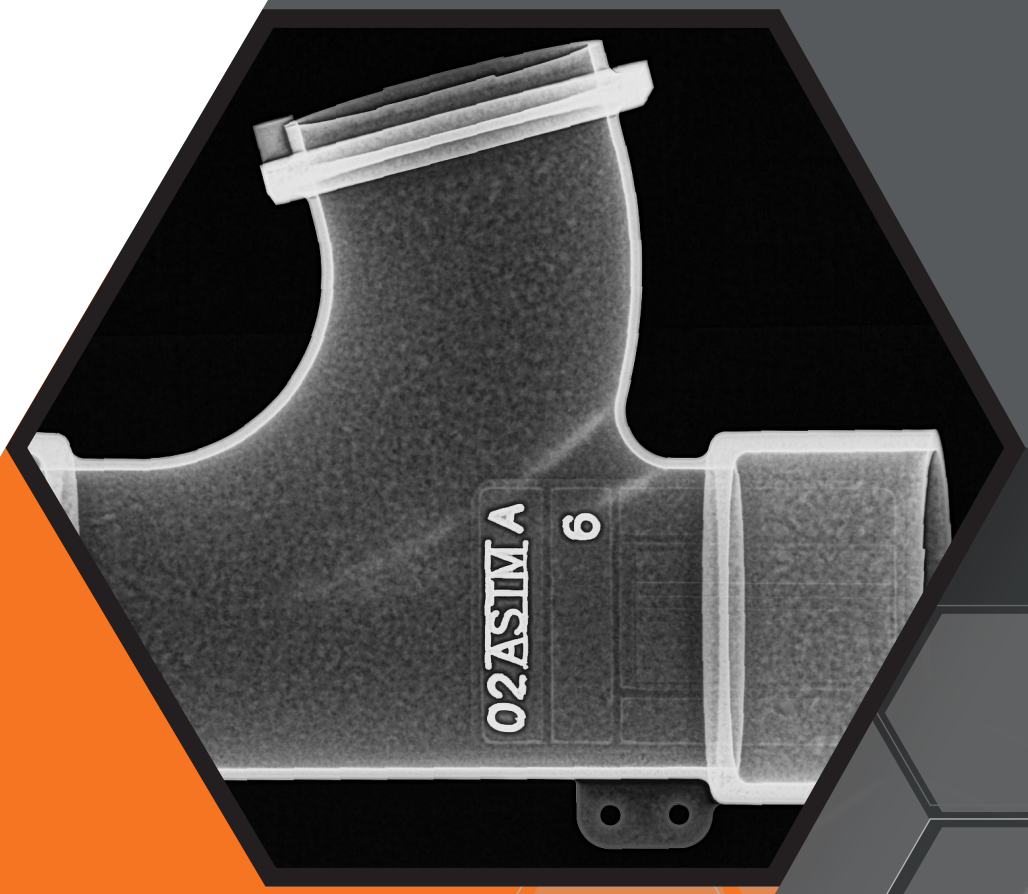
CarestreamNDT

WHITE PAPER

Digital transformation is not
a destination but a journey.

General Radiography Terms



INTRODUCTION

At Carestream NDT we want to share not only our technological developments and product portfolio, but also the knowledge and practical experience that our staff obtains by working shoulder-to-shoulder with customers like you. We aim to share this knowledge and experience in a straightforward fashion so that our readers may find practical applications in their everyday activities.

This series is directed but not limited to NDE professionals in the following industries: Oil & Gas, Nuclear, Construction, Foundry and Castings, Energy Generation, Aerospace, Transportation, Automotive, Military and Defense, Agriculture, Art Restoration & Museum Artifacts, and NDE Services Companies.

CarestreamNDT

150 Verona Street
Rochester, NY 14608

www.carestream.com

Often, when we start to explore a new field or professional activity, it's imperative to understand the basic vocabulary in that discipline. This is the second article in a series of five devoted to facilitating your understanding of basic NDE terminology as applicable to the radiographic imaging process. This article is centered on Gamma- and X-Radiologic Testing (RT) terms.

