

OCCUPATIONAL STANDARDS

FOR UAV REPAIR AND MAINTENANCE TECHNICIANS

DEVELOPING VOCATIONAL SKILLS OF ELECTRO-MECHANICAL TECHNICIANS FOR UAV

MAINTENANCE AND REPAIR

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Developing Vocational Skills of Electro-Mechanical Technicians for UAV Maintenance and Repair

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TABLE OF CONTENTS

ACKNOWLEDGEMENTS	4
TABLE OF CONTENTS.....	6
INTRODUCTION.....	8
<i>UAV Repair and Maintenance Technician</i>	<i>8</i>
<i>Why Occupational Standards.....</i>	<i>9</i>
<i>Target Audience.....</i>	<i>10</i>
JOB DESCRIPTION.....	11
<i>Tasks, Responsibilities and Working Environment.....</i>	<i>11</i>
<i>Required Skills and Expertise</i>	<i>12</i>
<i>Licensing and Certification</i>	<i>15</i>
MATRIXES.....	17
<i>Skill Level Matrix</i>	<i>17</i>
<i>Competencies</i>	<i>19</i>
PRACTICE	20
<i>Tasks and activities.....</i>	<i>20</i>
<i>Category 1 - Pre-flight Inspection and Maintenance</i>	<i>21</i>
<i>Category 2 – Troubleshooting.....</i>	<i>31</i>
<i>Category 3 - Maintenance & Repair of Basic UAV Components.....</i>	<i>44</i>
<i>Category 4 - Maintenance & Repair of Flight Controller Board, Sensors, and Remote Controller</i>	<i>59</i>
<i>Category 5 - Documentation and Communication.....</i>	<i>73</i>
<i>Expected performance Standards.....</i>	<i>86</i>
EVIDENCE GUIDE.....	87
1. <i>Practical Assessments:</i>	<i>87</i>
2. <i>Interviews:.....</i>	<i>88</i>
3. <i>Observations</i>	<i>89</i>
4. <i>Portfolio Reviews:</i>	<i>89</i>

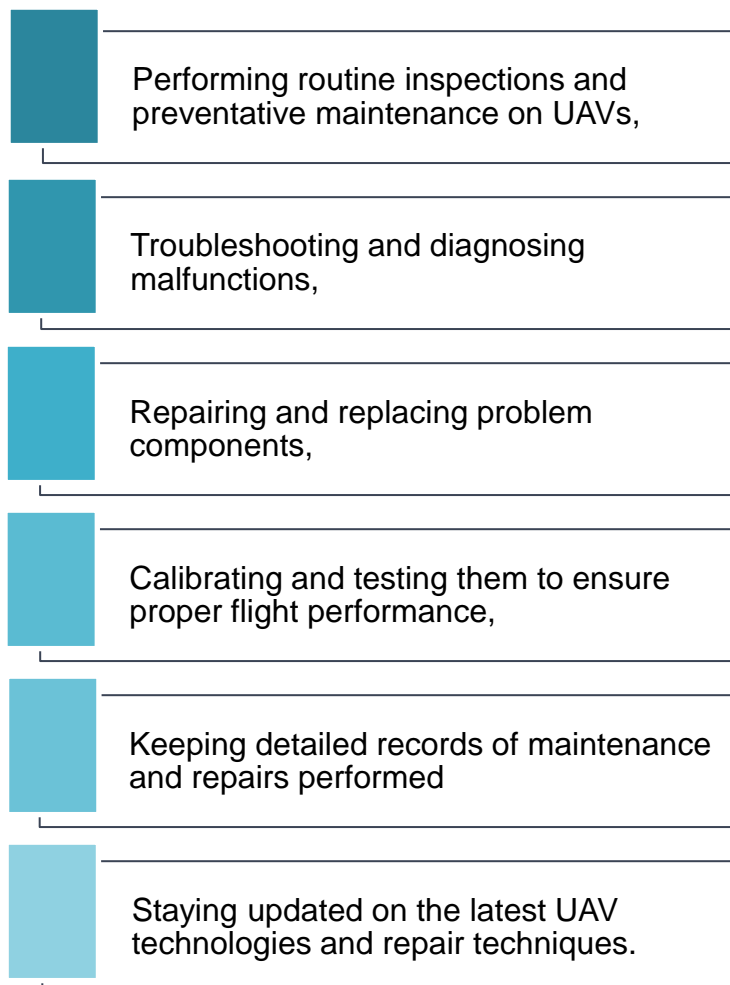
5. Technical Knowledge Tests and Online Exams	90
6. Software Proficiency	90
7. Documentation and Reporting.....	90
8. Adherence to Standards and Safety Procedures:	90
NATIONAL QUALIFICATIONS FRAMEWORK	91
Existing Regulations.....	91
Country-specific Adjustments.....	91
GLOSSARY	100

INTRODUCTION

UAV Repair and Maintenance Technician

A UAV (Unmanned -or Uncrewed- Aerial Vehicle) technician is a specialist responsible for keeping UAVs operational and functioning optimally.

Their job description includes:



UAV technicians should have a strong understanding of electronics and mechanical systems, the ability to diagnose and troubleshoot technical problems, good manual dexterity and problem-solving skills, familiarity with national regulations for UAV operation and strong communication and interpersonal skills.

Why Occupational Standards

The use of UAVs in various industries has increased in recent years, creating a demand for individuals who are knowledgeable and skilled in UAV assembly, repair, and maintenance. As UAVs become more complex and sophisticated, it's getting more and more important for electro-mechanical technicians to have a solid understanding of the technology and the skills to troubleshoot and repair them.

From this point of view, UAVET prioritises the adaptation of VET to labour market needs in line with the Erasmus+ programme priorities. Since this is a newly developing vocational area, UAV repair and maintenance technicians' occupational standards are also not clearly defined by the national vocational competency and certification bodies. UAVET puts emphasis on working on the project results in line with the occupational requirements in the context of:



Target Audience

A UAV repair and maintenance technician is someone with a background in:

- Electronic systems
- Diagnostic software and applications
- Communication systems
- Aerodynamics and propulsion systems
- Mechanics
- Sensors and instrumentation
- Safety protocols and regulations

This job is well-suited for technicians who enjoy working with their hands, solving electrical and mechanical problems, and staying up-to-date on the latest advancements in UAV technology.



JOB DESCRIPTION

Tasks, Responsibilities and Working Environment

UAV repair and maintenance technicians are responsible for conducting routine inspections and preventative maintenance to address potential issues before they lead to malfunctions. This includes pre and post-flight inspections, scheduled maintenance and regular firmware and software updates to ensure that UAVs are always in optimal working condition.

Another critical aspect of the job is troubleshooting and diagnosing malfunctions. Technicians use specialized tools and software, along with their experience to identify faults in UAV systems (power issues, sensor malfunctions, or communication problems) and conduct visual and functional assessments to determine the extent of damage or wear on UAV components.

Repair and replacement of components are also fundamental tasks. Technicians repair or replace damaged parts, such as motors, propellers, cameras, sensors, and control systems, ensuring that all replacements meet manufacturer specifications and safety standards.

Maintaining detailed records is another crucial responsibility. Technicians keep comprehensive logs of all maintenance and repair activities, including dates, performed tasks, and parts used.

Finally, effective customer service and communication is another crucial responsibility. Technicians communicate with clients to understand their needs and offer technical support and guidance on UAV operation, maintenance, and troubleshooting.

UAV technicians typically work in various environments. Indoor settings might include specialized repair facilities and stations designed for UAV repair and maintenance, while outdoor environments might include on-site client locations for field repairs, necessitating adaptability to different conditions. In office settings, technicians also manage administrative duties such as record-keeping and communication with clients. The job may require flexible hours, including evenings and weekends, to meet client needs and respond to urgent repair requests, and travel may be necessary for on-site repairs.

Required Skills and Expertise

Technical Knowledge and Proficiency

A UAV technician should have:

- Knowledge and comprehensive understanding of the various UAV types (including fixed-wing, rotary wing, and VTOL UAVs) and their components, including hardware such as motors, sensors, cameras, and control systems or software.
- Expertise in diagnosing and resolving technical issues in UAV systems, using both manual techniques and specialised diagnostic software.
- Skills in repairing and maintaining the components, assembling, and disassembling them. This requires good hand-eye coordination and manual dexterity for precise repairs and component replacements. Proficiency in performing maintenance tasks and repairing or replacing UAV components, such as motors, propellers, cameras, sensors, and control systems, while ensuring compliance with manufacturer specifications and safety standards are necessary.
- High level of attention to detail to ensure all maintenance and repairs are performed accurately and thoroughly.
- Familiarity with safety protocols and procedures to ensure the safe operation of UAVs during maintenance and repair activities. Furthermore, awareness of national and international regulations governing UAV operation, including airspace restrictions, safety standards, and certification requirements is very important.
- Strong analytical and problem-solving abilities to effectively address and resolve technical issues.
- A background in electronics repair, robotics, airframe maintenance, or mechanics. Formal education, training or certifications in these areas is advantageous.
- Ability to conduct thorough pre-flight inspections to ensure UAVs are in optimal condition before take-off
- Knowledge of national and international regulations governing UAV operation and maintenance

Hands-On Skills

A UAV repair and maintenance technician should have the following hands-on skills in general terms.

