

Remote Controlled Aircraft Inspection Device for Line- and Base Maintenance Applications

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Overall Problem – Aircraft Maintenance Business

- Record number of **Maintenance Engineers retirements** in 2020 – early Retirement
- Two Years of Pandemic **has discouraged** people to **enter Aviation Business**
- Over the next 20 Years – **626'000 Maintenance Engineers are needed**¹:
 - 31'300 New Maintenance Engineers per Year
 - 2-5% NDT personnel (Airline, MRO)
 - Approximately 2'000 New NDT Inspectors per Year

¹ Forecast Boeing 2022



Overall Problem – Aircraft Maintenance Business

- **Education and Awareness**

- Early Introduction
- Practical Inside

- **Career Paths and Development**

- Show Career Opportunities
- Illustrate long-term career prospective
- Provide example of successful professionals

- **Innovative Technologies**

- Technological Advancements – remote NDT, automation, AI, etc.
- Demonstration and Events

- **Work Environment and Culture**

- Attractive Work Conditions
- Work-Life Balance

- **Network and Community Building**

- Professional Communities
- Conferences and Trade Shows

Reference: "*Future of the Airline Industry 2035.*"
published by IATA in October 2016

Remote NDT Inspection

- **Remote NDT Inspection – Practical Example:**
 - Remote NDT Inspection Workflow
- **Technical Details Remote NDT Inspection Device**
 - Technical Specifications
 - Software
 - Communication
- **Approval Process for Remote NDT Inspection**

Remote NDT Inspection – Possible Application

- **Dent at AC Leading Edge**
 - Report the Defect - Line Maintenance Engineer
 - Damage Assessment
 - NDT Required for
 - Crack detection
 - Remaining Thickness measurement after blend out
- **What if AC is at Remote Location?**
 - Is NDT available? External Supplier?
 - Does the external Supplier have the right equipment, right Qualifications?
 - Are the external Supplier approved?
 - Etc.



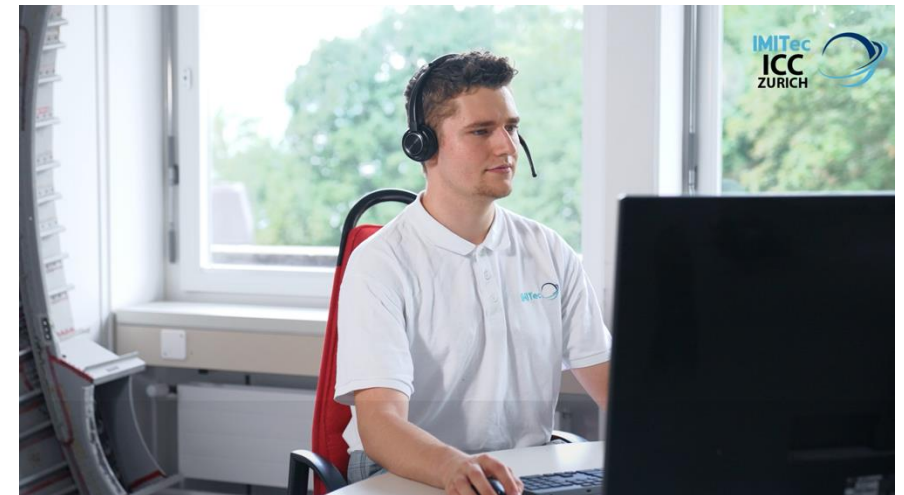
Remote NDT Inspection – Possible Application

- **Report of Damage to Inspection Control Center (ICC)**

- What kind of damage
- Damage Location at the AC (Frame, Stringer, Rip)
- NDT Requirements (NTM, SRM, etc.)

