proceedings

Abstract

Advancing Active Thermography for NDT: The Role of Standardization †

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Abstract

Infrared thermography, particularly its active form, is increasingly used in various industries in non-destructive testing (NDT). To support its broader adoption, structured standardization efforts have been developed within CEN/TC 138/WG11 and coordinated with ISO. Key standards—such as EN 16714, EN 17119, and EN 17501—define principles, procedures, and equipment requirements. Current activities include finalizing the draft on induction thermography, revising EN 17119, and developing new projects on optical lock-in, laser weld inspection, and thermal diffusivity. Standardization enhances comparability, reliability, and certification, making thermography a robust and scalable solution within the global NDT framework.

Keywords: Active thermography; non-destructive testing (NDT); standardization; CEN/TC 138/WG11; infrared inspection; industrial qualification.

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Infrared thermography—particularly in its active configuration—has emerged as a valuable tool in non-destructive testing (NDT), finding applications across sectors such as aerospace, automotive, energy and advanced manufacturing. Its ability to provide full-field, non-contact evaluation of surface and subsurface defects, often within short inspection times, makes it especially attractive in industrial contexts where efficiency and accuracy are essential.

Nevertheless, despite these strengths, the broader uptake of thermography in the industry has long been slowed by a fundamental issue: the absence of consistent and widely recognized standards.

As is often the case with evolving technologies, early implementations of thermography were developed independently, shaped by specific technical needs, equipment availability and in-house expertise. This autonomy encouraged experimentation but at the cost of interoperability and methodological coherence. Without shared procedures and reference frameworks, comparing results, validating processes, or certifying personnel and systems becomes difficult.

Recognizing these limitations, a structured approach to standardization has been steadily developed over the past decade. In the European context, this work is coordinated by CEN/TC 138/WG11, the working group dedicated to thermographic testing within the broader Technical Committee on Non-Destructive Testing. Since its formation, WG11 has brought together professionals from industry, research institutions, academia, and equipment manufacturers. Their shared objective is to establish clear, applicable, and technically robust standards that facilitate the adoption of thermography as a recognized and certifiable NDT method. This initiative aligns with the efforts of ISO/TC 135/SC8 and also benefits from contributions by IEC and ASTM ensuring international coherence.

Among the key outcomes of WG11's work is the EN 16714 series, which lays the foundation by defining core principles, equipment requirements, and a standardized vocabulary for thermographic testing. These initial documents provide common ground essential for further technical development.

The publication of EN 17119 in 2018 marked an important step forward. This standard is devoted to active thermography, describing how external energy sources—such as optical, inductive, or mechanical stimulation—can be applied to reveal internal anomalies. It offers guidance on setting up inspections in reflection and transmission modes and discusses data acquisition strategies, including static and dynamic approaches. The standard also addresses the post-processing phase, presenting recommended techniques for analyzing thermal signals in both time and frequency domains. A revision of this standard is currently being launched by WG11, with the aim of updating its content based on recent technological developments, field experience and the evolution of industrial practices.

The most recent addition, EN 17501, addresses laser excitation in active thermography. Lasers offer a highly controllable, localized, and repeatable energy source, which is especially advantageous for small-scale or intricate inspections and for materials where conventional heating methods are less effective. The standard includes information on system configuration, safety considerations, and performance parameters, making it particularly relevant for aerospace and additive manufacturing applications, where precision and consistency are paramount.

WG11 is also developing new standards to expand the method's applicability alongside these published documents. Among the current activities within WG11, the draft standard on induction thermography is in its final stages of development. At the same time, work continues a parallel document dedicated to optically pulsed excitation, a widely used technique that still lacks formal procedural references. In addition, the group has launched the revision of EN 17119:2018 – Active Thermography to update the standard to reflect recent technological improvements, field experience and expanded application scenarios. A graphical timeline of the main milestones in thermographic standardization is provided in **Figure 1** to illustrate this progression.

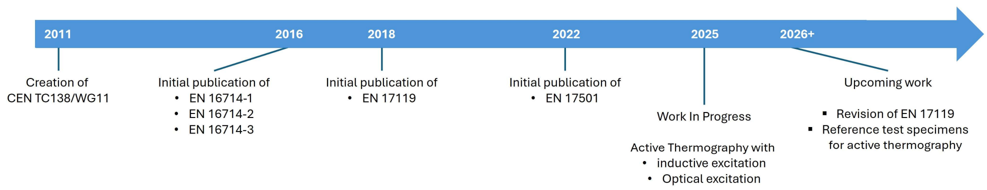

Figure 1. Timeline of key standards in thermographic testing developed by CEN/TC 138/WG11, including their publication, revision, and ongoing **projects**.

Other ongoing discussions address the need for standard reference blocks, the definition of quantitative analysis procedures, and the establishment of qualification frameworks for operators and methods—all essential elements for fully integrating thermography into mainstream NDT certification schemes.

These efforts are not just about regulatory compliance—they reflect a broader shift from experimental use toward industrial maturity. Thermographic inspection involves a range of interdependent factors: the energy input, the material's thermal properties, the geometry of the part, and the characteristics of the infrared detector. All of these contribute to the thermal signal and its interpretation. Standardization helps bring order to this complexity, making it easier to validate inspections, compare results from different systems, and build confidence in the method.

The practical impact of these standards is already visible. In aerospace, thermography supports the inspection of composite structures, bonded joints, and thermal protection systems. In automotive production, it is used to evaluate weld quality, adhesive integrity, and the condition of lightweight materials. In fossil and renewable power generation, thermography contributes to predictive maintenance strategies by detecting early signs of damage in turbines, piping, and electrical infrastructure. Additive manufacturing, in particular, is emerging as a fertile ground for thermographic NDT, with applications in process monitoring, defect detection, and post-build validation.

Still, some challenges remain open. One is the quantitative use of thermography, which involves extracting physical properties—such as thermal diffusivity or layer thickness—rather than simply identifying defects. Although several studies have shown this is possible, the absence of standardized procedures makes it difficult to implement in routine inspection workflows.

Another key area is metrological traceability. While relative measurements based on thermal contrast are often sufficient, specific applications require absolute temperature readings. This brings calibration and uncertainty evaluation into play, calling for dedicated standards that define how to characterize and qualify thermographic equipment consistently and traceably.

Thermography is also moving into automated and digital inspection scenarios. The method is increasingly part of integrated systems, from robotic platforms to drone-based monitoring. This raises new requirements for standardization regarding data structure, real-time analysis, interoperability with other inspection systems, and compatibility with AI-assisted evaluation. In these contexts, having a well-defined and reliable standard is essential for quality assurance and enabling innovation.

This trajectory reveals that thermographic standardization is not a fixed endpoint but a continuous process—an evolving framework shaped by technical progress, industrial needs, and collective insight. The strength of this process lies in its collaborative nature. Standards are not simply written but built through dialogue, testing, review, and shared experience.

To ensure that the next generation of standards reflects the realities of industrial practice and the possibilities of research, the involvement of a broad and active community is essential. New contributors are encouraged to participate—whether from companies using thermography, institutions developing new methodologies, or laboratories validating systems. Participation in standardization efforts offers the chance to influence technical developments, connect with a network of experts, and remain at the forefront of the field.

In conclusion, standardization is not a constraint to thermography's potential—it is the framework that allows it to grow. Thermographic testing can become a trusted and scalable part of the NDT toolkit through well-defined procedures and validated approaches. The ongoing work of CEN/TC 138/WG11 and other international initiatives are laying the foundation for this evolution. The next phase depends on collaboration, contribution, and shared commitment to quality and progress.

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