- **Electronics Repair**
Skills in repairing electronic components and systems, including soldering and circuit board repairs
- **Mechanical Aptitude**
Capability to handle mechanical repairs and maintenance, ensuring precise adjustments and alignments
- **Robotics and Airframe Maintenance**
Familiarity with principles of robotics and flight mechanics, particularly in the context of UAV technology

Soft Skills

The following soft skills are required for a UAV repair and maintenance technician to fulfil the tasks successfully.

- **Customer Service and Communication**
Strong communication skills to interact effectively with clients, understand their needs, and provide technical support and guidance
- **Problem-Solving**
Ability to think critically and solve complex technical problems efficiently
- **Attention to Detail**
Attention to detail in all tasks, from diagnostics to record-keeping, ensuring accuracy and quality in every aspect of the job
- **Adaptability**
Flexibility to work in various environments, including indoor repair facilities, outdoor client locations, and office settings, as well as adaptability to different working conditions and schedules

Tools and Equipment Proficiency

The proficiency in using the following tools and equipment is required for a UAV repair and maintenance technician.

- **Diagnostic Tools and Software**

Proficiency in using specialised tools and software for diagnosing UAV issues and conducting functional assessments

- **Repair and Measurement Tools**

Competence in using hand tools such as screwdrivers, pliers, multimeters, and soldering irons

- **Record-Keeping Tools**

Competence in maintaining detailed logs of maintenance and repair activities, using both manual and digital record-keeping systems

Occupational Safety and Risk Management

A UAV repair and maintenance technician should know about the following occupational safety and risk management issues.

- **Handling of Batteries and Electrical Components**

Knowledge of proper safety protocols for handling batteries and electrical components to prevent hazards such as electric shocks, fires, or explosions.

- **Environmental Safety**

Awareness of safety measures for working in different environments, ensuring personal and client safety during field repairs and maintenance tasks.

Continual Learning and Development

A UAV repair and maintenance technician should follow the latest developments in the sector in order to keep occupational skills up-to-date.

- **Staying Updated**

Commitment to keeping up with the latest advancements in UAV technology and repair techniques, including participation in ongoing training and professional development opportunities.

Licensing and Certification

At the moment there are few training programmes in Europe that offer certifications for UAV repair and maintenance technicians, and they are mostly focused on piloting skills. In general, the licensing and certification requirements may vary, based on local, national, and international regulations and standards governing UAV operations. Here are the key aspects to consider:

- Formal education, certification, and vocational training in the areas of electronics repair, robotics, airframe maintenance, or mechanics, is advantageous.
- Remote pilot certificate and compliance with the European Aviation Security Agency (EASA): In Europe, most countries adhere to EASA regulations, which mandate that every UAV pilot must obtain a Remote Pilot Certificate. This certification is also beneficial for UAV technicians, as it allows them to perform testing and maintenance activities without regulatory obstacles. Obtaining this certification ensures that technicians are aware of safe UAV operation procedures and compliant with airspace regulations.
- Compliance with Local Regulations: UAV technicians must stay informed on and comply with, the regulations applicable to the area wherein they aim to work (local, national and transnational), as the relevant framework might differ from place to place, proposing fewer or more standards that have to be taken into consideration. This includes understanding airspace restrictions, privacy laws, and safety standards.
- Training Programmes: Many UAV manufacturers, such as DJI, offer specialized training and certification programmes for their products. Completing these programmes ensures that technicians are familiar with the specific UAV models they will be working on and with the manufacturer's maintenance protocols and standards.
- Health and safety training: UAV technicians should complete health and safety training to ensure they adhere to workplace safety standards. This training covers safety procedures, and the proper handling of tools and equipment, which are crucial for preventing accidents and ensuring a safe working environment.

Benefits of Certification

Certified technicians are recognized for their expertise and adherence to industry standards, enhancing trust among clients and employers. In addition, certification can lead to career advancement opportunities, including roles in supervisory or specialised technician

positions. Certification ensures consistent quality of service, mitigating risks associated with improper maintenance practices and enhancing UAV reliability and longevity.

Process for Certification

- **Education and Training**

Completion of accredited training programmes or apprenticeships focused on UAV repair and maintenance

- **Examination**

Passing certification exams assessing theoretical knowledge and practical skills related to UAV systems, maintenance procedures, and safety protocols

- **Continued Compliance**

Fulfilment of continuing education requirements and periodic recertification to keep pace with the field and uphold certification standards. This is critical since the sector of Unmanned Aviation is developing rapidly and bringing about a lot of changes to UAV parts and their functioning that the technicians must be aware in order to perform their jobs successfully.

Industry Recognition

Affiliation with professional organisations in the UAV industry that offer certification programmes and advocate for technician standards and professional development is a requirement for UAV technicians. Moreover, UAV maintenance services should collaborate with regulatory bodies to establish and uphold licensing requirements that ensure safe and effective UAV operations within legal frameworks.

MATRIXES

Skill Level Matrix

Skills/Knowledge - Year of Experience	Entry Level (0-1 Year Experience)	Intermediate Level (1-3 Years Experience)	Advanced Level (3+ Years Experience)
UAV Systems	Identify basic components of a UAV (e.g., airframe, motors, propellers, flight controller).	Demonstrate a thorough understanding of major UAV subsystems (e.g., propulsion, navigation, communication).	Possess in-depth knowledge of advanced UAV systems, emerging technologies and fabricating custom UAV systems.
Safety Procedures	Understand and follow basic safety protocols for handling and repairing UAVs.	Conduct comprehensive risk assessments for UAV operations, including evaluating environmental factors and identifying potential hazards.	Design and manage comprehensive safety programmes, including training modules and continuous improvement processes.
Regulations	Demonstrate basic understanding of relevant local aviation authority regulations for UAV operation (if applicable).	Demonstrate comprehensive understanding of national UAV regulations and familiarity with international standards and guidelines.	Demonstrate expertise in interpreting and influencing UAV regulations, participating in regulatory forums, and contributing to policy development.
Software and Tools	Demonstrate familiarity with essential tools and software for UAV operation.	Proficient use of variety of diagnostic software and tools for advanced repairs.	Demonstrate mastery of advanced tools and equipment for specialized UAV maintenance and repair and stay updated on emerging software tools.
Calibration and Testing	Perform basic calibration procedures using manufacturer instructions.	Perform advanced calibration procedures in UAV systems proficiently.	Develop and implement custom calibration techniques for specialized UAVs.
Maintenance	Conduct regular inspections of UAVs to identify wear and tear on components.	Follow detailed maintenance schedules as per manufacturer guidelines, including preventive maintenance.	Conduct in-depth inspections and overhauls of the entire UAV system.

Repair	Have some ability to identify and replace basic UAV components.	Demonstrate proficiency in repairing more complex components such as gimbals, GPS modules, and ESCs.	Demonstrate expertise in repairing and replacing individual electronic components on circuit boards, such as resistors, capacitors, and microcontrollers.
Troubleshooting	Have some ability to identify common issues and symptoms reported by UAV users or observed during pre-flight checks.	Be skilled in performing root cause analysis to identify underlying issues contributing to UAV malfunctions.	Solve complex and rare issues through creative problem-solving and critical thinking in an expert manner.
Payload Integration	Have the knowledge of different types of payloads such as cameras, sensors, and delivery systems.	Demonstrate skills to integrate custom payloads not originally designed for the UAV, including modifying mounts and connectors.	Design and assemble custom mounts and housings for specialized payloads.
Documentation	Have the ability to maintain basic records of UAV flights, maintenance activities, and repairs.	Demonstrate proficiency in creating detailed documentation for UAV operations, including flight plans and incident reports.	Implement Quality Management Systems principles to establish standardized documentation processes.
Communication	Have the ability to communicate effectively with team members and clients, ensuring that messages are conveyed clearly and understood.	Maintain professionalism in all communication channels, including email, phone calls, and in-person interactions.	Develop and implement communication strategies to effectively convey complex information and address stakeholder concerns.