- **ICC Coordinates the Inspection**

- Requirements on Inspection: SRM, NTM, etc.
- Damage Limits
- Next available Remote Inspection device



Remote NDT Inspection – Possible Application

- **Remote Inspection Device Preparation:**

- Available at Airport (Tool Store)
- Dedicated Transport Box
- Automatic Calibration – Reference Standards integrated in Transport Box
- Automatic Calibration controlled by the ICC

- **Remote Inspection Device Application:**

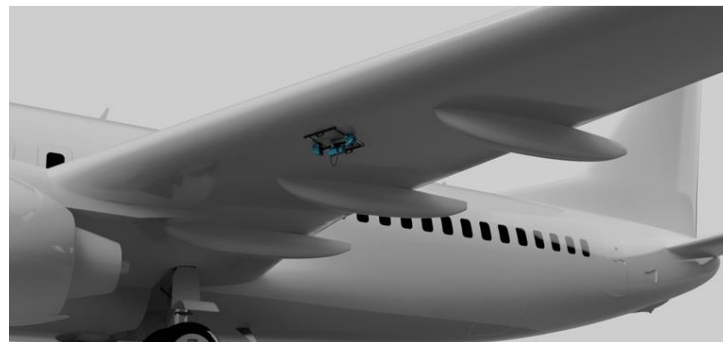
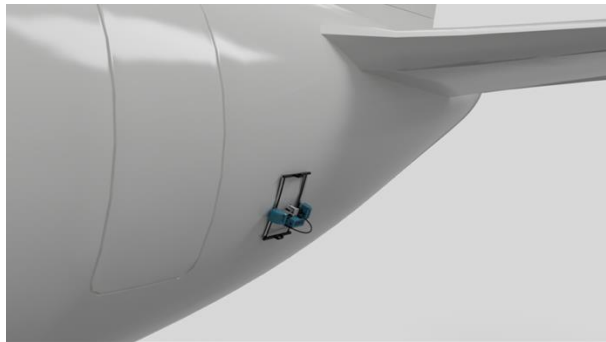
- Maintenance Technician (trained by Remote Service Provider) attaches the Rails
- Nearly all location at the AC can be inspected
- Needed time approximately 10 minutes



Remote NDT Inspection – Possible Application

IMITec Remote Aircraft Inspection Device:

- Installed within **10 Minutes** on Aircraft
- On nearly **any location** at the aircraft
- From the upper to the lower surface
- **Not depending** on the Material to inspect
- All **common NDT techniques** implemented



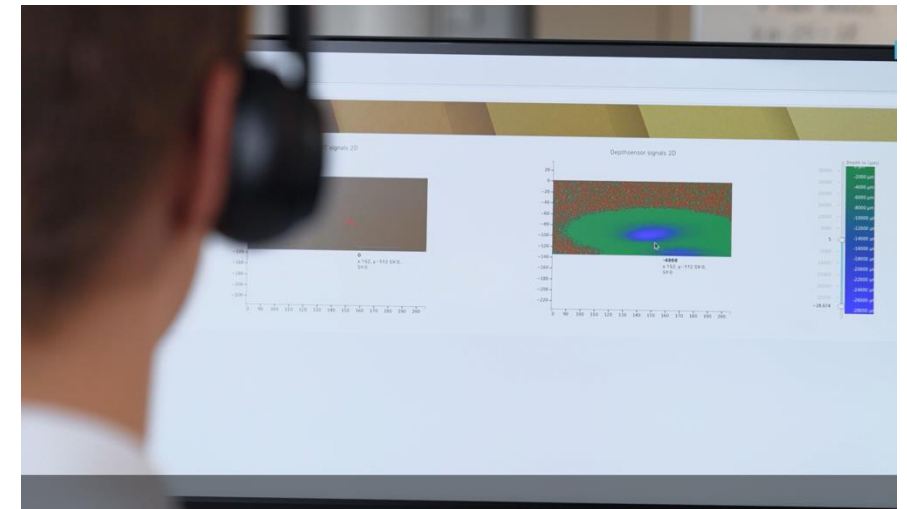
Remote NDT Inspection – Possible Application

- **Check of Measurement data:**

- C-Scan Map of ET Data and Damage data
- Size of damage, Limits, etc.
- Location at AC
- NDT Requirements (NTM, SRM, etc.)