PART 1 Common NDE Terms

PART 2 General Radiography Terms

This portion of the series will be beneficial, regardless if you are already involved in radiography or just interested in increasing your understanding of this field.

After reading this post and gaining new insights, we welcome you to explore other articles in this series.

PART 3 Film Radiography Terms

PART 4 Digital Radiography and Imaging Terms

PART 5 Image Quality and Discontinuity Indication Terms

Basic Gamma- and X-Radiologic Testing (RT) Terms

Table 1 proposes a series of terms related to both Gamma- and X-Radiologic Testing (RT) to help our readers understand the fundamental literature available in those subjects, including). This basic Basic Gamma- and X-Radiologic Testing (RT) terms list may be applicable to film radiography, digital radiography (DR) or computed radiography (CR).

This basic terms list is sorted in alphabetical order:

TERM	DEFINITION
absorbed dose	The amount of energy imparted by ionizing radiation per unit mass of irradiated matter. Denoted by "rad;" 1 rad = 0.01 j/kg. SI unit is "gray;" 1 gray = 1 j/kg.
absorbed dose rate	The absorbed dose per unit of time; rads/s. SI unit, grays/s.
absorption	The process whereby the incident particles or photons of radiation are reduced in number or energy as they pass through matter.
accelerating potential	The difference in electric potential between the cathode and anode in an X-ray tube through which a charged particle is accelerated; usually expressed in units of kV or MV.
activation	In neutron radiography, the process of causing a substance to become artificially radioactive by subjecting it to bombardment by neutrons or other particles.
acute radiation syndrome	The immediate effects of a short term, whole body overexposure of a person to ionizing radiation. These effects include nausea and vomiting, malaise, increased temperature, and blood changes.
alpha particle	A positively charged particle emitted by certain radio-nuclides. It consists of two protons and two neutrons, and is identical to the nucleus of a helium atom.
anode current	The electrons passing from the cathode to the anode in an X-ray tube, minus the small loss incurred by the back scattered fraction.
aperture	An opening in material, space, or time over which an element is considered to be active.
attenuation (X-ray)	Reduction of radiation beam intensity caused by the interactions of the beam with the matter through which it passes.
autoradiograph	The image of an object containing a radio-element obtained, on a recording medium, by means of its own radiation.
back scattered radiation	Radiation which is scattered more than 90° with respect to the incident beam, that is, backward in the general direction of the radiation source.
betatron	An electron accelerator in which acceleration is provided by a special magnetic field constraining the electrons to a circular orbit. This type of equipment usually operates at energies between 10 and 31 MEV.
blocking or masking	Surrounding specimens or covering their sections with absorptive material.

TERM	DEFINITION
cassette	A light-tight container for holding radiographic recording media during exposure, for example, film, with or without intensifying or conversion screens.
cine-radiography	The production of a series of radiographs that can be viewed rapidly in sequence, thus creating an illusion of continuity.
collimator	A device of radiation absorbent material intended for defining the direction and angular divergence of the radiation beam.
compton scatter radiation	The scattered X-ray or gamma ray which results from the inelastic scattering of an incident X-ray or gamma ray on an electron. Since the ejected electron has short range in most materials, it is not considered part of the scattered radiation.
constant potential	A method of electrically generating X-rays by placing a constant potential electrical source (voltage and current) across the x-ray tube anode and cathode; the ripple component of the constant potential electrical source is typically less than 2.0 %.
exposure, radiographic exposure	The subjection of a recording medium to radiation for the purpose of producing a latent image. Radiographic exposure is commonly expressed in terms of milliampere-seconds or millicurie-hours for a known source-to-film distance.
exposure table	A summary of values of radiographic exposures suitable for the different thicknesses of a specified material.
filter	Uniform layer of material, usually of higher atomic number than the specimen, placed between the radiation source and the film for the purpose of preferentially absorbing the softer radiations.
fluorescence	The emission of light by a substance as a result of the absorption of some other radiation of shorter wavelengths only as long as the stimulus producing it is maintained.
fluorescent screen	Alternative term for intensifying screen.
fluoroscopy	The visual observation on a fluorescent screen of the image of an object exposed to penetrating, ionizing radiation.
focal spot	For X-ray generators, that area of the anode (target) of an X-ray tube which emits X-ray when bombarded with electrons.
forward scattered radiation	Radiation which is scattered less than 90° with respect to the incident beam, that is, forward in the general direction of the radiation source.
gamma-radiography	A technique of producing radiographs using gamma-rays.
gamma ray	Electromagnetic penetrating radiation having its origin in the decay of a radioactive nucleus.
geometric unsharpness	The penumbral shadow in a radiological image which is dependent upon (1) the radiation source dimensions, (2) the source to object distance, and (3) object to detector distance.
half-life	The time required for one half of a given number of radioactive atoms to undergo decay.
half-value layer (HVL)	The thickness of an absorbing material required to reduce the intensity of a beam of incident radiation to one half of its original intensity.