Competencies

Skill	Entry Level	Intermediate Level	Advanced Level
Routine Inspections	Perform basic pre-flight inspections using a checklist	Conduct detailed inspections and identify potential issues before they occur	Develop inspection protocols and lead comprehensive inspections
Preventative Maintenance	Execute scheduled maintenance tasks according to instructions	Independently perform scheduled maintenance, identify wear and tear	Design and implement preventative maintenance schedules
Firmware and Software Updates	Install software and firmware updates as instructed	Diagnose and resolve software and firmware issues, perform updates regularly	Troubleshoot complex software problems, develop update strategies
Troubleshooting and Diagnosis	Identify and report basic malfunctions and issues	Use specialised tools and software to diagnose issues, troubleshoot common problems	Diagnose complex issues, provide expert-level troubleshooting and solutions
Repair and Replacement of Components	Replace simple parts such as propellers or sensors under supervision	Independently repair or replace key components like motors and cameras	Oversee major repairs, ensure all replacements meet safety standards and manufacturer specifications
Record Keeping	Maintain basic logs of performed tasks and used parts	Keep detailed records of maintenance and repairs, document dates and specific tasks	Manage comprehensive maintenance records, analyse data to improve processes
Customer Service and Communication	Communicate basic maintenance needs and instructions to clients	Provide detailed technical support and maintenance guidance to clients	Handle complex customer inquiries, offer expert advice and technical support
Adaptability to Different Conditions	Work in controlled indoor environments with standard equipment	Perform repairs and maintenance in various environments, including outdoor and field settings	Manage operations in diverse and challenging conditions, ensure quality regardless of environment
Administrative Duties	Assist with basic administrative tasks such as data entry and scheduling	Independently handle administrative duties, manage client communications	Oversee administrative operations, develop processes to streamline record-keeping and client interactions
Flexibility and Availability	Work standard hours with occasional overtime	Work flexible hours, including evenings and weekends, to meet client needs	Lead teams with flexible schedules, manage urgent repair requests and travel for on-site repairs

PRACTICE

Tasks and activities

This section offers a comprehensive overview of the tasks, activities, and assessment methods that are essential for developing proficiency in UAV repair and maintenance.

In this section, learners and their educators will find detailed descriptions of the practical responsibilities of UAV repair and maintenance technicians as well as the knowledge, skills, tools and equipment necessary to perform them. Each of those tasks is presented along with the suggestions for occupational safety and precautions against potential risks. This section includes tasks under 5 main categories:



This categorization is crucial in terms of occupational standards as it establishes a clear and comprehensive framework for defining the roles and responsibilities of UAV repair and maintenance technicians. This systematic approach aids in the development of consistent training programmes, certification processes, and performance evaluations, all of which are essential for maintaining industry-wide standards.

The identification of key competencies and qualifications required for technicians can be used to develop job descriptions, recruitment criteria, and career progression pathways.

Category 1 - Pre-flight Inspection and Maintenance

1. Record basic details

2. Clean the chassis from dirt and dust

3. Inspect airframe for cracks, loose components, and signs of wear

4. Check propellers for damage, balance, and secure mounting

5. Verify motor function and power delivery

6. Calibrate sensors and flight controllers

7. Perform firmware updates as required

8. Battery life assessment and charging procedures

9. Ground control system (GCS) and flight app functionality checks

Category No: 1				
Category Name: Pre-flight Inspection and Maintenance				
Task 1: Record basic details (technicians name, date, UAV model name, UAV ID, UAV weight in the form.				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
		✓		
Importance of the task				
Not at all important	Slightly important	Important	Very important	
		✓		
Complexity of the task				
Easy	Moderate	Complex		
✓				
Which knowledge is necessary for this task?				
1. The model, the UAV ID (maybe even the UAV number) 2. What is necessary to complete and what the current regulations are				
Which skills are necessary for this task?				
1. No special skills required, just the ability to write.				
Which tools and equipment are necessary for this task?				
1. Paper and pen/pencil				
Additional notes on occupational safety and risks:				
1. It is required to complete the form before the operation.				

Category No: 1				
Category Name: Pre-flight Inspection and Maintenance				
Task 2: Clean the chassis from dirt and dust				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
			✓	
Importance of the task				
Not at all important	Slightly important	Important	Very important	
		✓		
Complexity of the task				
Easy	Moderate	Complex		
✓				
Which knowledge is necessary for this task?				
1. No special knowledge required.				
Which skills are necessary for this task?				
1. No special skills are required.				
Which tools and equipment are necessary for this task?				
1. Brush 2. Personal protective equipment 3. Cleaners				
Additional notes on occupational safety and risks:				
1. The UAV must be turned off.				

Category No: 1				
Category Name: Pre-flight Inspection and Maintenance				
Task 3: Inspect airframe for cracks, loose components, and signs of wear.				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate	Complex		
✓				
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Visual judging 2. How the UAV operates and how to disassemble certain parts and inspect them. 3. Careful inspection is needed. 4. You need to understand that something is wrong, if something is out of place, something is loose, or if you hear an unusual sound. 5. Understand the manufacturer's instructions for inspection and maintenance 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Aviation Expertise 2. Attention to detail 3. To know how to use tools 4. Observation skills 5. Practical experience 6. Ability to identify cracks, loose parts, and signs of wear through visual inspection 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. Screwdrivers for dismantling or fixing components. 2. Fixed work surface 3. Sunglasses 4. Magnifying glass 5. Personal protective equipment 6. Cleaners 				
Additional notes on occupational safety and risks:				
<ol style="list-style-type: none"> 1. It is important that the UAV is switched off during the check. 2. Care should be taken when using tools, as there is a risk of injury. 				

Category No: 1				
Category Name: Pre-flight Inspection and Maintenance				
Task 4: Check propellers for damage, balance, and secure mounting.				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate	Complex		
✓				
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Technical knowledge to disassemble the propellers and how to check their balance. 2. Visual judgement for bumps, breaks. 3. The correct way of fitting (in the right direction). The propellers must be placed in an X formation. 4. Flight knowledge 5. Understand the aerodynamic function of propellers and how they generate thrust. 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Skills to disassemble and inspect propellers safely 2. Must be able to identify damage to propellers, such as cracks, or signs of wear 3. Attention to detail 4. Technical skills for screwing and unscrewing 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. Screwdrivers 2. Cleaners for removing dirt or dust from propellers 3. Personal protective equipment 4. Brush 				
Additional notes on occupational safety and risks:				
<ol style="list-style-type: none"> 1. The UAV should be switched off during this procedure. Caution when removing and assembling the propellers. Risk should be mitigated to the greatest extent possible. 				

Category No: 1				
Category Name: Pre-flight Inspection and Maintenance				
Task 5: Verify motor function and power delivery.				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate	Complex		
✓				
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. No special knowledge is required. Visual inspection of the UAV needs to be done to check for strange sounds when it is put into operation. 2. Make sure the batteries are fully charged and in good condition. 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. No skills required. 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. The UAV's controller to control the readings when it is turned on. 				
Additional notes on occupational safety and risks:				
<ol style="list-style-type: none"> 1. It is necessary to keep a safe distance from the UAV. The activity should be done in the presence of 2 people for safety. 				

Category No: 1				
Category Name: Pre-flight Inspection and Maintenance				
Task 6: Calibrate sensors and flight controllers.				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
		✓		
Importance of the task				
Not at all important	Slightly important	Important	Very important	
		✓		
Complexity of the task				
Easy	Moderate	Complex		
✓				
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. No special knowledge is needed. Follow the manufacturer's instructions 2. To know how to use a smartphone or computer 3. Must know how a UAV's sensors and flight control system work and recognize signs of imbalance or inaccuracy in the UAV's motion or stability 4. Flight knowledge 5. To know how to perform sensor and flight controller calibration procedures accurately, following the manufacturer's instructions and using appropriate tools and software 6. To know if there are magnetic fields in the surrounding area 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Visual judgement 2. You must be able to identify problems. Be able to tell when something is wrong. 3. Calibration requires accuracy and attention to detail. 4. You have to be able to recognize signs of imbalance or non-stability of the UAV. 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. Calibration Panel 2. Smartphone 3. UAV App 4. UAV Controller 				
Additional notes on occupational safety and risks:				
<ol style="list-style-type: none"> 1. The manufacturer's instructions on calibration should be followed. Risk mitigation should be carried out to the greatest extent possible. The UAV must be switched off. 				