- **Issue of NDT Report:**

- Statement of Work performed
- EASA Form 1 – Inspected
- Electronically transferred to Maintenance Facility
- Maintenance Facility – AC release to Service



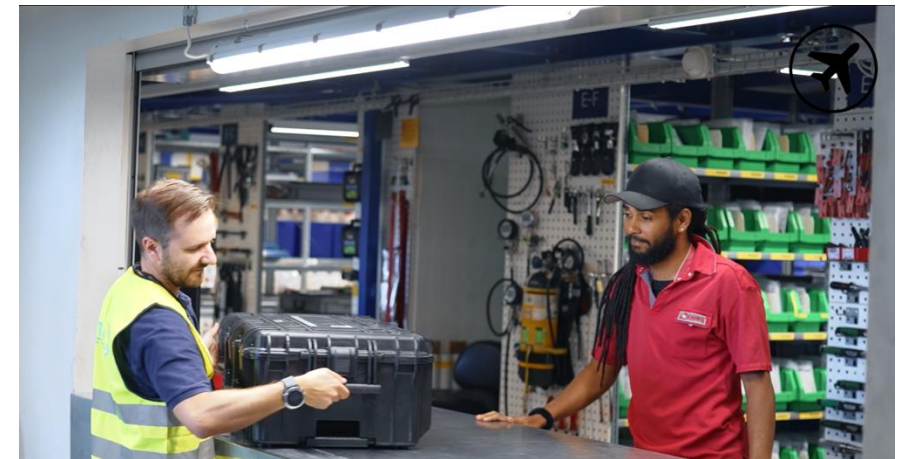
Remote NDT Inspection – Possible Application

- **After NDT Inspection:**

- Maintenance Technician removes Inspection Device
- Inspection Device perform an automatic post-calibration in ist transport box
- Technician removes rails from the AC

- **Remote Inspection Device**

- Stored in its Transport Box
- Charging of Device remote controlled by ICC



Remote NDT Inspection – Possible Application

| @ Airport / Hangar / Line Station | | Remote NDT Inspector |
|--|--|--|
| On-Site Technican (Trained by IMITec) | Remote Inspection Device (RID) | Inspection Corrdination Center (ICC) (NDT Level 2) |
| <ul style="list-style-type: none"> ▪ Reports Damage to ICC ▪ Pick Up the Remote Inspection Device (RID) from Tool store ▪ Switch on RID ▪ Install RID Rails to the Aircraft ▪ Attach RID onto the Rails ▪ Dettach RID form Rails & put it back into Transport box ▪ Switch of Device ▪ Returns the RID back to Tool Store | <ul style="list-style-type: none"> ▪ Starts Automized Pre-Calibration Sequence ▪ Scan of Inspection Area ▪ Starts Automated Post-Calibration Sequence | <ul style="list-style-type: none"> ▪ Collects all needed Information ▪ Check Pre-Calibration Results ▪ Starts Inspection Sequence ▪ Control Measurement Data in Real Time ▪ Initiat Post Calibration ▪ Check Post-Calibration Sequence |