TERM	DEFINITION
half-value thickness	The thickness of a specified substance which, when introduced into the path of a given beam of radiation, reduces its intensity to one half.
image quality indicator (IQI)	In industrial radiology, a device or combination of devices whose demonstrated image or images provide visual or quantitative data, or both, to determine radiologic quality and sensitivity. Also known as a penetrameter (disparaged). *DISCUSSION – It is not intended for use in judging size nor establishing acceptance limits of discontinuities.*
indication	The response or evidence from a nondestructive examination that requires interpretation to determine relevance.
intensifying screen	A material that converts a part of the radiographic energy into light or electrons and that, when in contact with a recording medium during exposure, improves the quality of the radiograph, or reduces the exposure time required to produce a radiograph, or both. Three kinds of screens in common use are: **(a) metal screen –** a screen consisting of dense metal (usually lead) or of a dense metal compound (for example, lead oxide) that emits primary electrons when exposed to X- or gamma-rays. **(b) fluorescent screen –** a screen consisting of a coating of phosphors which fluoresces when exposed to X or gamma radiation. **(c) fluorescent-metallic screen –** a screen consisting of a metallic foil (usually lead) coated with a material that fluoresces when exposed to X or gamma radiation. The coated surface is placed next to the film to provide fluorescence; the metal functions as a normal metal screen.
IQI sensitivity	In radiography, the minimum discernible image and the designated hole in the plaque-type, or the designated wire image in the wire type image quality indicator.
keV (kilo electron volt)	A unit of energy equal to 1,000 electron volts, that is, the energy gained by an electron or proton moving through a potential difference of 1,000 volts in a vacuum. *DISCUSSION – A unit of the maximum photon energy of a bremsstrahlung X-ray spectrum, when used to describe an X-ray source.*
kV (kilo volts)	A unit of electrical potential difference equal to 1,000 volts. *DISCUSSION – Often used to express the accelerating potential of an electrostatic X-ray source, such as an X-ray tube.*
kVp (kilo volts peak)	A unit used to express the peak voltage of a time varying electrical potential of an X-ray source, such as a rectified X-ray generator system.
latent image	A condition produced and persisting in the image receptor by exposure to radiation and able to be converted into a visible image by processing.
lead screen	See intensifying screen.
linear accelerator	An electron generator in which the acceleration of the particles is connected with the propagation of a high-frequency field inside a linear or corrugated wave guide.

