

Implementation of Thermographers' Certification in Brazil

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ABSTRACT

In recent years Brazil has experienced extraordinary growth despite the recent economic global crisis. The demand for infrared thermography products and services has accompanied this growth. Like other non-destructive testing and inspection, the results obtained by thermography are highly dependent on the skills of thermographer. Therefore, it is very important to establish a serious and recognized process of certification to assess thermographers' qualifications and help services suppliers to establish credibility with their customers and increase the confidence of these costumers on the quality of these services.

The Brazilian Society of Non-Destructive Testing and Inspection, ABENDI, a non-profitable, private technical-scientific entity, recognized nationally and internationally, has observed the necessity of starting a process for certification of thermographers in Brazil. With support of a work group composed by experts from oil and energy industries, transportation, universities and manufactures, the activities started in 2005.

This paper describes the economic background required for installation of the certification process, its initial steps, the main characteristics of the Brazilian certification and the expectation for initiating the certification process.

Keywords: Thermography, personnel certification, Brazilian certification, non-destructive testing

1. INTRODUCTION

Certification has been defined by some standards and guides as a "procedure used by the certification body to confirm that the qualification requirements for a method, level and sector have been fulfilled, leading to the issuing of a certificate"¹ or as "written testimony of qualification"². The word "qualification" is usually associated to physical attributes, knowledge, skill, training and experience required to a person properly performs specific tasks¹.

The results achieved by non-destructive testing and inspection are highly dependent on the qualification of person who performs the tests or inspection and, the thermography is not an exception. Therefore, in a competitive world where quality of products and reliable service is increasingly demanded, it becomes necessary to establish a reliable and recognized process of certification to assess and attest the qualification of thermographers.

Everyone wins with a reliable process of certification. Manufactures can validate the quality of their products through tests performed by a person demonstrably qualified. Services suppliers can establish credibility with their customers and, customers can have more confidence in choosing products and services.

In recent years Brazil has experienced an extraordinary growth. The demand for infrared thermography products and services has accompanied this growth. As a result, a general concern about standardization in that area has increased to meet the demands of both domestic and external markets.

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2. ECONOMIC SCENARIO THAT REQUIRED THE CERTIFICATION

Brazil is one of the BRIC countries (Brazil, Russia, India, and China) and as such has attracted attention from the world due its weight on world economy³. Since 2003, Brazil has steadily improved its macroeconomic stability and it had an extraordinary growth in 2007 and 2008. During the recent global financial crisis, Brazil experienced an economic decline, but it was one of the first emerging markets to begin a recovery and returned to growth in the second quarter of 2009⁴. It finished 2010 with a GDP of around 7.5%.

Energy is vital to support and help to boost that economic scenario and, in the last 10 years, Brazil increased its power generation capacity in 50.1%. Currently, it can produce over 112,000 MW of electric power and an addition of 47,000 MW is planned for the coming years. This additional power is coming from 139 power plants under construction and another 475 granted⁵. Until 2007, Brazil was a medium-sized oil producer when it was revealed a series of huge “pre-salt” resources off its coast. Those resources have raised it into one of the world's leading energy⁶.

Good news like its have contributed to Brazil to improve its status around the world. Its choice to host the soccer World Cup in 2014 and Olympic Games in 2016 are examples about that.

To build, maintain and improve that growth, qualified people are needed in all sectors of the industry and in Non Destructive Testing (NDT) they are essential. In 1991, Brazil began its personnel certifications in NDT. Today, certifications in seven methods are working: Visual Testing, Liquid Penetrant, Magnetic Particle, Ultrasonic, Radiographic Testing (X-rays and gamma rays), Acoustic Emission and Eddy Currents.

2.1. Who is the major certifier of NDT personnel in Brazil?

The Brazilian Society of Non-Destructive Testing and Inspection (ABENDI) is the Personnel Certification Body under ISO Standard 17024 accredited by the National Institute of Metrology, Standardization and Industrial Quality (INMETRO) to qualify and certify personnel in NDT.

INMETRO is a Brazilian institute signatory body of International Accreditation Forum (IAF). The purpose of IAF is to develop a single worldwide program of conformity and to establish develop a unique worldwide program of conformity and to establish mutual recognition arrangements, known as Multilateral Recognition Arrangements (MRA)¹⁴. Figure 1 shows that process of NDT personnel certification in Brazil.

