Back to basics: why fundamentals matter for blade inspection

Rapid turbine growth, increasingly complex composite structures and a global shortage of skilled inspectors are reshaping wind blade inspection. For CICNDT founder Jeremy Heinks, the answer is a return to disciplined nondestructive testing fundamentals.

A shortage of qualified inspectors, blades stretching beyond 100 meters and an industry tempted by technological novelty: these are the pressures reshaping nondestructive testing (NDT) in wind energy today. But for companies operating at the cutting edge of composite inspection, the most urgent message is a surprisingly timeless one: get the fundamentals right.

For Jeremy Heinks, founder and CEO of CICNDT, a specialist NDT firm operating out of Ogden, Utah, with clients across North America and beyond, that message has never been more relevant.

With roots in wind blade inspection dating back to 2007 and a team that collectively carries well over 100 years of combined field experience, Heinks has watched the industry evolve through multiple turbine generations. What he sees today concerns him as much as it excites him.

'NDT is not a magic wand,' Heinks says. 'When used properly, it is a very useful tool that could save millions, and even lives, as it does in other industries.'

The inspector shortage: the industry's quiet crisis

Ask any experienced NDT professional what keeps them awake at night, and workforce scarcity is near the top of the list. The wind industry is no exception. Properly trained and certified NDT technicians are already in short supply across all sectors, but those with specific knowledge of wind blade materials and structural behavior are rarer still.

'Properly trained and certified NDT technicians are in short supply,' Heinks claims, 'and those with wind blade or composites knowledge are even harder to find. This often leads to substandard practices and corners being cut.'

This is not merely a resourcing challenge; it is a structural risk. Composite wind blades are complex, multilayer structures that demand inspectors who understand the behavior of glass fiber and carbon fiber laminates, foam cores, bondlines and structural adhesives under fatigue and environmental loading.

An inspector trained primarily on steel or weld inspection will not instinctively recognize the difference between a manufacturing void and a delamination caused during service or understand why an anomaly at the root station may carry dramatically different risk implications than one near the trailing edge.

CICNDT's response to this challenge has been to invest in expertise across industries. The company brings inspection knowledge developed in aerospace, defense, automotive, and marine applications to bear on wind energy problems; a transfer of capability that pays dividends when novel defect types or unusual structural geometries demand adaptive thinking in the field.

'Our biggest advantage is the amount of experience we have, not only in blades, but in composites in general,' Heinks explains. 'We bring a wealth of knowledge from aviation, space, automotive, and marine industries.'


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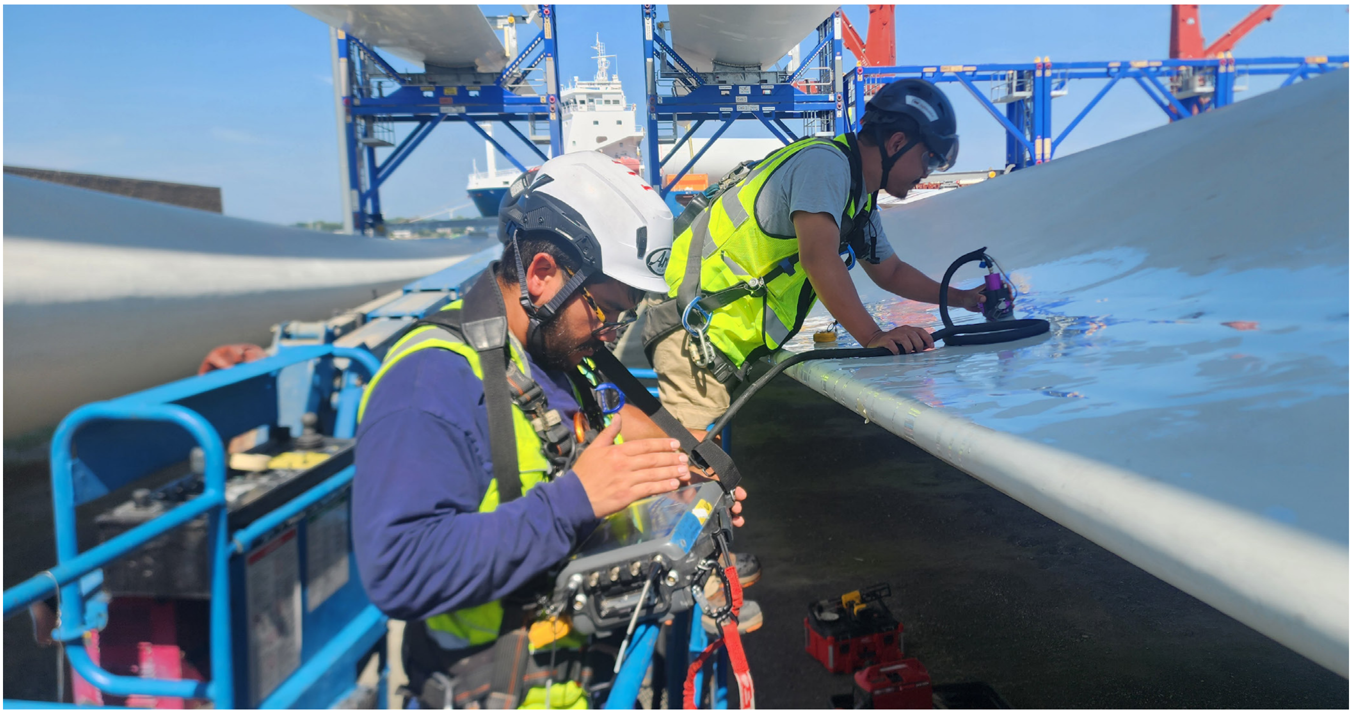


