CRITERIA AND TECHNICAL REQUIREMENTS FOR EXTENSION TO QUALIFICATION OF NDT PERSONNEL WORKING ON COMPOSITE MATERIALS AND BONDING

1. General

The requirements laid down in this document are intended to be applicable only to qualification and certification of technical personnel responsible for the conduction of non-destructive tests on composite material structures, including structural bonding.

With regard to Infrared Thermography method and for what is not expressly specified in this document reference shall be made to the requirements of annex 1.

For any information not provided above reference shall be made to the requirement of the ISO 9712 standard.

2. Definitions

2.1 Composite material

A composite material is a material made from two or more constituent materials with significantly different physical or chemical properties that, when combined, produce a material with enhanced characteristics or, in any case, more suitable for the intended use, if compared to those of each single component.

A composite material is made up of:
2.1.1 - A matrix which, holding the fibres in position, transfers the external load to them and protects them against weather, wear and any mechanical actions that may break their structural continuity; polymeric matrices are normally used in the industrial sector: these matrices are made up of thermosetting resins in the form of polyester, phenol, epoxy and polyamide resins.

2.1.1.1 – Thermosetting resins: they consist of a very rigid material made of cross-linked polymers in which the motion of polymer chains is highly limited by the high number of cross-linkings. The main characteristic of thermosetting resins is that they are subject to curing, which consists of obtaining covalent primary links between the various chains of polymers. When cured they undergo an irreversible chemical transformation. This type of resins, under the influence of heat in the initial phase, are melted (become plastic) and then, always under the influence of heat, solidify. Once cured, thermosetting resins cannot be reprocessed and, instead of melting, they degrade, after heat application; this may be a limit to the possibilities of application of these resins.

2.1.1.2 - Thermoplastic resins: these are linear or branched polymers that can be melted by an appropriate quantity of heat. They are not cured or hardened since they consist of long polymer chains linked by weak secondary links, therefore, during the plasticizing phase they do not undergo any chemical modification. They can be forged (and re-forged) into any form using techniques such as injection molding and extrusion. These polymers are melted by heat, breaking secondary links which then, when heat is no more applied, solidify by cooling. The material melting/solidifying process can be repeated without substantially affecting the resin performances.

2.1.2 - Reinforcing material, that is included in the matrix in the form of long, short fibres or particles; the most used reinforcing materials in polymeric-matrix composites are glass, carbon and aramic fibres.

2.1.2.1- Carbon fibers: they are obtained from some organic precursors containing high percentages of carbon, from which through successive production processes from spinning to carbonization to graphitization, fibers with diameters between 5-15µm are obtained. These fibers are wound continuously on bobbins or spools and destined for a weaving process, resin impregnation, or more simply used directly for the production of components on a mold or mandrel. More commonly, these fibers are woven for subsequent cutting and processing by the end user. The mechanical characteristics of carbon fibers are generally excellent for structural applications, both in terms of Module and tensile strength but the greatest advantage is their very low density.

2.1.2.2 - fibers: glass is a ceramic material characterized by an amorphous structure, and the fibers are basically composed of silicon dioxide. These fibers constitute a valid reinforcing material for composites both in terms of mechanical performance and from an economic point of view. There are various types of glass used on the basis of specific uses, for example E glass (Electric) with a density of 2.6 kg/dm3, S glass developed for aerospace applications which guarantees excellent mechanical behavior even at high temperatures. In general it is less performing when compared to carbon but has the advantage of having good resistance to impact and heat; another important advantage is the relatively low cost. Like carbon fibers also glass is wound on bobbins or spools to be used in the weaving process.

2.2 Bonding

Permanent adhesion of one or more structures / components made of similar or different materials (e.g.: composite with metal or composite with composite).

3. Limitations of use of the certificates

Within the "composite materials" product sector, only the "frp" sector (reinforced plastics, such as reinforced polymers) is deemed to be applicable.

The applicable industrial sectors are "m" (manufacturing) and "s" (pre-and in-service testing which includes manufacturing).

The applicable methods and techniques are listed below:

NDT method	Method abbreviation and related technique
Visual testing + TAP TEST	VT + TAP
Ultrasonic testing *	UT
Thermal/Infrared testing	TT
Acoustic emission testing	AT
Microwave testing	MW
Radiographic testing	RT-CT

* The Ultrasonic testing method includes the UT-PA; UT-AUT; UT-TH techniques applied to the composite materials product sector.

4. Training for the Composite Materials product sector

4.1 A specific course shall be envisaged for the certification of NDT operators working on composite materials; this course is dedicated to composite materials, in relation to the method for which certification is sought, and shall have a duration not lower than the number of hours shown in the next Table.

4.2 The course mentioned in previous paragraph [4.1] is made up of a general part, which includes the VT and TP methods, common to all methods, and a specific part relating to the method for which certification is sought.

4.3 Irrespective of the qualification level required, to access the specific examination relating to the Composite Materials product sector, the operators must already be certified in accordance with the UNI EN ISO 9712 standard for the same level and for the same method for which certification is requested for at least one product sector; i.e. they must have attended a basic course, concerning the same qualification level and the same method for which certification is requested, with a duration not lower than the number of hours specified by the ISO 9712 standard.

Minimum additional training for NDT methods relating to composite material structures for levels 2

NDT method	Abbreviation	Duration of the course Basic part (hours)	Duration of the course Specific part (hours)
Visual testing and Tap Test (basic course)	VT +TP	32*	---
Ultrasonic testing	UT	---	32
Acoustic emissions	AT	---	32
Radiographic testing	RT-CT	---	40
Thermography	TT	---	24
Microwaves	MW	---	40

*mandatory preparatory course required to access all other methods

5. Industrial experience required in the Composite Materials product sector

The minimum specific industrial experience in the composite material product sector is detailed in the table below and expressed in months.

Methods	Level 1 – 2	Level 3
VT +TP	6	18
UT	6	18
AT	6	18
RT	6	18
TT	6	18
MW	6	18

6. Visual acuity

The requirements of the ISO 9712 standard apply.

7. Certification examinations of Levels 1, 2 and 3 in the Composite Materials product sector

The examination relating to each method consists of a specific test, the drafting of an operating instruction (for levels 2) or of a procedure (for levels 3) and a practical test as specified below:

NDT method	Specific examination: Number of questions relating to Composite Materials	Operating instruction (for levels 2) / Procedure (for levels 3)	Practical tests on samples only for levels 2
Visual + Tap test - (VT + TAP) – Basic	30	1	2
Ultrasonic – (UT)	20	1	2
Acoustic emissions - (ET)	20	1	2
Radiography - (RT)	20	1	2
Thermography - (TT)	20	1	2
Microwaves – (MW)	20	1	2

To request certification in the UT, ET, RT, TT and MW methods it is necessary to first obtain certification in the VT+TAP method.

Certification extension to the Composite Materials product sector with direct access is granted only to level 2 satisfying the training and experience requirements envisaged for levels 1 and 2.

Candidates who request a level 3 certificate extended to the Composite Materials product sector must already hold a level 3 certificate in compliance with ISO 9712 for at least one method and they shall have held a level 2 certificate for the Composite Materials product sector for at least 18 months in the method for which they request certification.