Category No: 1				
Category Name: Pre-flight Inspection and Maintenance				
Task 7: Perform firmware updates as required.				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
		✓		
Importance of the task				
Not at all important	Slightly important	Important	Very important	
		✓		
Complexity of the task				
Easy	Moderate	Complex		
✓				
Which knowledge is necessary for this task?				
1. No special knowledge is required. An update notification appears when necessary.				
Which skills are necessary for this task?				
1. No skills required.				
Which tools and equipment are necessary for this task?				
1. The UAV controller and the UAV app				
2. Internet connection				
Additional notes on occupational safety and risks:				
Not applicable				

Category No: 1				
Category Name: Pre-flight Inspection and Maintenance				
Task 8: Battery life assessment and charging procedures.				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate	Complex		
✓				
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Check the battery level from the app 2. You need to know the type of batteries, how to remove them from the UAV, and how to charge them. 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. No special skills required. 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. Battery chargers 				
Additional notes on occupational safety and risks:				
<ol style="list-style-type: none"> 1. Do not remove the battery while the UAV is in operation. First, turn off the UAV and then remove the battery. 2. Do not allow the battery to come into contact with any liquid or flammable element. If water gets inside the battery, there is a risk of explosion, fire or short circuit. 3. Do not use non-approved batteries other than those recommended by the manufacturer. 4. The manufacturer's instructions must always be followed. 5. Do not use the battery if its temperature exceeds the permissible values (-4 °C to 40 °C). 6. Avoid flying your UAV with a battery that has been heavily damaged, or after a fall. 7. Make sure to charge the batteries, following a balanced charging schedule to maintain battery life. Charge it to 100%, without interruption, and use it until it is discharged. During charging, be present in case something goes wrong. 8. Before each flight, check the battery for any cracks, bubbles, and blisters. etc. If anything is detected, do not use it and withdraw it. 				

Category No: 1				
Category Name: Pre-flight Inspection and Maintenance				
Task 9: Ground control system (GCS) and flight app functionality checks.				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate	Complex		
✓				
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Knowledge of basic UAV functions and control systems 2. Familiarity with the GCS software used 3. Knowledge of emergency situations 4. Knowledge of UAV technical limits and normal UAV operating procedures 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Attention to detail 2. Good perception of the surroundings 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. The UAV controller and the UAV app. 2. Thermometer 3. Internet connection (optional) 				
Additional notes on occupational safety and risks:				
<ol style="list-style-type: none"> 1. Great attention should be paid to the physiology of the operator's space. He should be in a cool and shady place so that his judgment and perception are not affected during this procedure. 				

Category 2 – Troubleshooting

1. Opening of the maintenance record and ensuring the physical inspection of the UAV.

2. Inspection of connection equipment such as cables and sockets.

3. Diagnosis of the problem with pre-flight maintenance tests.

4. Analysing flight and crash logs.

5. Repairing mechanical failures

6. Troubleshooting sensor errors

7. Debugging with product software (or firmware) updates.

8. Performing basic calibration and adjustments in flight parameters.

9. Implementing and suggesting preventive maintenance actions

10. Post-maintenance test flight

11. Recording troubleshooting details (technician name, date, UAV model name, UAV ID, UAV weight) in a form

Category No: 2 Category Name: Troubleshooting				
Task 1: Opening of the maintenance record and ensuring the physical inspection of the UAV				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate	Complex		
	✓			
Which knowledge is necessary for this task?				
1. Having basic knowledge of electronics and computers 2. Being knowledgeable about physical UAV components				
Which skills are necessary for this task?				
1. Technical proficiency in a foreign language that allows understanding of technical terms 2. Manual dexterity 3. Analytical thinking and problem-solving skills 4. Communication skills 5. Photography skills				
Which tools and equipment are necessary for this task?				
1. Computer-like system for opening the form record 2. Illuminated magnifier 3. Photography equipment 4. Antistatic gloves 5. Class D fire extinguisher				
Additional notes on occupational safety and risks:				
1. Risk of ignition and explosion of UAV battery 2. Risk of injury from propeller-like cutting surfaces 3. Risk of irritation in carbon Fiber and fiberglass products				

Category No: 2 Category Name: Troubleshooting				
Task 2: Inspection of connection equipment such as cables and sockets.				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate		Complex	
			✓	
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Basic knowledge of electronics 2. Familiarity with connection equipment 3. Knowledge of basic UAV components 4. Awareness of basic occupational safety measures 5. Understanding of connection methods and configurations of UAV components 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Possessing analytical thinking and problem-solving skills 2. Manual dexterity 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. Illuminated magnifier 2. Antistatic gloves 3. Class D fire extinguisher 4. Tweezers, forceps, etc. 				
Additional notes on occupational safety and risks:				
<ol style="list-style-type: none"> 1. Risk of short circuit for electronic components and battery 2. Risk of battery ignition and electric shock 3. Cuts and puncture injuries 4. Exposure to chemicals, burns and high temperatures 5. Eye injuries 6. Ergonomic risks 7. Exposure to high noise levels 8. Risk of impact from rotating moving parts 				

Category No: 2 Category Name: Troubleshooting				
Task 3: Diagnosis of the problem with pre-flight maintenance tests.				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
			✓	
Importance of the task				
Not at all important	Slightly important	Important	Very important	
		✓		
Complexity of the task				
Easy	Moderate	Complex		
		✓		
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Basic knowledge about flight for control systems 2. Functions and testing methods of sensors and servo motors 3. Standard flight test procedures and safety measures 4. Fault detection and analysis methods 5. Analysis of telemetry data and identification of problem sources 6. Utilization of flight control software and other relevant software 7. Safety protocols to be followed during flight tests 8. Effective reporting of flight test results and technical collaboration 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Possessing analytical thinking and problem-solving skills 2. Manual dexterity 3. Communication skills 4. Piloting skills 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. Video recording device 2. Computer 3. Telemetry device 				
Additional notes on occupational safety and risks:				
<ol style="list-style-type: none"> 1. Risk of short circuit for electronic components and battery and battery ignition 2. Risk of electric shock 3. Cuts and puncture injuries 4. Exposure to burns and high temperatures 				

5. Eye injuries
6. Exposure to chemicals
7. Ergonomic risks
8. Exposure to high noise levels.
9. Risk of impact from rotating moving parts
10. Risk of collision with people by the UAV

Category No: 2				
Category Name: Troubleshooting				
Task 4: Analysing flight and crash logs.				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate		Complex	
			✓	
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Knowledge of logging data 2. Knowledge of data analysis 3. Knowledge of sensors 4. Knowledge of the device's technical specifications 5. Knowledge of reporting and technical documentation 6. Knowledge of flight software 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Computer proficiency 2. Ability to use log analysis software 3. Critical and analytical thinking skills 4. Technical document reading skills 5. Communication skills 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. Computer 2. Connection cable 3. Data storage unit 				
Additional notes on occupational safety and risks:				
Not applicable				

Category No: 2				
Category Name: Troubleshooting				
Task 5: Repairing mechanical failures				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
			✓	
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate		Complex	
			✓ (Depending on the mechanical problem)	
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Knowledge of repair and assembly 2. Knowledge of using mechanical equipment 3. Knowledge of the functions and placements of UAV parts and equipment 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Fine motor skills 2. Proficiency in using mechanical equipment 3. Ability to determine if UAV mechanical equipment needs repair, replacement, or maintenance 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. Safety equipment. 2. Mechanical inspection devices. 3. Electronic and mechanical assembly tools 				
Additional notes on occupational safety and risks:				
<ol style="list-style-type: none"> 1. Risk of short circuit for electronic components and battery 2. Risk of battery ignition or electric shock 3. Cuts and puncture injuries 4. Exposure to chemicals, burns and high temperatures 5. Eye injuries 6. Ergonomic risks 7. Exposure to high noise levels 8. Risk of impact from rotating moving parts 9. Risk of UAV collision with people 				

Category No: 2				
Category Name: Troubleshooting				
Task 6: Troubleshooting sensor errors				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
		✓		
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate		Complex	
			✓	
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Basic electronics knowledge 2. Knowledge of sensor types and functions 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Ability to use electronic and testing equipment 2. Ability to interpret sensor output graphs 3. Technical document reading skills 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. Testing equipment (such as oscilloscopes, optical tachometers, multimeter) 2. Electronic devices (soldering equipment, hot glue guns, etc.) 3. Mechanical devices (antistatic tweezers, screwdriver sets, etc.) 4. Circuit cleaning equipment (air blowers) 				
Additional notes on occupational safety and risks:				
<ol style="list-style-type: none"> 1. Using appropriate personal protective equipment (PPE) such as helmets, goggles, gloves, and sturdy shoes to provide protection against risks like electric shocks, cuts, and burns 2. Following safe work procedures (such as electrical isolation, lockout/tagout) and taking necessary safety precautions 3. Performing tasks in accordance with assembly procedures and checklists 4. Utilizing ESD protective equipment 				

Category No: 2				
Category Name: Troubleshooting				
Task 7: Debugging with product software (firmware) updates.				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate	Complex		
	✓			
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Basic software algorithm knowledge 2. Knowledge of calibration software interfaces (such as mission planners, DJI Fly, etc.) 3. Knowledge of current versions 4. Understanding of flight software 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Intermediate computer proficiency 2. Basic programming skills 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. Computers, tablets, etc. 2. Internet connection 3. Connection cables 4. Installed calibration software (DJI Assistant, Mission Planner, Ground Control, etc.) 				
Additional notes on occupational safety and risks:				
<ol style="list-style-type: none"> 1. The necessary safety measures should be taken in the working environment 2. Possibility of virtual security vulnerabilities 				

Category No: 2 Category Name: Troubleshooting				
Task 8: Performing basic calibration and adjustments in flight parameters.				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate	Complex		
	✓			
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Basic software algorithm knowledge 2. Knowledge of calibration software interfaces (such as Mission Planner, DJI Fly, etc.) 3. Understanding of flight software 4. Awareness of units to be calibrated (compass, IMU, etc.) 5. Knowledge of calibration procedures and their application steps 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Intermediate computer proficiency 2. Basic programming skills 3. Psychomotor skills 4. Technical document reading skills 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. Computers, tablets, etc. 2. Internet connection 3. Connection cables 4. Installed calibration software (DJI Assistant, Mission Planner, QGround Control, etc.) 				
Additional notes on occupational safety and risks:				
<ol style="list-style-type: none"> 1. Necessary safety precautions should be taken in the working environment. 2. Safety risk posed by the armed state and the presence or absence of propellers. 3. Risks of collision, injury, fire, and explosion. 				

