

TRAINING DOCUMENTS	Doc. Nr.:	INF-012-TD
Title: Syllabus for Radiographic Testing Training Course – Level 1, 2, and Level 3	Revision No.:	00
	Valid from:	20.4.2021

1 REASON FOR LATEST REVISION

Revision No.:	Keywords:	Chapter:	Valid from:	Respon.
00	Development document	All	20.04.2021	Ch.Dürager

2 SCOPE OF APPLICATION

This document contains the information about the training syllabus for the NDT training course “Radiographic Testing – Aerospace Applications” provided by IMITec NDT Training School.

The training course is offered for Level1 (L1), Level 2 (L2), and Level 3 (L3) personnel which are intend to qualify for Non-destructive Testing personnel based on the standard EN4179 (Aerospace applications).

The syllabus covers the required course content for the general part based on the EN4179 and in some points the requirements for the specific and practical part. However, it may be necessary to adapt the specific part to the specific requirements of the candidate’s company.

2.1 Information for the reader

In principle the syllabus is provided for the different Levels. Level 3 candidates, however, are expected to have already learned and tested a large part of the theory material in the Level 2 course. These parts are required for the Level 3 course and will be tested during the final exam.

Some parts of the teaching material will be covered in the course and will be dealt with in more detail in a further course. To explain:

X = Teaching the basic knowledge,

X = Teaching of the in-depth knowledge.

3 REFERENCE DOCUMENTS

Document	Addition	Remarks / Description
Radiographic Testing – Aerospace Applications	2020	Training book IMITec NDT Training School.
EN 4179	2017	Aerospace series – Qualification and approval of personnel for non-destructive testing.
Radiographic Testing L2 Training	2017	The Southwest School of NDT- Training book.
Lehrgang Durchstrahlprüfung Stufe 3	1998	Daimler-Benz Aerospace Airbus (J. Krüger)
Syllabus -Radiographic Testing	2015	European Federation for Non-Destructive Testing – Forum on Aerospace

4 SYLLABUS RADIOGRAPHIC TESTING film

Chapter	Training Content		L1	L2	L3
RT General					
Physical and technical concept of radiographic inspection	Introduction	History	X	X	X
		Purpose of Radiographic Testing			
		Principle of Radiographic Testing			
		Electromagnetic spectrum			

TRAINING DOCUMENTS	Doc. Nr.:	INF-012-TD
Title: Syllabus for Radiographic Testing Training Course – Level 1, 2, and Level 3	Revision No.:	00
	Valid from:	20.4.2021

Chapter	Training Content	L1	L2	L3	
	Electromagnetic waves	Spectrum of electromagnetic waves	X	X	X
	Structure of matter	Bohr atom model	X	X	X
		Atom, Molecule	X	X	X
		Structure of the electron shells of the atom	X	X	X
	Isotopes	Overview, Basics	X	X	X
	Dose and dose rate	Energy dose / dose rate	X	X	X
		Ion dose / dose rate	X	X	X
		Dose equivalent / equivalent dose rate	X	X	X
	X-rays generation	Generation principle for X-radiation, spectrum of radiation	X	X	X
		X-ray tube, Components of an x-ray tube up to 600 KV	X	X	X
		Types of X-ray tubes	X	X	X
		Power supply of an X-ray tube	X	X	X
	Propagation, Penetration, and Attenuation of radiation	Inverse square law	X	X	X
		Thickness, density, and radiation quality influence	X	X	X
		Photo-Electrical effect	X	X	X
		Compton effect	X	X	X
		Pair production	X	X	X
	Radiographs	Structure of radiographic films	X	X	X
		Function of photographic layer	X	X	X
		Intensification screens	X	X	X
		Film packing	X	X	X
		Film material and classification systems	X	X	X
		Formation of the latent image on film	X	X	X
		Inherent unsharpness		X	X
	Radiographic Films	Radiation quality	X	X	X
		Effect of changing kV	X	X	X
		Significance and effect of type of x-ray source	X	X	X
		Effect of time	X	X	X
		Milliamperage and FFD on exposure	X	X	X
		Exposure charts	X	X	X
		Identification, marking out and sitting up	X	X	X