The full scope of blade defects

Modern wind blades are inspected across their entire lifespan, from preinstallation verification through scheduled in-service campaigns and post-event assessments following lightning strikes or extreme weather. The range of defects that NDT must address reflects the complexity of blade construction.

In CICNDT's operational experience, common findings include root cracks and loose inserts, bondline anomalies encompassing voids, thickness deviations, poor placement and insufficient width, delaminations within the laminate stack, core damage, leading and trailing edge cracks, erosion, lightning strike damage, missing or incomplete laminate plies, and repair verification. Each category demands careful technique selection and calibration.

The blade root region receives particular attention. It is one of the highest stress locations on any turbine, the zone where all aerodynamic and gravitational loading funnels into the hub connection. Root cracks and insert failures at this location can propagate rapidly, making timely detection critical.

'Blade root inspection is one of our specialties,' Heinks notes. 'Preinstallation inspections might be the most important thing an end user can do today.'

This point is worth dwelling on. Blades are now arriving from manufacturers with increasingly complex supply chains and quality assurance processes are not always consistent across production sites. An independent preinstallation inspection provides a baseline record of the blade's condition before it ever turns in service, creating defensible documentation that can be invaluable when warranty disputes arise or anomalies are detected later in the asset's life.

The right tool for the right problem

A recurring theme in conversations with experienced blade inspectors is that technology selection must follow the inspection objective, not the other way around. CICNDT deploys a broad methodology portfolio, and understanding when each technique adds genuine value is central to the company's approach.

Heinks is candid that conventional encoded ultrasound remains the workhorse of field blade inspection. 'Standard encoded ultrasound is still the mainstay of wind blade inspection and is very effective when used properly,' he says, a reminder that advances in technology do not always displace what works.

Linear array ultrasonic testing is deployed when greater imaging detail is required, offering electronic beam focusing that allows rapid, high-resolution cross-sectional mapping of laminate and bondline features.

Laser shearography provides rapid full-field coverage of large surface areas and is particularly effective for detecting structurally significant anomalies such as disbonds, delaminations and laminate wrinkles in areas up to approximately 30 mm in thickness, characteristics well suited to the skins of modern blades.

Thermography, including advanced photothermal approaches, adds sensitivity for bondline integrity, core defect detection, and near-surface laminate assessment.

For detailed characterization of specific findings, computed tomography (CT) provides volumetric imaging that no surface-applied technique can match, though its role in wind is primarily confirmatory rather than screening oriented. Bond testing fills gaps where defect access is through core materials. Visual inspection, increasingly aided by drone platforms, rounds out the capability set for external surface assessment.

CICNDT has recently deployed the Windbotix NEMO internal inspection robot, a system capable of navigating the full internal length of a blade to provide visual inspection data that would otherwise require significant manual access effort. An external crawler system, the HausBots platform, is also in development for surface inspection applications.

The length problem

If the workforce shortage is the industry's quiet crisis, the growth in blade dimensions is its loudest engineering challenge. Offshore blade lengths now regularly exceed 80 meters, with designs beyond 100 meters set up to become the new normal. The inspection implications are significant.

'Blade length has become the biggest issue, creating many problems for NDT,' Heinks says. Access becomes increasingly difficult as blades grow longer. The logistics of deploying adequate scanning coverage across such structures, particularly at height and in variable weather, strain conventional inspection approaches. External access for ultrasonic scanning of root and spar structures demands rope access or robotic systems that can operate reliably at the necessary distances from the hub.

It is in this context that automation becomes genuinely compelling rather than merely fashionable. Heinks is cautiously optimistic, 'I think we will finally get automation and robotics to a point where it works in this industry.' The emphasis is telling; the wind industry has seen numerous robotic inspection concepts that have not delivered consistent field performance. The expectation is that this is changing, but measured expectations are warranted.