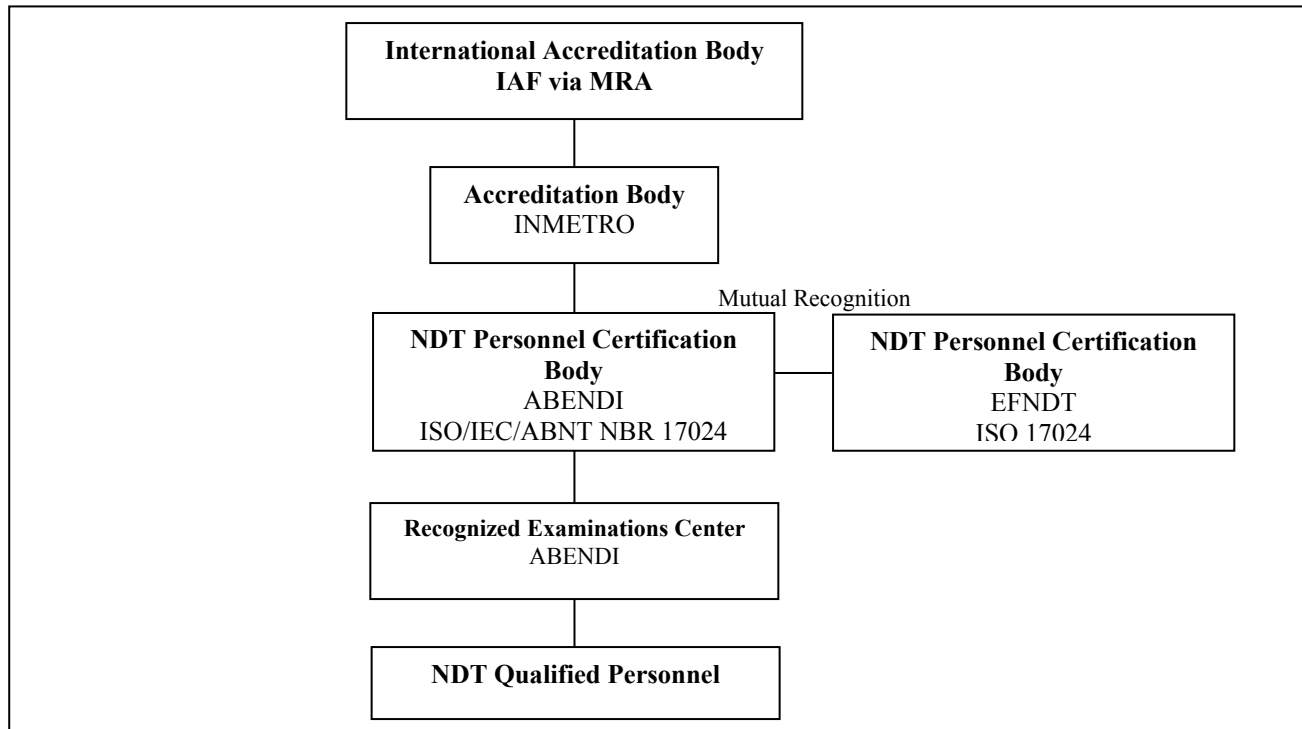


Figure 1 – NDT personnel certification process.

ABENDI is a non-profitable, private technical-scientific entity, with headquarters in the city of São Paulo, established in March, 1979, with the purpose of disclosing NDT and Inspection methods, through actions oriented towards technology improvement and, consequently, the personnel and companies involved in this area.

It is recognized by the Ministry of Science and Technology (MCT) as sectorial Technologic Entity (ETS) for technical management in NDT area and certified by the Brazilian Association of Technical Standards (ABNT) as the Sectorial Standardization Agency (ONS-58) to prepare the NDT standards.

ABENDI is recognized by the European Federation for NDT (EFNDT), through a Mutual Recognition Agreement (MRA), by which Brazilian certified personnel have their qualification acknowledged by European countries signatories of this document.

ABENDI is a member of the NDT International Committee and of the NDT Pan-American Committee and is a P-Member of ISO/TC-135/SC-09⁸.

3. THE INITIAL STEPS

Although thermography is being used in Brazil since the beginning of the 70s⁷, efforts for its standardization only began in 2004 as a result of increased demand for its products and services. ABENDI perceived the need of the Brazilian market for the standardization and started to articulate the first steps.

In 2005, ABENDI invited different sectors of society to create a commission responsible for development of standards concerning to thermography. Universities, manufacturers, service suppliers and companies from energy sector and transportation heeded to the call.

On June 30, in the same year, a meeting was held to establish the commission of thermography, the CE-58:000.11. Since then, and under the guidance of ABENDI, experts from all involved entities have been meeting to develop the standards pertaining to thermography.