Category No: 2				
Category Name: Troubleshooting				
Task 9: Implementing and suggesting preventive maintenance actions.				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not at all important	Slightly important	Important	Very important	
		✓		
Complexity of the task				
Easy	Moderate	Complex		
✓				
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Knowledge of storage and usage conditions for UAV components 2. Knowledge of equipment-specific maintenance schedules 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Communication skills 2. Mechanical assembly and maintenance knowledge 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. Li-Po protective bags 2. Waterproof electronic equipment protectors 3. Protective covers for camera and gimbal systems 4. Carrier protective cases 5. Pitot tube plug 6. Propeller guards 7. Air intake cover 				
Additional notes on occupational safety and risks:				
<ol style="list-style-type: none"> 1. Risk of fire and explosion due to impact and overcurrent in Li-Po batteries 2. Necessary safety precautions should be taken in the working environment 				

Category No: 2 Category Name: Troubleshooting				
Task 10: Post-maintenance test flight				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate		Complex	
	✓			
Which knowledge is necessary for this task?				
1. Basic UAV piloting knowledge 2. Knowledge of standard flight characteristics				
Which skills are necessary for this task?				
1. Ability to interpret flight data 2. UAV piloting skills				
Which tools and equipment are necessary for this task?				
1. UAV and its controller 2. Computer 3. Telemetry device				
Additional notes on occupational safety and risks:				
1. Necessary precautions should be taken in case of UAV fall or loss of control 2. Ensuring the safety of the flight area is necessary.				

Category No: 2 Category Name: Troubleshooting				
Task 11: Recording troubleshooting details (technician name, date, UAV model name, UAV ID, UAV weight) in a form				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate	Complex		
	✓			
Which knowledge is necessary for this task?				
1. Information about the brand, model, and serial number of the repaired UAV				
Which skills are necessary for this task?				
1. Reporting skills 2. Filing and archiving skills 3. Basic computer usage skills				
Which tools and equipment are necessary for this task?				
1. Computer 2. Repair and maintenance form 3. Office supplies				
Additional notes on occupational safety and risks:				
1. File organization should be meticulous, and documents should not be mixed up.				

Category 3 - Maintenance & Repair of Basic UAV Components

1. Prepare and use technician checklists for each specified component

2. Track and report on component procurement in parallel with sector developments

3. List and prepare basic tools used for repairing, disassembling, and assembling specified components

4. Adhere to appropriate security protocols while dealing with electronic components

5. Disassemble and assemble UAV components

6. Repair or replace damaged electronic components from the specified components

7. Repair or replace damaged mechanical parts among the specified components

8. Configure custom flight settings and autonomous operating profiles (software fix and update)

9. Perform the installation and configuration of additional components (payload, etc.)

10. Perform post-maintenance calibrations

11. Perform test flights to ensure repairs and parts replacement are performed correctly

12. Ensure control of flight test parameters

13. Perform periodic maintenance

14. Record basic information on the form (technician's name, repair date, repair information, UAV model, UAV ID, weight)

Category No: 3				
Category Name: Maintenance & Repair of Basic UAV Components				
Task 1: Prepare and use technician checklists for each specified component				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not important	Less important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderately complex	Complex		
✓				
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. To possess product model information 2. To be proficient in the functions and structures of the components within a UAV 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Documentation skills for filling out technical forms 2. Basic computer literacy skills 				
Which equipment and tools are required for this task?				
<ol style="list-style-type: none"> 1. Devices e.g., computer, tablet, etc. 2. Internet 				
Additional notes about the occupational safety procedures and risks of this task:				
<ol style="list-style-type: none"> 1. Checklists must be carefully filled out in accordance with the established rules. 				

Category No: 3				
Category Name: Maintenance & Repair of Basic UAV Components				
Task 2: Track and report on component procurement in parallel with sector developments				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
		✓		
Importance of the task				
Not important	Less important	Important	Very important	
		✓		
Complexity of the task				
Easy		Moderately complex	Complex	
		✓		
Which knowledge is necessary for this task?				
1. Being knowledgeable about the definition and functions of components within the vehicle structure 2. Being knowledgeable about UAV and UAV equipment manufacturers within the sector				
Which skills are necessary for this task?				
1. Basic computer literacy knowledge 2. Technical interpretation capability				
Which equipment and tools are required for this task?				
1. Devices e.g., computer, tablet, etc 2. Internet				
Additional notes about the occupational safety procedures and risks of this task				
Not applicable				

Category No: 3				
Category Name: Maintenance & Repair of Basic UAV Components				
Task 3: List and prepare basic tools used for repairing, disassembling, and assembling specified components				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not important	Less important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderately complex	Complex		
	✓			
Which knowledge is necessary for this task?				
1. Being knowledgeable about the usage and functions of tools to be used at basic and intermediate levels.				
Which skills are necessary for this task?				
1. Ability to organise				
Which equipment and tools are required for this task?				
1. Assembly and maintenance platforms 2. Equipment stands 3. Control Devices				
Additional notes about the occupational safety procedures and risks of this task:				
1. Careful placement of cutting and drilling materials 2. Organising hazardous chemicals in line with safety protocols				

Category No: 3				
Category Name: Maintenance & Repair of Basic UAV Components				
Task 4: Adhere to appropriate security protocols while dealing with electronic components				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not important	Less important	Important	Very important	
			✓	
Complexity of the task				
Easy		Moderately complex	Complex	
		✓		
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Being familiar with the specified security protocols 2. Having basic electronic knowledge 3. Having knowledge of UAV (Unmanned Aerial Vehicle) electronics, being trained to acquire information about all risks and measures that can be taken before performing UAV repair and maintenance 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Ability to use electronic devices and measurement instruments 2. Critical and analytical thinking skills 3. Having appropriate psychomotor skills 				
Which equipment and tools are required for this task?				
<ol style="list-style-type: none"> 1. Electronic measuring devices (multimeter, LC meter, etc.) 2. Antistatic ESD protective equipment (gloves, wrist strap, apron, etc.) 				
Additional notes about the occupational safety procedures and risks of this task:				
<ol style="list-style-type: none"> 1. Take necessary safety precautions in the workplace. 2. Use appropriate personal protective equipment (PPE) such as helmet, goggles, gloves, and sturdy shoes to provide protection against risks like electric shock, cuts, and burns. 3. Follow safe working procedures (such as electrical cutting, locking, and tagging). 				

Category No: 3				
Category Name: Maintenance & Repair of Basic UAV Components				
Task 5: Disassemble and assemble UAV components				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not important	Less important	Important	Very important	
			✓	
Complexity of the task				
Easy		Moderately complex	Complex	
			✓	
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Being proficient in UAV equipment and missions at intermediate and advanced levels 2. Having advanced knowledge of assembly techniques 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Ability to use advanced assembly equipment 2. Problem-solving skills 3. Analytical thinking skills 				
Which equipment and tools are required for this task?				
<ol style="list-style-type: none"> 1. Assembly equipment 2. Assembly platform 3. Mechanical and electronic measurement devices 4. Safety equipment 				
Additional notes about the occupational safety procedures and risks of this task:				
<ol style="list-style-type: none"> 1. Use appropriate personal protective equipment (PPE) such as helmet, goggles, gloves, and sturdy shoes to provide protection against risks like electric shock, cuts, and burns. 2. Follow safe working procedures (such as electrical cutting, locking, and tagging) and take necessary safety precautions. 3. Perform operations in accordance with assembly procedures and checklists. 				