Complacency: the underestimated risk

Among the common failure modes Heinks has observed in wind blade inspection programs, one stands out as both preventable and persistent: system complacency.

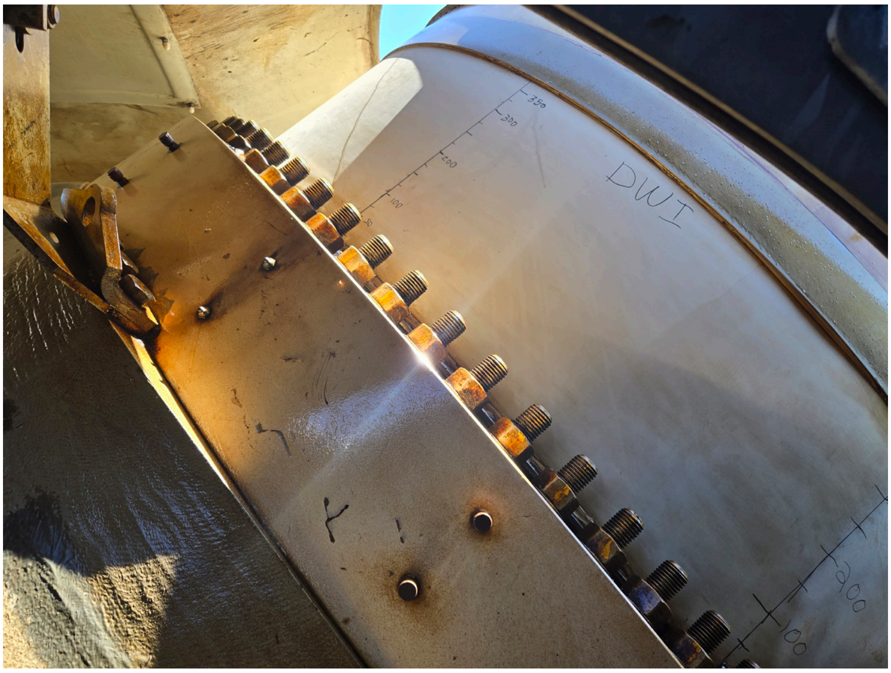
'Forgetting the basics and letting system complacency seep in' is how he characterizes the most frequent professional error. It is a problem familiar to any industry where repetitive inspection work creates the illusion of routine. A technician who has scanned hundreds of blades without finding a critical anomaly may unconsciously lower their vigilance, a cognitive drift that can have serious consequences when, statistically, the anomaly is eventually there.

This is precisely where professional certification, rigorous procedural discipline, and periodic independent auditing of inspection data provide systemic protection. NAS 410 certification, the North American aerospace NDT standard that CICNDT's team holds at Level III, establishes formal competency frameworks that are directly applicable to composite wind blade inspection, even though the standard was developed primarily for the aerospace sector.

The cross-applicability is not accidental: both domains involve safety-critical composite structures where missed indications carry serious consequences.

Deployed under pressure

One of the characteristics that distinguishes genuinely experienced NDT teams from those with narrower operational backgrounds is the capacity to develop effective inspection solutions rapidly under field conditions. CICNDT has been called to sites with minimal advance information on numerous occasions, situations that demand both technical breadth and adaptive problem-solving.



'Multiple times CICNDT has been called on extremely short notice, often without knowing much about the problem,' Heinks recounts. 'But with our experienced technicians and Level 3s, we can deploy to the project site and develop an effective application solution on the fly, giving the customer information to work with and setting us up to come up with a more long-term solution.'

He is clear about the limitations of this approach. 'This isn't the optimal way to set up an inspection, but it's often what we have to start with until more information is available.' That candor is itself instructive. A team that overpromises what can be definitively determined from a reactive deployment is doing the client a disservice. Providing actionable data while being transparent about the scope of the assessment is the professional standard.

Jeremy Heinks

What the industry needs now

The wind energy sector is adding capacity at a pace that the supporting inspection infrastructure is struggling to match. Wind farm owners and operators, particularly those installing new turbines, face a genuine challenge in securing qualified inspection services at the point of commissioning and throughout the asset lifecycle.

CICNDT's position, drawing on over 15 years in the wind sector and a broader composites inspection pedigree that spans aerospace and defense programs for some of the largest manufacturers in North America, is that the answer lies not in chasing the newest technology, but in applying the right combination of proven methods with the depth of knowledge to deploy them correctly.

The additions, such as robotics, advanced photothermal imaging, phased array capabilities, and internal inspection systems, matter and CICNDT is investing in them. But they augment, rather than replace, the discipline of a properly certified team working from sound procedural foundations.

In Heinks' framing, the goal is simple to articulate and demanding to execute: get back to basics, do the proven methods right, and build from there.

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