All companies that have taken part in the commission are equally important in the development of standards, but it is worth mentioning the involvement of some of the largest companies in Brazil, which demonstrates the importance delegated to standardization of thermography. They are:

- **Petrobras** - The biggest company in Brazil and the 3rd biggest energy company in the world, a publicly traded corporation controlled by the Government of Brazil. It performs as an energy company in the following sectors: exploration and production, refining, oil and natural gas trade and transportation, petrochemicals, and derivatives, electric energy, biofuel and other renewable energy source distribution. It closed 2010 with an annual production level higher than 2 million barrels a day⁶.
- **Eletrobras** – Represented on the commission by its subsidiaries **Eletrobras Furnas** and **Eletrobras Chesf**, and **Itaipu**. It is the biggest company of the electric power sector in Latin America. It is the leader of a system consisting of six subsidiary companies, six distribution companies, the Electric Power Research Center (Eletrobras Cepel) and Eletrobras Participações S.A. (Eletrobras Eletropar) and is also holder of 50% of the capital stock of Itaipu Binacional. The generating capacity of Eletrobras, in addition to 50% of the power of Itaipu belonging to Brazil, reached 39,453 MW, corresponding to 37% of the total power nationwide. The transmission lines have approximately 60,000 kilometers of extension⁹. Its subsidiary **Eletrobras Furnas** was a pioneer in using of thermography in Brazil and has used it since the early 70s⁷.
- **Vale** is the second largest metals and mining company in the world, one of the 30 largest publicly traded companies in the world and the largest private sector company in Latin America. It is the world leader in iron ore and pellet production and the second biggest nickel producer¹⁵.
- **Alcoa** is the world's leading producer of primary and fabricated aluminum, as well as the world's largest miner of bauxite and refiner of alumina¹⁶.

From 2005 to 2010, the commission CE-58:000.11 prepared and Brazilian Association of Technical Standards (ABNT) has published five standards concerning thermography¹⁰:

- NBR 15424 - Terminology - This standard defines the terms used in the method of thermography;
- NBR 15572 - Guide for inspection of electrical and mechanical equipment with thermography - This standard is a guide to inspection of electrical and mechanical equipment. It also lists the responsibilities of the end-user and the thermographer when examining electrical and mechanical systems;
- NBR 15718 - Guideline to check infrared cameras - This standard provides guidelines to ensure the reliability of measurements of infrared cameras during the interval of validity of the calibration set by the user;
- NBR 15763 - Criteria for inspection periodicity definition in electrical power systems - This standard describes the criteria for defining the intervals for thermographic inspection of electrical power systems;
- NBR 15866 - Methodology of working temperature evaluation for equipment in electric systems - This standard is intended to guide the methodology for thermal evaluation, qualitative and / or quantitatively, to be carried out by the personnel responsible for conducting thermographic analysis, according to different contexts and situations in which the various electrical equipments are subjected.

In October 2005, a work group was established to start the thermography personnel certification process. Members of the work group and the commission were basically the same.

The first question of the working group was concerning on what standard Brazil should adopt as basis. Two standards and one recommended practice were presented and discussed by the working group:

- ISO 9712 – Non destructive testing - Qualification and certification of personnel was prepared by Technical Committee ISO/TC 135, Subcommittee SC 7 and published by International Organization for Standardization (ISO)^{1, 11};
- Recommended Practice No. SNT-TC-1A - Personnel Qualification and Certification in Nondestructive Testing published by The American Society for Nondestructive Testing (ASNT) and under the direction of the SNT-TC-1A Review Committee². ANSI/ASNT CP-105* is packaged with SNT-TC-1A and provides training outlines for qualification of nondestructive personnel.
- ISO 18436 - Condition monitoring and diagnostics of machines - Requirements for qualification and assessment of personnel - Part 7*: Thermography was prepared by Technical Committee ISO/TC 108, Subcommittee SC 5 and published by International Organization for Standardization (ISO)^{11, 17}.

ISO 18436-7 was chosen to be used as the basis. The main reasons for this choice were:

- Global market trend;
- Central certification by third-party. “A centrally issued examination gives uniformity to qualification. Third-party certificates are personal proof of qualification and transferable worldwide. The independence and impartiality of the certification body gives value, respect, integrity and confidence in the certificate holder”¹².
- ISO 18436 specifies the requirements for qualification and assessment of personnel who perform machinery condition monitoring and diagnosis using infrared thermography¹¹. Therefore, it is more closely related to predictive maintenance, a major application of thermography in Brazil.

Although ISO 18436-7 have been adopted as basis, some training content from ANSI/ASNT CP-105 were considered to be very interesting and added to the Brazilian standard. Also, adjustments were made on 18436-7 to meet Brazilian needs, by becoming more restrictive. The result was the standard *ABENDI NA-009 Qualification and Certification of Personnel in Thermography*.

*At the beginning of the tasks, ISO 18436-7 was still a draft international standard under the name ISO DIS 18436-8 and the “Recommended Training Course Outlines” was included in the 2001 edition of SNT-TC-1A not in separated ANSI/ASNT CP-105.

From 2009 to early 2010, ABENDI certified thirteen thermographers as Level III based on their documented evidence (education, training and experience). This group has been charged for developing the theoretical and practical examinations to complement the certification process. The expectation of the ABENDI is to start the thermography certification by the end of 2011.