TERM	DEFINITION
line pair test pattern	a pattern of one or more pairs of objects with high contrast lines of equal width and equal spacing. The pattern is used with an imaging device to measure spatial resolution.
location marker	A number or letter made of lead (Pb) or other highly radiation attenuative material that is placed on an object to provide traceability between a specific area on the image and the part.
low-energy gamma radiation	Gamma radiation having energy less than 200 keV.
mA (milliampere)	A unit of current equal to 0.001 amperes, used to express the tube current of an X-ray tube.
MeV (mega electron volt)	A unit of energy equal to 1,000,000 electron volts, that is, the energy gained by an electron or proton moving through a potential difference of 1,000,000 volts in a vacuum. *DISCUSSION – A unit of the maximum photon energy of a bremsstrahlung X-ray spectrum, when used to describe an X-ray source.*
microfocus X-ray tube	An X-ray tube having an effective focal spot size not greater than 100 µm.
milliamperes (mA)	The technical term is tube current and is defined as the current passing between the cathode and anode during the operation of an X-ray tube, measured in milliamperes (mA) and usually taken as a measure of X-ray intensity.
minifocus X-ray tube	An X-ray tube having an effective focal spot size between 100 and 400 µm.
MV (mega volt)	Unit of electrical potential difference equal to 1,000,000 volts. *DISCUSSION – Often used to express the accelerating potential of an electrostatic X-ray source; when used to describe an accelerator-based X-ray source, the accelerating potential that would produce the same electron energy and X-ray spectrum if an electrostatic source were available.*
MVp (mega volts peak)	a term commonly used to express the equivalent electrostatic accelerating potential of an accelerator based X-ray source, see MV (mega volt). *DISCUSSION – While not a technically correct term, MVp is used as an analog to kVp in the mega volt X-ray regime.*
net density	Total density less fog and support (film base) density.
neutron radiography (NRT)	A process of making an image of the internal details of an object by the selective attenuation of a neutron beam by the object.
nuclear activity	The number of disintegrations occurring in a given quantity of material per unit of time. "Curie" is the unit of measurement. One curie is equivalent to 3.7 × 1010 disintegrations per second.
object-detector distance (ODD)	The distance between the surface of the source side of the object and the radiation detector.
object-detector distance for computed tomography (ODDCT)	The distance between the center of rotation of the object and the radiation detector.

TERM	DEFINITION
object-film distance	The distance between the surface of the source side object and the plane of the recording medium. *DISCUSSION – In the case where the recording medium is placed directly in contact with the object being examined, the distance is equal to the thickness of the object.*
optical line pair test pattern	see line pair test pattern. pair production — The process whereby a gamma photon with energy greater than 1.02 MeV is converted directly into matter in the form of an electron-positron pair. Subsequent annihilation of the positron results in the production of two 0.511 MeV gamma photons.
pair production	The process whereby a gamma photon with energy greater than 1.02 MeV is converted directly into matter in the form of an electron-positron pair. Subsequent annihilation of the positron results in the production of two 0.511 MeV gamma photons.
pencil beam	A radiation beam which has little divergence, usually created by collimating an intense source of radiation.
penetrameter	Alternative term for image quality indicator.
penetrameter sensitivity	Alternative term for IQI sensitivity.
phosphor	Any substance that can be stimulated to emit light by incident radiation.
photo fluorography	A photograph of the image formed on a fluorescent screen.
primary radiation	Radiation coming directly from the source.
radiograph	Any retrievable image produced by penetrating radiation passing through a material being examined. *DISCUSSION – This may be hard copy, film, or a digital image.*
radiographic equivalence factor	That factor by which the thickness of a material must be multiplied in order to determine what thickness of a standard material (often steel) will have the same absorption.
radiographic exposure	See exposure.
radiographic inspection	The use of X-rays or nuclear radiation, or both, to detect discontinuities in material, and to present their images on a recording medium.
radiography	The art, act, or process of making radiographs.
radiological examination	The use of penetrating ionizing radiation to display images for the detection of discontinuities or to help ensure integrity of the part.
radiology	The science and application of X-rays, gamma rays, neutrons, and other penetrating radiations.
radioscopy	The electronic production of a radiological image that follows very closely the changes with time of the object being imaged.
rare earth screens	See intensifying screen.
real-time radioscopy	Radioscopy that is capable of following the motion of the object without limitation of time.
recording media	Material capable of capturing or storing, or both, a radiological image in digital or analog form.
recording medium	A film or detector that converts radiation into a visible image.