Category No: 3				
Category Name: Maintenance & Repair of Basic UAV Components				
Task 6: Repair or replace damaged electronic components from the specified components				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not important	Less important	Important	Very important	
			✓	
Complexity of the task				
Easy		Moderately complex	Complex	
			✓	
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Mastering medium and advanced UAV equipment and tasks 2. Having knowledge of advanced assembly techniques 3. Having advanced knowledge of UAV electronic equipment 4. To know about whether UAV electronic equipment needs repair, replacement or maintenance 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Ability to use electronic devices and measuring devices 2. Must have critical and analytical thinking skills 3. Having good psychomotor skills 4. Ability to decide whether UAV electronic equipment requires repair, replacement or maintenance 				
Which equipment and tools are required for this task?				
<ol style="list-style-type: none"> 1. Mechanical and electronic measuring devices 2. Safety equipment 3. Electronic control devices 4. Electronic and mechanical installation equipment 				
Additional notes about the occupational safety procedures and risks of this task:				
<ol style="list-style-type: none"> 1. Wearing appropriate personal protective equipment (PPE), such as a helmet, goggles, gloves and sturdy shoes, to protect against risks such as electric shock, cuts and burns 2. Following safe working procedures (such as power cut-off, locking and tagging) and taking necessary security measures 3. Carrying out operations in accordance with installation procedures and checklists 				

Category No: 3				
Category Name: Maintenance & Repair of Basic UAV Components				
Task 7: Repair or replace damaged mechanical parts among the specified components				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not important	Less important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderately complex	Complex		
		✓		
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Mastering medium and advanced UAV equipment and tasks 2. Have advanced knowledge of assembly techniques 3. Having advanced knowledge of UAV mechanical equipment 4. To know whether UAV mechanical equipment needs repair, replacement or maintenance. 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Ability to use mechanical and measuring devices 2. Must have critical and analytical thinking skills 3. Having good psychomotor skills 4. Ability to decide if UAV mechanical equipment requires repair, replacement or maintenance 				
Which equipment and tools are required for this task?				
<ol style="list-style-type: none"> 1. Mechanical and electronic measuring devices 2. Safety equipment 3. Mechanical control devices 4. Electronic and mechanical assembly equipment 				
Additional notes about the occupational safety procedures and risks of this task:				
<ol style="list-style-type: none"> 1. Wearing appropriate personal protective equipment (PPE), such as a helmet, goggles, gloves and sturdy shoes, to protect against risks such as electric shock, cuts and burns. 2. Following safe working procedures (such as power off, locking and tagging) and taking necessary safety precautions. 3. Performing operations in accordance with assembly procedures and checklists 				

Category No: 3				
Category Name: Maintenance & Repair of Basic UAV Components				
Task 8: Configure custom flight settings and autonomous operating profiles (software fix and update)				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
		✓		
Importance of the task				
Not important	Less important	Important	Very important	
		✓		
Complexity of the task				
Easy		Moderately complex	Complex	
		✓ (Depends on the situation)		
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Programming knowledge 2. Use of computer 3. Hardware, software update 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Ability to update software 2. Having fine motor skills 				
Which equipment and tools are required for this task?				
<ol style="list-style-type: none"> 1. Input ports and converters such as USB and Type C 2. Electronic tweezers 3. Static wristband 4. Computer that can connect to the network 				
Additional notes about the occupational safety procedures and risks of this task:				
<ol style="list-style-type: none"> 1. The necessary safety precautions must be taken in the working environment. 				

Category No: 3				
Category Name: Maintenance & Repair of Basic UAV Components				
Task 9: Perform the installation and configuration of additional components (payload, etc.)				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
	✓			
Importance of the task				
Not important	Less important	Important	Very important	
	✓			
Complexity of the task				
Easy		Moderately complex	Complex	
		✓		
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Having knowledge about what additional ingredients are. 2. Having knowledge about the part to be assembled. 3. Performing tasks in a way that does not affect the center of gravity. 4. Knowing which repair tools are used 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Having psycho-motor skills 2. Having analytical thinking skills 3. Having problem solving skills 				
Which equipment and tools are required for this task?				
<ol style="list-style-type: none"> 1. Basic equipment 2. Additional components required 				
Additional notes about the occupational safety procedures and risks of this task:				
<ol style="list-style-type: none"> 1. For this task, the technician must work by paying attention to her/his environment and occupational safety principles. 				

Category No: 3				
Category Name: Maintenance & Repair of Basic UAV Components				
Task 10: Perform post-maintenance calibrations				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not important	Less important	Important	Very important	
			✓	
Complexity of the task				
Easy		Moderately complex	Complex	
		✓		
Which knowledge is necessary for this task?				
1. Having information about the calibration steps of the relevant part				
Which skills are necessary for this task?				
1. Must have critical and analytical thinking skills				
2. Having good psychomotor skills				
Which equipment and tools are required for this task?				
1. Computer and device control				
2. DJI Assistant 2 etc.				
Additional notes about the occupational safety procedures and risks of this task:				
1. The necessary safety precautions must be taken in the working environment. 2. Before performing UAV repair and maintenance, to be trained to learn about all risks and precautions that can be taken against them 3. It may be necessary to use appropriate personal protective equipment (PPE), such as a helmet, goggles, gloves and sturdy shoes, to protect against risks such as electric shock, cuts and burns. 4. Following safe work procedures (such as power off, locking out and tagging out)				

Category No: 3				
Category Name: Maintenance & Repair of Basic UAV Components				
Task 11: Perform test flights to ensure repairs and parts replacement are performed correctly				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not important	Less important	Important	Very important	
			✓	
Complexity of the task				
Easy		Moderately complex	Complex	
		✓		
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Knowing pre-flight checks 2. Having meteorological knowledge 3. Knowing safe flight zones 4. Knowing test flight procedures 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Manual skills 2. Problem solving skills 3. Analytical thinking skills 4. Communication skills 				
Which equipment and tools are required for this task?				
<ol style="list-style-type: none"> 1. UAV and controller 				
Additional notes about the occupational safety procedures and risks of this task:				
<ol style="list-style-type: none"> 1. The necessary safety precautions must be taken in the working environment. 				

Category No: 3				
Category Name: Maintenance & Repair of Basic UAV Components				
Task 12: Ensure control of flight test parameters				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not important	Less important	Important	Very important	
		✓		
Complexity of the task				
Easy		Moderately complex	Complex	
			✓	
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Type and model information 2. Information on technical specifications 3. Sensors and hardware information 4. Information about ground control software 5. Device control software information 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Manual skills 2. Problem solving skills 3. Analytical thinking skills 				
Which equipment and tools are required for this task?				
<ol style="list-style-type: none"> 1. Ground control software 2. Device control software 3. internet connected computer 4. Multimeter etc. Electronic measuring devices 				
Additional notes about the occupational safety procedures and risks of this task:				
Not applicable				

Category No: 3				
Category Name: Maintenance & Repair of Basic UAV Components				
Task 13: Perform periodic maintenance				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
		✓		
Importance of the task				
Not important	Less important	Important	Very important	
			✓	
Complexity of the task				
Easy		Moderately complex	Complex	
		✓ (Depends)		
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Flight time information 2. Information about whether the software is up to date 3. Information about UAV cleaning 4. Information about sensors 5. Information on the properties of mechanical parts 6. Information regarding review of flight records 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Manual dexterity 2. Problem solving skills 3. Analytical thinking skills 				
Which equipment and tools are required for this task?				
<ol style="list-style-type: none"> 1. Compressed air 2. Various solutions (cleaning and anti-rust) 3. Microfiber fabric 				
Additional notes about the occupational safety procedures and risks of this task:				
<ol style="list-style-type: none"> 1. It is necessary to consider weather conditions, the presence of people and animals in the flight area, and other potential risks. 				

Category No: 3				
Category Name: Maintenance & Repair of Basic UAV Components				
Task 14: Record basic information on the form (technician's name, repair date, repair information, IHA model, IHA ID, weight)				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not important	Less important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderately complex		Complex	
	✓			
Which knowledge is necessary for this task?				
1. Information about the brand, model and serial number of the repaired UAV				
Which skills are necessary for this task?				
1. Reporting skill				
2. Filing and archiving skills				
Which equipment and tools are required for this task?				
1. Computer				
2. Repair and maintenance form				
3. Office materials				
Additional notes about the occupational safety procedures and risks of this task:				
1. One must be careful about filing and avoid disrupting documents.				