TRAINING DOCUMENTS	Doc. Nr.:	INF-012-TD
Title: Syllabus for Radiographic Testing Training Course – Level 1, 2, and Level 3	Revision No.:	00
	Valid from:	20.4.2021

Chapter	Training Content		L1	L2	L3	
		Intensifying screens role and use	X	X	X	
		Filters	X	X	X	
	Film processing - automatic	Developing	X	X	X	
		Stop bath	X	X	X	
		Fixer and replenishment	X	X	X	
		Final soaking step	X	X	X	
		Drying	X	X	X	
	Processing of film - manual	Developer and replenishment	X	X	X	
		Stop bath	X	X	X	
		Fixer and replenishment	X	X	X	
		Washing	X	X	X	
		Prevention of water spots	X	X	X	
		Drying	X	X	X	
		Temperature control	X	X	X	
Exposure Technique	General principles	Contrast: object, image, average gradient	X	X	X	
		Radiation energy	X	X	X	
		Scattered radiation, limitations		X	X	
		Source-to-film distance	X	X	X	
	Exposure	Focal-spot size	X	X	X	
		Determination of focal spot size		X	X	
		Exposure parameters determination	X	X	X	
		RT-techniques, with constant exposure		X	X	
		Defect's position, triangulation		X	X	
		Enlargement and projection		X	X	
	Single-wall radiography	Specimen configuration	X	X	X	
	Double-wall radiography	Double-wall exposure, single-wall viewing	X	X	X	
		Offset double-wall exposure, single-wall viewing		X	X	
		Elliptical projections		X	X	
		Panoramic radiography		X	X	
		Specimen configuration		X	X	
		Multiple-film techniques	Use of Multiple-film loading		X	X
			Thickness-variation parameters		X	X
			Film speed	X	X	X

TRAINING DOCUMENTS	Doc. Nr.:	INF-012-TD
Title: Syllabus for Radiographic Testing Training Course – Level 1, 2, and Level 3	Revision No.:	00
	Valid from:	20.4.2021

Chapter	Training Content	L1	L2	L3	
	Film latitude		X	X	
	Geometric exposure principles	Shadow formation and distortion	X	X	X
		Shadow enlargement calculation		X	X
		Shadow sharpness		X	X
		Geometric un-sharpness	X	X	X
	Arithmetic of radiographic exposure	Milliamperage-Distance-time relationship	X	X	X
		Reciprocity law	X	X	X
		Photographic density	X	X	X
		Invers-square-law considerations	X	X	X
	Radiographic Image Quality	Radiographic sensitivity	X	X	X
Radiographic contrast		X	X	X	
Film contrast		X	X	X	
Subject contrast		X	X	X	
Film graininess and screen mottle effects		X	X	X	
Penetrometers or image-quality indicators		X	X	X	
Darkroom Facilities, Film Processing	Photographic emulsion chemistry	X	X	X	
	Film filing and storage	Retention-life measurements		X	X
		Long-term storage		X	X
		Filing and separation techniques		X	X
	Unsatisfactory radiographs – causes and cures	High film density	X	X	X
		Insufficient film density	X	X	X
		High contrast	X	X	X
		Low contrast	X	X	X
		Poor definition	X	X	X
		Fog	X	X	X
		Light leaks	X	X	X
	Handing faults, Artifacts	X	X	X	
Film density	Step-wedge comparison film	X	X	X	
	Densitometers	X	X	X	
Evaluation	Radiographic standards		X	X	
	Radiographic Viewing	Film-illuminator requirements		X	X
		Background lighting		X	X
		Multiple-composite viewing			X
	Penetrometer placement	X	X	X	
	Personnel dark adaptation and visual acuity	X	X	X	

TRAINING DOCUMENTS	Doc. Nr.:	INF-012-TD
Title: Syllabus for Radiographic Testing Training Course – Level 1, 2, and Level 3	Revision No.:	00
	Valid from:	20.4.2021