4. MAIN CHARACTERISTICS OF THE BRAZILIAN CERTIFICATION

An overview of the main characteristics of the Brazilian personnel certification in thermography will be presented in the following items.

4.1. Levels of Qualification

There are three levels of qualification as shown below:

- Level 1 - Qualified to perform infrared thermography measurements according to established and recognized procedures.
- Level 2 - Qualified to perform and/or direct infrared thermography analysis according to established and recognized procedures.
- Level 3 - Qualified to perform and/or direct all types of infrared thermography measurements and analysis.

Personnel Level 2 require all the knowledge and skills expected of personnel Level 1, and personnel classified as Level 3 require all the knowledge and skills expected of personnel Level 2.

4.2. Eligibility

Candidates shall have physical aptitude, education, training and experience to ensure that they understand the principles and the applicable procedures to thermographic measurement and analysis.

- Physical aptitude
 - Near-Vision acuity - natural or corrected near-distance acuity in at least one eye (ability to read the letters Jaeger J-1 for a distance not less than 30 cm (11.8 inches).
 - Color differentiation (Ishihara test color) for initial certification. When a deficiency color perception is detected, the recognized Examination Center (CEQ) should provide the candidate with examinations does not required analysis of color images or replace the color images with images in shades of gray. Candidates with this deficiency should be guided by CEQ to use monochrome palette in future thermographic inspections.
- Training – The minimum training hours is provided on Table 1.

Table 1. Minimum training hours

Level 1	Level 2	Level 3
40 h	80 h	120 h

Training course requirements are presented on Table 2.

Table 2. Training course requirements

Subject	Level		
	1	2	3
Introduction	0,5	0,5	0,5
Concepts of physics - Theory applied to termography	15	9,5	9,5
Operation of the thermal imager, data Acquisition, documentation and registration	11	4	2
Applications of Thermography and Interpretation of results	3	4	4
Diagnostics	1	4	2
Condition Monitoring applications	1	2	2
Condition monitoring programme design	0,5	2	4
Condition monitoring programme implementation	0,5	4	5
Condition monitoring programme management	0,5	4	6
Condition monitoring practice	3	2	1
Examination	2	2	2
Practice Examination	2	2	2
Total Hours	40	40	40

- Education – The minimum requirement of education is a technical school diploma.
- Experience, i.e., work activities accomplished in thermography – Table 3 shows the months required to each level. Experience for Level 3 changes according to the education.

Table 3. Experience and minimum education requirements

Level	Minimum education requirements	Experience
1	Technical School	6 months
2	Technical School	12 months
3	Technical School	60 months
	College degree	36 months

4.3. Examinations

All examinations shall be conducted only at recognized Examinations Centers (CEQ).

For all levels of qualification, candidates shall take a theoretical and a practical examination.

- Theoretical examination - Shall be composed of 60 questions and the candidate shall complete it within 2 (two) hours. The content of theoretical training is presented in Table 2.
- Practical examination - Consists of a representative test of a specific application where the candidate shall be able to interpret boundary conditions and the results obtained by thermography.

To be certified, the candidate shall have a passing grade of at least 75 percent in both, the theoretical and practical examination.

4.4. Certification

The certification body issues a certificate after the candidate satisfies all requirements for a certification at a given Level. The validity period shall not exceed five years from the date of issue certificate. After this period, certification may be renewed by another new 5-year period.

5. CONCLUSIONS

In the last decade Brazil had a solid and steady growth which was disturbed only by a few months due to recent global crisis. The need for qualified personnel has also increased due to the demands of internal and external markets.

In order to a qualification to be considered reliable and uniform, it is necessary a recognized certification process based on internationally approved standards. Brazil has created a culture of certifications and currently is able to provide certification for seven non-destructive testing methods, all of them based on ISO Standard.

With increasing demand for infrared thermography products and services, The Brazilian Society of Non-Destructive Testing and Inspection (ABENDI) observed the need to create a certification to thermography. In 2005, it established a commission to initiate the certification process. The standard chosen to server as a basis was ISO 18436-7 which seems to be a worldwide trend and has features well-suited to the Brazilian market. Although ISO 18436-7 have been chosen as basis, some training content from ANSI/ASNT CP-105 were added to the Brazilian standard. Also, adjustments were made on ISO 18436-7 to meet Brazilian needs, by becoming more restrictive.

The main differences between ISO 18436-7 standard and ABENDI NA-009 Brazilian standard are the minimum education requirement, which is technical school diploma; training hours are 40 hours for each level; and a practical exam is required.

Brazil today has thirteen Level III thermographers certified by documented evidence, and looks forward to the end of 2011 to start the regular process of certification.

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