Category 4 - Maintenance & Repair of Flight Controller Board, Sensors, and Remote Controller

1. Record basic details (technician's name, date, UAV model name, UAV ID, UAV weight) in the form

2. Prepare the basic tools to be used in the repair, removal, and installation

3. Replace or repair damaged components like motors, ESCs, and flight controllers

4. Solder/Desolder and circuit board repair for basic electronics issues

5. Perform sensor replacements and calibrations

6. Disassemble and reassemble UAV for component access and repair

7. Follow proper safety protocols for handling batteries and electrical components

8. Conduct flight test to ensure the correct repair or replacement operation

Category No: 4				
Category Name: Maintenance & Repair of Flight Controller Board, Sensors, and Remote Controller				
Task 1: Record basic details (technician's name, date, UAV model name, UAV ID, UAV weight) in the form.				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
			✓	
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate	Complex		
✓				
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Basic understanding of UAV components and models. 2. Familiarity with inventory management systems or data entry software. 3. Knowledge of standard weights and measurement 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Attention to detail. 2. Accurate data entry skills. 3. Basic computer literacy. 4. Good organizational skills. 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. Computer or tablet. 2. Inventory management software or database. 3. Forms (digital or paper). 4. Weighing scale (for UAV weight measurement). 				
Additional notes on occupational safety and risks:				
<ol style="list-style-type: none"> 1. Ensure proper posture while entering data to avoid repetitive strain injury. 2. Handle UAVs carefully to avoid physical damage. 3. Maintain a clean and organized workspace to prevent accidents. 				

Category No: 4				
Category Name: Maintenance & Repair of Flight Controller Board, Sensors, and Remote Controller				
Task 2: Prepare the basic tools to be used in the repair, removal, and installation				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
			✓	
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate	Complex		
✓				
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Understanding of various UAV models and their specific repair requirements. 2. Knowledge of the different types of tools required for UAV repair and maintenance. 3. Familiarity with safety procedures related to handling and using tools. 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Organizational skills to ensure all necessary tools are prepared and accounted for. 2. Attention to detail to avoid missing or incorrect tools. 3. Basic tool-handling skills. 4. Time management skills to efficiently prepare tools. 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. Screwdrivers (various sizes) 2. Pliers (needle nose, cutting) 3. Soldering iron and solder 4. Multimeter 5. Spare parts (e.g., propellers, motors, screws) 6. Cleaning supplies (e.g., brushes, wipes) and Safety equipment (e.g., gloves, goggles) 				
Additional notes on occupational safety and risks:				
<ol style="list-style-type: none"> 1. Ensure all tools are in good condition and properly maintained to avoid accidents. 2. Wear appropriate personal protective equipment (PPE) such as gloves and safety goggles. 3. Follow proper lifting techniques when handling heavy equipment to prevent injuries. 4. Keep the work area clean and free of clutter to prevent tripping and other accidents. 				

Category No: 4				
Category Name: Maintenance & Repair of Flight Controller Board, Sensors, and Remote Controller				
Task 3: Replace or repair damaged components like motors, ESCs, and flight controllers.				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
			✓	
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate	Complex		
		✓		
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. In-depth understanding of UAV architecture and components. 2. Knowledge of electronic components, including motors, ESCs (Electronic Speed Controllers), and flight controllers. 3. Familiarity with troubleshooting and diagnosing component failures. 4. Understanding of electrical safety and soldering techniques. 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Proficiency in soldering and desoldering electronic components. 2. Ability to use diagnostic tools such as multimeter. 3. Manual dexterity for handling small and delicate components. 4. Problem-solving skills to identify and fix issues. 5. Precision and attention to detail. 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. Soldering iron and solder. 2. Multimeter. 3. Screwdrivers and pliers. 4. Replacement parts (motors, ESCs, flight controllers). 5. Heat shrink tubing and electrical tape. 6. Anti-static wrist strap. 7. Tweezers and magnifying glass. 				
Additional notes on occupational safety and risks:				

1. Ensure the workspace is well-ventilated when soldering to avoid inhaling fumes.
2. Wear safety glasses to protect eyes from solder splashes.
3. Use an anti-static wrist strap to prevent static discharge from damaging electronic components.
4. Follow proper electrical safety procedures to avoid electric shock.
5. Keep the work area organized to prevent accidents and damage to components.

Category No: 4				
Category Name: Maintenance & Repair of Flight Controller Board, Sensors, and Remote Controller				
Task 4: Solder/Desolder and circuit board repair for basic electronics issues				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
			✓	
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate	Complex		
	✓			
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Basic understanding of electronic circuits and components 2. Knowledge of soldering techniques and best practices 3. Familiarity with common electronics issues in UAVs 4. Understanding of safety procedures related to soldering 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Proficiency in soldering and desoldering 2. Ability to identify and diagnose issues on a circuit board 3. Manual dexterity and precision 4. Attention to detail 5. Problem-solving skills 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. Soldering iron and solder 2. Desoldering pump or wick 3. Multimeter 4. Flux 5. Tweezers 6. Magnifying glass or microscope 7. Circuit board holder 8. Heat shrink tubing 9. Safety glasses and anti-static wrist strap 				

Additional notes on occupational safety and risks:

1. Ensure proper ventilation when soldering to avoid inhaling fumes.
2. Wear safety glasses to protect eyes from solder splashes.
3. Use an anti-static wrist strap to prevent damage to sensitive electronic components.
4. Follow proper handling and storage procedures for tools and materials to avoid injuries.
5. Keep the work area clean and organized to prevent accidents and ensure efficient work.

Category No: 4				
Category Name: Maintenance & Repair of Flight Controller Board, Sensors, and Remote Controller				
Task 5: Perform sensor replacements and calibrations				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
			✓	
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate	Complex		
	✓			
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Understanding of various types of sensors used in UAVs (e.g., GPS, gyroscope, accelerometer, barometer) 2. Knowledge of sensor installation procedures and calibration techniques 3. Familiarity with UAV flight dynamics and control systems 4. Awareness of software tools required for sensor calibration 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Ability to carefully handle and install sensitive electronic components 2. Precision and attention to detail during installation and calibration 3. Proficiency in using calibration software and tools 4. Problem-solving skills to troubleshoot sensor-related issues 5. Basic programming knowledge (for software-based calibrations) 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. Screwdrivers and pliers 2. Replacement sensors (e.g., GPS modules, IMUs) 3. Calibration tools and software 4. Computer or tablet for running calibration software 5. Multimeter for testing electrical connections 6. Anti-static mat and wrist strap 7. Safety glasses 				

Additional notes on occupational safety and risks:

1. Handle sensors with care to avoid damaging sensitive components.
2. Use an anti-static wrist strap to prevent static discharge from damaging electronic parts.
3. Follow proper calibration procedures to ensure accurate sensor readings.
4. Maintain a clean and organized work environment to prevent accidents.
5. Wear safety glasses to protect eyes from potential debris during sensor installation.

Category No: 4				
Category Name: Maintenance & Repair of Flight Controller Board, Sensors, and Remote Controller				
Task 6: Disassemble and reassemble UAV for component access and repair				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
			✓	
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate	Complex		
	✓			
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Knowledge of UAV architecture and components 2. Understanding of how different UAV parts are connected and function together 3. Familiarity with manufacturer-specific assembly and disassembly procedures 4. Basic electronics and mechanical principles 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Manual dexterity and precision 2. Proficiency with hand tools used for disassembly and reassembly 3. Ability to follow technical diagrams and manuals 4. Attention to detail to avoid damaging components 5. Organizational skills to keep track of small parts and screws 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. Screwdrivers (various sizes and types) 2. Pliers 3. Tweezers 4. Spadgers and plastic opening tools 5. Magnetic parts tray 6. Anti-static mat and wrist strap 7. Technical manuals and diagrams 8. Safety glasses 				

Additional notes on occupational safety and risks:

1. Use an anti-static wrist strap to prevent static discharge from damaging electronic components.
2. Keep the work area clean and organized to avoid losing small parts.
3. Handle sharp tools carefully to prevent injury.
4. Wear safety glasses to protect eyes from potential debris during disassembly.
5. Follow manufacturer guidelines to ensure proper reassembly and avoid structural weaknesses.

Category No: 4				
Category Name: Maintenance & Repair of Flight Controller Board, Sensors and Remote Controller				
Task 7: Follow proper safety protocols for handling batteries and electrical components				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate	Complex		
✓				
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Understanding of the risks associated with lithium-polymer (LiPo) and other types of batteries. 2. Knowledge of electrical safety principles. 3. Familiarity with manufacturer guidelines for battery handling and storage. 4. Awareness of fire safety protocols related to battery handling. 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Ability to follow detailed safety instructions 2. Precision in handling batteries and electrical components 3. Problem-solving skills for identifying potential hazards 4. Organizational skills for maintaining a safe work environment 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. Fireproof storage bags or containers for batteries 2. Insulated tools for electrical work 3. Multimeter for checking battery voltage and health 4. Personal protective equipment (PPE) such as gloves and safety glasses 5. Battery disposal containers 6. Fire extinguisher (Class D for metal fires) 				
Additional notes on occupational safety and risks:				

1. Always store batteries in a fireproof container when not in use.
2. Avoid overcharging or puncturing batteries, which can lead to fires or explosions.
3. Use insulated tools to prevent electrical shocks or short circuits.
4. Follow proper procedures for disposing of damaged or old batteries.
5. Wear PPE to protect against potential battery leaks or electrical hazards.
6. Ensure a fire extinguisher is readily available in the work area.