TERM	DEFINITION
scintillators and scintillating crystals	A detector that converts ionizing radiation to light.
screen	Alternative term for intensifying screen.
secondary radiation	Radiation emitted by any substance as the result of irradiation by the primary source.
shim	A material, typically placed under the IQI which is radiologically similar to the object being imaged.
source	A machine or radioactive material that emits penetrating radiation.
source-detector distance (SDD)	The distance between the X-ray focal spot or gamma source and the radiation detector.
source-film distance	The distance between the radiation-producing area of the source and the film.
source-object distance (SOD)	The distance between the X-ray focal spot or gamma source and the source side of the object.
source-object distance for computed tomography (SODCT)	The distance between the X-ray focal spot or gamma source and the center of rotation of the object.
step-wedge comparison film	A processed film with defined discrete optical density steps, used to characterize the optical density on a radiograph.
subject contrast	The logarithm of the ratio of the radiation intensities transmitted through selected portions of the specimen.
target	That part of the anode of an X-ray emitting tube hit by the electron beam.
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 by a factor of ten.
tomography	Any radiologic technique that provides an image of a selected plane in an object to the relative exclusion of structures that lie outside the plane of interest (see tomogram and computed tomography (CT)).
tube current	The flow of electrons from the filament to the anode target in an X-ray tube; usually expressed in units of milliamperes or microamperes.

Table 1 – Basic Gamma- and X-Radiologic Testing (RT) Terms - Reprinted, with permission, from ASTM E1316-22, Standard Terminology for Nondestructive Examinations, copyright ASTM International.
A copy of the complete standard may be obtained from https://www.astm.org/e1316-22.html.

How to make use of the information in this post

Here are some supplementary information resources from Carestream NDT's products and services portfolio:

Products:

- HPX-DR 3543 PE Non-Glass, Large Format Detector
- HPX-DR 2530 PH High-Resolution, Compact Detector
- HPX-DR 2530 PC High-Speed, Compact Detector
- HPX-DR 4336 GH High-Resolution, Large Format Detector
- HPX-DR 2329 GK, High-Resolution, Compact Detector

INDUSTREX Digital Radiography (DR)

- HPX-PRO Portable Digital System
- INDUSTREX HPX-1 Plus Digital System
- INDUSTREX Flex GP, HR and XL Blue Digital Imaging Plates
- HPX-1 Diagnostic Tool & HPX-1 Digital Plate Carrier

INDUSTREX Computed Radiography (CR)

- INDUSTREX Digital Viewing Software
- NDT Archive Solution

- INDUSTREX Films
- INDUSTREX Chemicals for Automatic Processing
- INDUSTREX Chemicals for Manual Processing
- INDUSTREX Eco-Friendly Chemicals
- INDUSTREX Processors

INDUSTREX Film

Training Services:

- **Advanced Industrial Radiographic Training Academy**
  Computed Radiography - 40 Hour Online Course
  Digital Imaging - 40 Hour Classroom Training

Other Carestream NDT Resources:

- Carestream NDT Virtual NDT Showcase
- Carestream NDT Resource Center

Resources from ASNT:

- Radiographic Interpretation, Revised Edition 2020:
https://www.asnt.org/Store/ProductDetail?productKey=826c3c22-42a3-4250-9040-913d40aa0946
- Nondestructive Testing Handbook, fourth edition: Volume 3, Radiographic Testing:
https://www.asnt.org/Store/ProductDetail?productKey=83ea27b3-d68f-483d-9354-e447ef2b3915

References:

1. ASTM (2021), ASTM E1316 – 21a, Standard Terminology for Nondestructive Examinations, West Conshohocken, PA, ASTM International, 2020.

carestream.com/ndt

CARESTREAM NDT AND YOU.
WE'RE BETTER TOGETHER.

ASNT AFFILIATE PROGRAM.

© Carestream Health, Inc., 2022. CARESTREAM and INDUSTREX are trademarks of Carestream Health. CAT 7500 700 08/22

Carestream