Chapter	Training Content	L1	L2	L3	
	Film identification	X	X	X	
	Location markers	X	X	X	
	Film-density measurement	X	X	X	
	Film artifacts	X	X	X	
	Viewing conditions	X	X	X	
	Illuminator requirements		X	X	
Evaluation of casting images	Casting-method review	X	X	X	
	Casting discontinuities	X	X	X	
	Origin and typical orientation of discontinuities	X	X	X	
	Radiographic appearance	X	X	X	
	Casting codes/standards – applicable acceptance criteria		X	X	
	Reference radiographs		X	X	
	Welding-method review	X	X	X	
	Welding discontinuities	X	X	X	
	Origin and typical orientation of discontinuities	X	X	X	
	Radiographic appearance	X	X	X	
	Welding codes/standards – applicable acceptance criteria		X	X	
	Reference radiographs or pictograms		X	X	
Safety	Radiation Safety Principles	Controlling personnel exposure	X	X	X
		Time, distance, shielding concepts	X	X	X
		Radiation-device operation characteristics	X	X	X
Quality assessment	Standards, codes and Procedures for Radiography	Acceptable radiographic techniques and setups		X	X
		Applicable employer procedures		X	X
		Procedure for radiograph parameter verification		X	X
		Radiographic reports		X	X
	Documentation	Issue of inspection procedures		X	X
	Inspection report		X	X	
Construction concept	Safe Live	X	X	X	
	Fail Safe	X	X	X	
	Damage Tolerance	X	X	X	
	Limits of RT inspections	X	X	X	
	Detectable flaw size	X	X	X	

TRAINING DOCUMENTS	Doc. Nr.:	INF-012-TD
Title: Syllabus for Radiographic Testing Training Course – Level 1, 2, and Level 3	Revision No.:	00
	Valid from:	20.4.2021

Chapter	Training Content		L1	L2	L3
Comparison to other NDT methods	Other NDT Methods		X	X	X
Manufacturing Processes and Associated Discontinuities	Casting processes and associated discontinuities	Ingots, blooms and billets	X	X	X
		Sand casting		X	X
		Centrifugal casting		X	X
		Investment Casting		X	X
	Wrought processes and associated discontinuities	Forging	X	X	X
		Rolled products	X	X	X
		Extruded products	X	X	X
	Welding processes and associated discontinuities	Submerged arc welding	X	X	X
		Shielded metal arc welding	X	X	X
		Gas metal arc welding	X	X	X
		Flux corded arc welding	X	X	X
		Gas tungsten arc welding	X	X	X
Composite materials	Concepts of development		X	X	X
	Composite NDT inspection	Tangential shooting	X	X	X
		NDT technique instructions	X	X	X
		Shooting, use of the IQI and interpretation / evaluation	X	X	X
		Disposition and NDT report		X	X
Indications, Discontinuities and Defects	Indications	Adventitious images	X	X	X
		Causes and effects	X	X	X
	Discontinuities	Inherent	X	X	X
		Processing	X	X	X
		Service	X	X	X
	Defects		X	X	X
	RT -Specific Training				
Airframe	Water ingress honeycomb structures		X	X	X
	Imperfections in composites	Blow holes	X	X	X
		Porosity	X	X	X
		Inclusions	X	X	X
	Crack and corrosion, porosity detection	Fittings and lugs	X	X	X
		Fastener holes	X	X	X
		Riveted structures	X	X	X
		Bolts	X	X	X
		Tubes	X	X	X
		Multilayered structure	X	X	X
		Welded structure	X	X	X
Wrought materials		X	X	X	

TRAINING DOCUMENTS	Doc. Nr.:	INF-012-TD
Title: Syllabus for Radiographic Testing Training Course – Level 1, 2, and Level 3	Revision No.:	00
	Valid from:	20.4.2021

Chapter	Training Content		L1	L2	L3
		Forged materials	X	X	X
Engine	Crack detection in:	Blades	X	X	X
		Stators	X	X	X
		Welded parts	X	X	X
		Wrought materials	X	X	X
		Forged materials	X	X	X
		Cast materials	X	X	X
Composite	Imperfections in composites	Blow holes	X	X	X
		Porosity	X	X	X
		Inclusions	X	X	X
		Layer orientation	X	X	X
		Distribution of glass fibers	X	X	X
Components	Crack detection in:	Tubes	X	X	X
		Welded parts	X	X	X
		Bolts	X	X	X
	Imperfections in components	Blow holes	X	X	X
		Porosity	X	X	X
		Inclusions	X	X	X
		Foreign objects	X	X	X
		Blocked gas passes	X	X	X
		Misalignments of parts	X	X	X