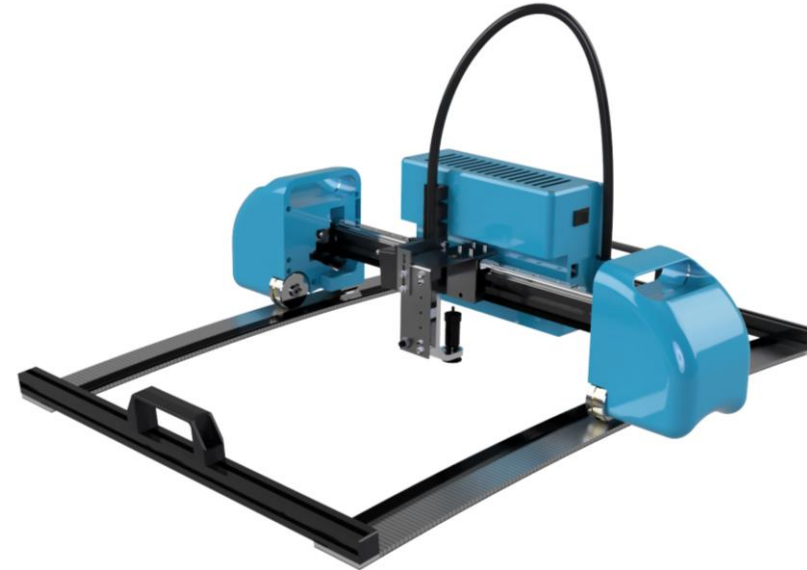
Testing Devices - Specifications

Dent size Measurement

| | |
|----------------------------|------------------|
| Resolution depth | 1 μm |
| Measurement accuracy depth | 50 μm |
| Resolution x-direction | 0.2 mm |
| Resolution y-direction | 1 mm |

Eddy current Measurement

| | |
|-----------------------------|--------|
| Resolution x-direction | 0.2 mm |
| Resolution y-direction | 1 mm |
| High-Frequency Eddy Current | |
| Minimal crack length = | 1 mm |



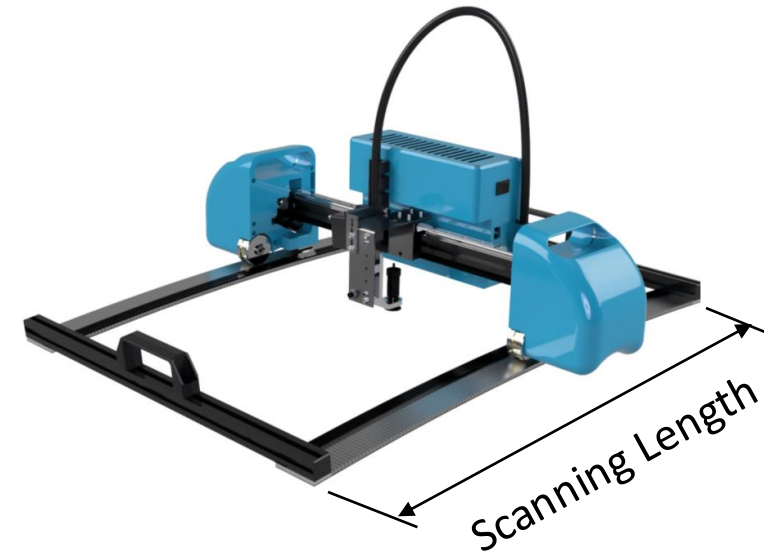
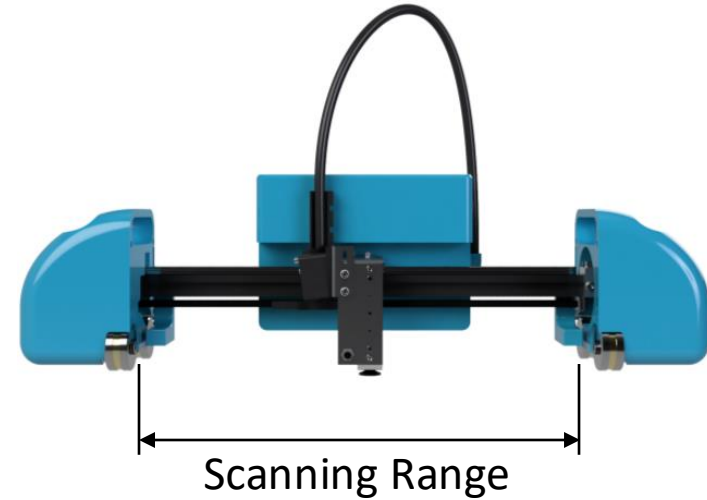
Ultrasonic Remaining Thickness

| | |
|-------------------------------|------------|
| Resolution x-direction | 0.2 mm |
| Resolution y-direction | 1 mm |
| Pulse-Echo Ultrasonic Testing | |
| Thickness Range Skin | 0.6 -10 mm |

