrical wire.

**kilovoltage (kVp)** Potential difference applied across the x-ray tube at the time the exposure is initiated, kVp determines the speed at which the electrons in the tube current move.

**latent image** The invisible image within the image receptor.

what happens to silver halide crystals when exposed to x-rays and light.

**leakage radiation** Any x-rays, other than the primary beam, that escape the tube housing.

**line focus principle** Describes the relationship between the actual and the effective focal spots in the x-ray tube. A smaller target angle produces a smaller effective focal spot.

**linear grid** Contains lead lines that run in only one direction.

**long-dimension linear grid** Contains lead strips that run parallel to the long axis of the grid.

**long-scale/low contrast** A radiograph with a large number of densities but little differences among them.

**lookup tables (LUT)** Provides a method of altering the image to change the display of the digital image in a variety of ways.

**luminescence** The emission of light from the screen when stimulated by radiation.

**magnification** An increase in the image size of the object compared with its true or actual size. Also known as *size distortion*.

**magnification factor (MF)** Indicates how much size distortion or magnification is shown on a radiograph. MF = SID divided by SOD.

**magnification mode** Image intensifiers have a multifold function to increase the size of the area of interest displayed on the television monitor. Changing the voltage of the electrostatic focusing lenses tightens the diameter of the electron stream, giving the appearance of magnification.

**manifest/visible image** The visible image after processing.

**mAs/distance compensation formula** A formula that provides a mathematical calculation for adjusting mAs when changing the SID.

**mAs readout** The actual mAs used for the image is displayed immediately after the AEC exposure, sometimes for only a few seconds.

**matrix** A digital image is displayed as a combination of rows and columns (array) of small, usually square, “picture elements” called *pixels*.

**maximum contrast** The greatest difference in optical densities.

**milliamperage (mA)** The unit used to measure the tube current.

**minification gain** Increased light intensities as a result of the reduction in size of the output phosphor image compared with that of the input phosphor image.

**minimum response time** Refers to the shortest exposure time that the AEC system can produce.

**modulation transfer function (MTF)** A measure of the imaging systems ability to display contrast of anatomic objects varying in size.

**Moiré effect** An artifact that can occur when a stationary grid is used during computed radiography (CR) imaging if the grid frequency is similar to the scanning frequency. Also known as the *Zebra pattern*.

**object-to-image-receptor distance (OID)** Distance created between the object radiographed and the image receptor.

**off-focus radiation** Occurs when projectile electrons are reflected and x-rays are produced outside the focal spot.

**optimal kVp** The kVp value that is high enough to ensure penetration of the part but not too high to diminish radiographic contrast.

**parallel/nonfocused grid** A grid with lead lines that run parallel to one another.

**penetrometer** A device comprising uniform absorbers of increasing thicknesses.

**photocathode** Converts the visible light in the image intensifier into electrons.

**photoelectric effect** Complete absorp**322**tion of the incoming x-ray photon occurs when it has enough energy to remove (eject) an inner-shell electron. The ionized atom has a vacancy, or electron hole, in its inner shell, and an electron from an outer shell drops down to fill the vacancy.

**photoelectron** The ejected electron resulting from ionization during the photoelectric effect.

**photomultiplier (PM) tube** An electronic device that converts visible light energy into electrical energy.

**photon** A small, discrete bundle of energy.

**photostimulable luminescence (PSL)** The emission of visible light from the photostimulable phosphor when stimulated by a high-intensity laser beam.

**photostimulable phosphor (PSP)** The phosphor layer of the imaging plate (IP) composed of barium fluorohalide crystals doped with europium.

**phototimer** Uses a fluorescent (light-producing) screen and a device that converts light to electricity in an AEC device. (old)

**picture archival and communication system (PACS)** A computer system designed for digital imaging that can receive, store, distribute, and display digital images.

**pixel** The smallest component of the matrix. Also known as *picture elements*.

**pixel density** The number of pixels per unit area.

**pixel pitch** The pixel spacing or distance measured from the center of a pixel to an adjacent pixel.

**pulsed fluoroscopy** The x-ray exposure has gaps of exposure between each image frame.

**quantum** A small, discrete bundle of energy.

**quantum noise** Visible as brightness or density fluctuations on the image as a result of too few photons reaching the image receptor to form the image. *Quantum mottle* is the term typically used when referring to noise on a film image.