Testing Devices - Specifications

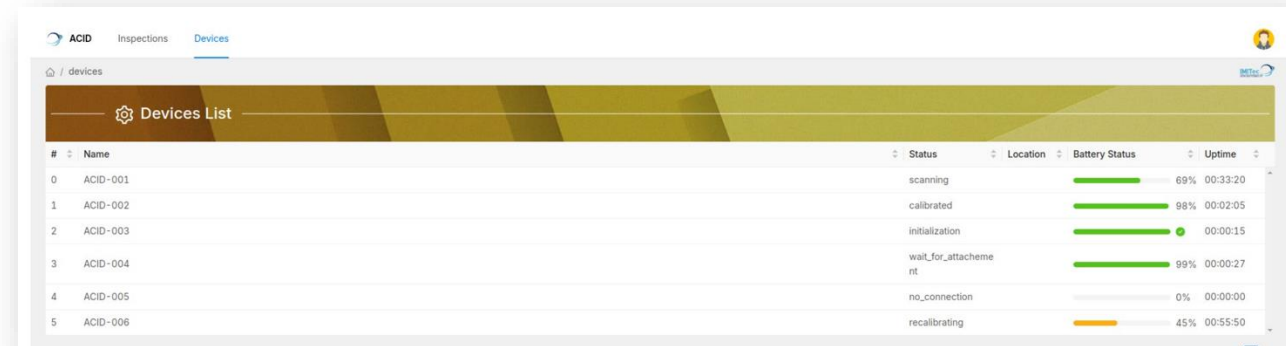
Technical Specifications

| | |
|-------------------------|--------------------------------------|
| Scanning Range | 20, 40, 80 cm (7.9, 15.7, 31.5 inch) |
| Scanning Length | 20 cm – 10 m (7.9 – 400 inch) |
| Weight Device | 5 kg (11 pounds) |
| Operational Temperature | - 10 to 50°C (14 to 122F) |
| Operational Duration | 1.5 hours |
| Charging time | 45 minutes |
| Connectivity | 4G or 5G mobile network |

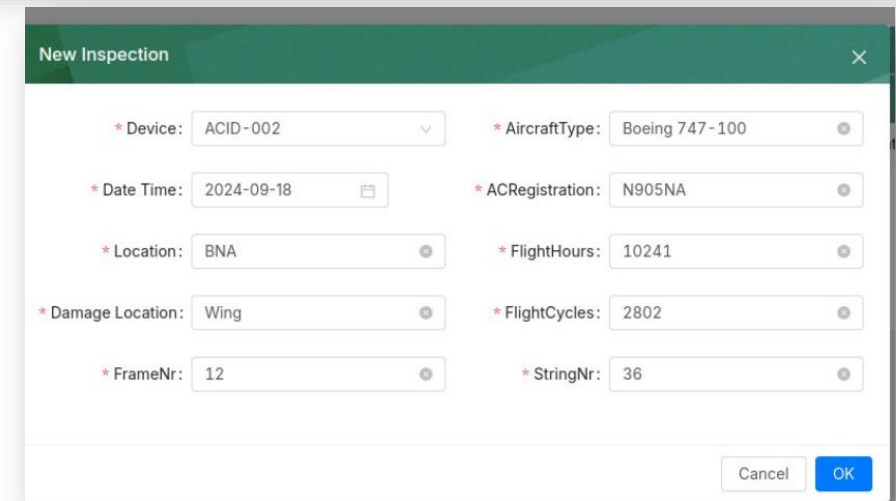


Remote Testing Device - Software

- **Embedded Software (Firmware)**
 - Linux based Firmware
 - Embedded Micro Controller
 - 4G up tp 5G Connectivity
- **Graphical User Interface – Front End**
 - Web based Application
 - Server based Back- and Frontend Software
 - No need for local software installation
 - Operation Status of Remote Inspection Devcie
 - C-Scan illustration of Measurement results (ET, UT, Dent)
 - Connection between Remote Inspection Device and Server via VPN connection
 - Connectivity via GSM standard 4G or 5G
 - Nearly Real Time Measurement data transmission



| # | Name | Status | Location | Battery Status | Uptime |
|---|----------|----------------------|----------|---------------------------------------|----------|
| 0 | ACID-001 | scanning | | <div style="width: 69%;"></div> 69% | 00:33:20 |
| 1 | ACID-002 | calibrated | | <div style="width: 98%;"></div> 98% | 00:02:05 |
| 2 | ACID-003 | initialization | | <div style="width: 100%;"></div> 100% | 00:00:15 |
| 3 | ACID-004 | wait_for_attachement | | <div style="width: 99%;"></div> 99% | 00:00:27 |
| 4 | ACID-005 | no_connection | | <div style="width: 0%;"></div> 0% | 00:00:00 |
| 5 | ACID-006 | recalibrating | | <div style="width: 45%;"></div> 45% | 00:55:50 |



New Inspection

* Device: ACID-002 * AircraftType: Boeing 747-100

* Date Time: 2024-09-18 * ACRegistration: N905NA

* Location: BNA * FlightHours: 10241

* Damage Location: Wing * FlightCycles: 2802

* FrameNr: 12 * StringNr: 36

Cancel OK

Remote NDT Inspection Approval

NANDTB/29 – UK NANDTB POLICY ON REMOTE NDT

<https://www.bindt.org/admin/Downloads/NANDTB29.pdf>

UNCONFIRMED MINUTES OF THE 34th MEETING OF THE AEROSPACE NDT BOARD FORUM, 21. November 2023, Prague

9. Open session, activities, requests as submitted

- o Remote inspection, please submit your presentation
- o Documents, review and updates required
- o ANDTBF vision, strategy and focus for next years
- o ISO 18490 NDT - Evaluation of vision acuity of NDT personnel

A presentation was provided by CD from the Swiss NDT Board on Remote NDT. Remote NDT Inspection is not new, CD made reference to the Policy implemented by the UK Board through the UK Aviation Authority. KP confirmed that it was an accepted procedure to provide the required rigor and confidence when carrying out remote inspections.

CD has used much of the UK Board's document within his presentation and asked specific question, is there a need to adopt this across the European Forum, should they establish a procedure to address Remote NDT?

Should a working group for remote inspection be established, who would be participating?

- Spanish Board
- UK Board
- Czech Board
- Swiss Board
- Italian Board

EASA held a brainstorming session confirming that some rulemaking for remote inspection needs to be established, they confirmed that when remote inspections are carried out other human senses should be considered which are not present within any remote inspection such as dexterity of touch.

Aerospace NDT Board Forum

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UNCONFIRMED MINUTES OF THE 34th MEETING OF THE AEROSP.

Meeting Date: 21 November 2024

Location: ATG – Advanced Technology Group, Prague, Czech

UK National Aerospace NDT Board

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NANDTB/29 – UK NANDTB POLICY ON REMOTE NDT

1. Status.
Initial issue, approved for publication at the 28th February 2022 meeting of the UK NANDTB.
2. Scope.
This document sets out the UK NANDTB policy for Remote NDT (RNDT). It is intended to regulate and provide recommendations & guidance for NDT tasks that are carried out collaboratively by personnel at different locations.
The use of RNDT is not mandatory, but where organisations choose to implement it, they must comply with this policy in such a manner that does not contradict or circumvent higher-level regulation and standards (eg EN4179, CAP 747, other NAndTB policy documents, etc).
This document applies only to EN4179 common and emerging NDT methods, plus the 'material evaluation' and 'direct readout' methods & techniques that are set out in NAndTB/18. It does not apply to any other form of aircraft maintenance or support.
This document does not cover any form of remote training for NDT. This is set out in the broader context of aerospace engineering training in CAA CAP 1533 – Guidance for use of Web based training, Distance Learning, Simulation and Virtual Reality.
Given the constantly evolving diversity & complexity of NDT, this enabling policy is intended to be as neutral as possible regarding specific methods, techniques and technologies.
3. Introduction.
The concept of Remote NDT has been widely applied in radiography since the 1970s. A Level 1 may take a radiographic exposure, process the film, check the image quality, then send the radiograph to a Level 2 who interprets it and sentences the part. With the advent of digital radiography, the physical transfer of film is replaced with the electronic transfer of image data, speeding up the process, but still involving a delay. The introduction of web-enabled digital detector arrays to capture and share radiograph data in real time allows image quality to be assessed as it is generated, by a Level 2, possibly on the other side of the world. Where corrections are needed to optimise the image, the exposure can be suspended and instructions fed back to the Level 1 (eg to adjust shot angle, source distance or exposure time). Such an approach is now established practice in medical radiology (diagnostic imaging), where radiographers and radiologists at different locations work together as a team.