**radioactivity** Unstable atoms spontaneously emitting particles and energy from the nucleus in an effort to attain stability.

**rare earth elements** Chemical compounds of elements that are relatively difficult and expensive to extract from the earth and range in atomic number from 57 to 71 on the periodic table of elements.

**remnant radiation** When the attenuated x-ray beam leaves the patient, the remaining x-ray beam is composed of both transmitted and scattered radiation. Also known as *exit radiation*.

**rotor** A device in the x-ray tube that causes the target to rapidly rotate during x-ray production.

**sampling frequency** How often the analog signal is reproduced in its discrete digitized form.

**sampling pitch** The distance between the sampling points.

**scale of contrast** The range of densities visible in a film image.

**scattering** Some incoming photons are not absorbed but instead lose energy during interactions with atoms comprising tissue.

**scintillator** A phosphor material that converts the exit radiation into visible light.

**secondary electron** The ejected electron resulting from the Compton effect interaction. Also known as a *Compton electron*.

**sensitometer** A device designed to produce consistent step-wedge densities.

**shape distortion** Images of objects that appear longer or shorter than the true objects.

**short-dimension linear grid** Contains lead strips running perpendicular to the long axis of the grid.

**short-scale contrast** A film radiograph with few densities but great differences among them is said to have *high contrast*..

**signal-to-noise ratio (SNR)** A method of describing the strength of the radiation exposure compared with the amount of noise apparent in a digital image.

**size distortion/magnification** Refers to an increase in the image size of an object compared with its true, or actual, size.

**source-to-image-receptor distance (SID)** The distance between the source of the radiation and the image receptor.

**source-to-object distance (SOD)** Refers to the distance from the x-ray source (focal spot) to the object being radiographed.

**space charge** The electrons liberated from the filament during thermionic emission that form a cloud around the filament.

**space charge effect** The tendency of the space charge not to allow more electrons to be boiled off the filament.

**spatial frequency** Variation in anatomic details imaged as white to black **323**brightness levels that can be defined by the unit of line pairs per millimeter (lp/mm).

**spatial resolution** The smallest detail that can be detected in an image; the term typically used in digital imaging.

**stator** An electric motor that turns the rotor at very high speed during x-ray production.

**step-wedge densities** A radiograph of uniform densities resembling a step wedge.

**subject contrast** A result of the absorption characteristics of the anatomic tissue radiographed along with the quality of the x-ray beam.

**target** A metal that abruptly decelerates and stops electrons in the tube current, allowing the production of x-rays.

**thermionic emission** The boiling off of electrons from the cathode filament.

**tissue density** Matter per unit volume or the compactness of the anatomic particles comprising the anatomic part.

**total filtration** The sum of the x-ray tube’s added and inherent filtration.

**transmission** The incoming x-ray photon passes through the anatomic part without any interaction with the atomic structures.

**trough filter** A double-wedge compensating filter added to the primary beam to produce more consistent exposure to the image receptor.

**tube current** The flow of electrons from cathode to anode, measured in milliamperage (mA).

**values of interest (VOI)** Determines the range of the histogram data set included in the displayed image.

**variable kVp/fixed mAs technique chart** A type of exposure technique chart based on the concept that kVp can be increased as the anatomic part size increases. The baseline kVp is increased by 2 for every 1 cm increase in part thickness, and the mAs is maintained.

**voltage ripple** The amount of consistency in voltage waveforms during x-ray production.

**wafer grid** A type of stationary grid placed on top of the image receptor.

**wavelength** The distance between two successive crests or troughs.

**wedge filter** The most common type of compensating filter. The thicker part of the wedge filter is lined up with the thinner portion of the anatomic part that is being imaged, allowing fewer x-ray photons to reach that end of the part.

**window level** Sets the midpoint (center) of the range of brightness visible in the digital image.

**window width** The range or number of shades of gray visible on the digital image.

**x-ray emission spectrum** The range and intensity of emitted x-rays.