Remote NDT Inspection Approval

IMITec Maintenance Organisation Exposition MOE IMITec-MOE-001, Rev.03

2.31.2 Remote Non-destructive Inspection (Remote NDT) Procedure

The IMITec procedure for Remote NDT Inspection is described in detail in the company NDT Written Practice PRO-001-WP and in the General Procedure for Remote NDT Inspection PRO-008-NDTP.

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NDT Company Written Practice PRO-001-WP, Rev.03

6.4.3 Remote Non-destructive Testing

This section is based on the document "NANDTB/29 – UK NANDTB POLICY ON REMOTE NDT" developed and published by the British (UK) National Non-destructive Board for Aviation (UK NANDTB) (<https://www.bindt.org/admin/Downloads/NANDTB29.pdf>). In this section the idea and detailed description on the requirements for Remote NDT published by the UK NANDTB are taken into consideration and adapted to the requirements of the company IMITec.

MAINTENANCE ORGANISATION EXPOSITION Doc. Nr.: IMITec-MOE-001
Title: IMITec Maintenance Organisation Exposition MOE Revision No.: 03
Valid from: 01.11.2024

IMITec
INNOVATIVE MAINTENANCE AND INSPECTION TECHNOLOGY

MAINTENANCE ORGANIZATION EXPOSITION
for
IMITec GmbH
General-Wille-Strasse 201
CH-8706 Meilen, Switzerland

Approved Maintenance Organization (AMO)
FEDERAL OFFICE OF CIVIL AVIATION
CH.145.0195
(based on EASA Part-145; Annex II, EC 1321/2014)

Issue 1 Revision 03
Date: 01.11.2024

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WRITTEN PRACTICE Doc. Nr.: PRO-001-WP
Title: IMITec Company Written Practice for Part 145 Revision No.: 03
Valid from: 30.06.2024

NDT COMPANY WRITTEN PRACTICE
Qualification and Approval of NDT Personnel

| Name | Date | Visum |
|-------------------|------------|------------------------------------|
| PREPARED: | | |
| Marc Vogt | 30.06.2024 | electronical signed MF, 30.06.2024 |
| CHECKED: | | |
| Fritz Erni | 30.06.2024 | electronical signed FE, 30.06.2024 |
| APPROVED: | | |
| Christian Diräger | 30.06.2024 | |

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Inspire young Engineers to NDT

- **Education and Awareness**
 - 5 Universities and High Schools involved, Internship for Students
 - Teamwork between NDT Inspectors, Research & Development Staff
- **Career Paths and Development**
 - Technical & Management Carrier
 - Innovation and development is an ongoing process
 - Maintenance Technician -> Mechanical Engineer -> NDT Level 2/3 -> NDT Engineer
- **Innovative Technologies**
 - Remote NDT Inspection, Software Development, Mechanical Development
 - NDT Simulations
- **Work Environment and Culture**
 - varied work
 - International Team
 - Remote working possibility
- **Network and Community Building**
 - A4A, European Forum on NDT in Aerospace, National NDT Board
 - Conferences and Trade Shows

IMITec - we keep your Aircrafts flying



Part of Solution – Innovative Technologies

- **Remote-Controlled Inspection Device**
 - At different destinations (Airports)
- **Authorized NDT Inspector (Level 2)**
 - Available at NDT Service Center
- **Requirement at Remote Location**
 - Inspection Device handled by trained **Maintenance Technician**
 - Connection to **NDT Service Center** via Web transfer
 - Inspection based on **OEM Requirements** (NDT, SRM, etc.)