Category No: 4				
Category Name: Maintenance & Repair of Flight Controller Board, Sensors, and Remote Controller				
Task 8: Conduct flight test to ensure the correct repair or replacement operation				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
			✓	
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate	Complex		
	✓			
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Understanding of UAV flight dynamics and control systems 2. Knowledge of pre-flight and post-flight checklists 3. Familiarity with troubleshooting flight issues 4. Awareness of local regulations and safety guidelines for UAV operation 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Proficiency in operating UAVs 2. Ability to identify and diagnose flight performance issues 3. Attention to detail during pre-flight and post-flight inspections 4. Problem-solving skills to address any detected issues 5. Communication skills to document and report flight test results 				
Which tools and equipment are necessary for this task?				
<ol style="list-style-type: none"> 1. Fully charged UAV batteries, remote controller 2. Ground control software (if applicable) 3. Pre-flight checklist, notebook or digital device for recording observations 4. Safety equipment (e.g., safety glasses, gloves) 				
Additional notes on occupational safety and risks:				
<ol style="list-style-type: none"> 1. Conduct flight tests in a safe, open area away from people and obstacles. 2. Ensure all safety checks are completed before flight to prevent accidents. 3. Follow local regulations for UAV operation to avoid legal issues. 4. Be prepared to handle emergency situations, such as loss of control or power failure. 5. Use PPE as needed to protect against potential hazards during flight tests. 				

Category 5 - Documentation and Communication

1. Documentations of UAV repair and maintenance activities

2. Property inventory and storage conditions

3. Records of completed flights and reporting incidents

4. Safety regulations and compliance requirements

5. Standard operating procedures (SOP) and work orders (WO)

6. Reporting the condition of drones and recommending maintenance

Category No: 5 Category Name: Documentation and Communication				
Task 1: Documentations of UAV repair and maintenance activities				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate	Complex		
	✓			
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Knowledge of how to communicate malfunctions to the customer 2. Knowledge of how to use manuals and repair instructions 3. Knowledge of the UAV design and operation 4. Knowledge of electronics 5. Knowledge of how to retrieve and interpret logs 6. Knowledge of how to record what happened to the UAV 7. Knowledge of earlier service and repair history 8. Information about usage and operating the UAV 9. Basic knowledge of UAV repair procedures and documentation 10. Knowledge of technical language/terminology 11. Knowledge of the rules of operation of UAV 12. Knowledge of equipment, tools including specialized tools 13. Knowledge of materials and means used while performing UAV repair and maintenance 14. Knowledge of creating and reading and interpreting documentation 15. Knowledge of schedule and maintenance procedures 16. Knowledge how to read manuals and repair instructions 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Being able to use diagnostics tools 2. Being able to use basic tools 3. Being able to analyse logs 4. Being able to use technical language while noting down the maintenance procedures 				

5. Being able to record undertaken repair procedures through proper documentation
6. Being able to create proper technical documentation related to service or repair
7. Being able to interpret and read previous technical documentation related to previous service or repair
8. Being able to precisely state undertaken repair procedures
9. Being diligent in documentation
10. Being able to use computer and dedicated computer software

Which tools and equipment are necessary for this task?

1. Diagnostic equipment.
2. Printer.
3. PC, filing cabinet.
4. Access to documentation.
5. PC, laptop computer, tablet.
6. Relevant software.
7. Internet access.
8. Office equipment and stationery.
9. Physical flight logs.
10. Documents and office equipment.

Additional notes on occupational safety and risks:

1. Proper and detailed documentation of undertaken procedures will enable workers to communicate efficiently with the customer.
2. It is important to record detailed steps undertaken while repairing the drone especially if the drone repair is undertaken by more than one technician.
3. It is important to take down notes from all the maintenance and repair procedures.
4. Often maintenance documentation is neglected or is vague. Obscurity of the documentation may negatively impact on further UAV repair and maintenance procedures.
5. It is important to make sure that the records are stored in a safe place and back-up procedures are implemented regularly.
6. Filing reports and forms does not impose any risk or danger to the technician. Recording all activities is essential for drone operation and maintenance. It is the source of knowledge what has been done to the drone.
7. Documentation should be prepared in accordance with regulatory demands and restriction.

Category No: 5 Category Name: Documentation and Communication				
Task 2: Property inventory and storage conditions				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not at all important	Slightly important	Important	Very important	
		✓		
Complexity of the task				
Easy	Moderate	Complex		
✓				
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Knowledge of health and safety rules related to storage of UAV parts 2. Knowledge of the internal rules and regulations related to inventory and storage procedures 3. Knowledge of various UAV components and their specifications 4. Knowledge of the proper storing conditions 5. Knowledge how to read and maintain proper inventory documentation 6. Knowledge about documentation attached to processed drones 7. Knowledge how to read and interpret the specification related to different UAV 8. Knowledge of rules and regulations relating to organizing the warehousing the equipment 9. Knowledge of UAV design and parts 10. Knowledge of tools, equipment, parts, substances required to maintain and repair UAV 11. Knowledge of how to store and use dangerous or inflammable substances and equipment in the warehouse 12. Proper stocktaking procedures while the equipment is taken into the warehouse from the customer or in a form of a purchase 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Being meticulous, tidy, organised, and scrupulous 2. Being able to follow internal rules and procedures provided by the company 3. Being able to recognize technical data of various UAV components 4. Being able to follow the specification provided by the UAV manufacturer 5. Being able to manage and run the warehouse and use warehouse equipment 				

6. Being able to produce documents related to storing and inventory
7. Being able to timely organize equipment turnover
8. Being able to file and catalogue all the elements disassembled from the drone
9. Being able to prevent loss or damage of UAV elements and parts
10. Being able to prevent mistakenly reassembling wrong parts in the UAV
11. Being able to prepare and maintain proper storage conditions

Which tools and equipment are necessary for this task?

1. Personal computer, laptop, tablet with necessary software
2. Document file. Printer
3. Basic mechanical tools
4. Equipment for maintaining and storing LIPO/LION batteries
5. Warehouse management software
6. Internet access
7. Proper documentation such as UAV admission card stating in detail the parts and their condition while admitting the equipment
8. Paper documentation, pens and pencils

Additional notes on occupational safety and risks:

1. It is important that the company assigns a dedicated member of staff to supervise and manage inventory and storage procedures.
2. It is important to properly analyse the incoming equipment and file it into the inventory.
3. Inventory checks and periodic control are advisable.
4. Proper organization of inventory rules and regulations is necessary to allow all the team members work efficiently with the equipment.
5. It is important to meticulously detail all the parts that are received from the customer with the signature of the customer proving the list of the inventory given to the company for the maintenance or repair.
6. Strict electric battery storage is required in accordance with health and safety regulations and requirements provided by manufacturer.
7. It is crucial to secure documentation from unauthorised personnel.
8. It is important to regularly perform back-up of all documentation used in the warehouse.
9. It is vital to have procedures relating to unexpected events such as floods, fires, burglary.

Category No: 5				
Category Name: Documentation and Communication				
Task 3: Records of completed flights and reporting incidents				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate	Complex		
		✓		
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Knowledge of how to report incidents, technical issues, malfunction needs technical knowledge about principles of drones' operation 2. Knowledge of avionics 3. Knowledge of UAV structural design and UAV systems 4. Knowledge of basic electronics 5. Knowledge of proper verification procedures. 6. Knowledge of how to retrieve and read logs from flights 7. Knowledge of how to report pre-flight, post-flight records. 8. Knowledge of how to record and read the conditions under which the flight takes place 9. Knowledge of the rules of usage and maintaining UAV 10. Knowledge of operating procedures 11. Knowledge of how to analyse flight records and how to interpret diagnostic logs and parameters 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Engineering analysis. – for proper reporting of malfunctions 2. Ability to operate equipment related to photographic and video recording 3. Log analysis skills 4. Proper usage of flight book 5. Ability to pilot UAV 6. Ability to read logs 7. Ability to understand how the logs correspond with the design of UAV 				

8. Diligence and meticulousness
9. The ability to analyse flight logs
10. The ability to extract and read digital log information and its interpretation
11. The ability to connect to the UAV computer and retrieve logs
12. The ability to use various software designed to retrieving logs and storing logs
13. The ability to maintain proper records and documents related to drone usage
14. Being able to analyse, note, and record malfunctions
15. Being able to properly articulate all malfunctions to the customer

Which tools and equipment are necessary for this task?

1. Tools for extracting and storing logs from autopilot
2. Camera/Movie camera
3. GCS or radio
4. PC or laptop computer with required software
5. Internet access
6. Basic toolbox

Additional notes on occupational safety and risks:

1. Appropriate reporting number of flight and malfunction happened is crucial for the system development and safety.
2. Any given flight should be performed and analysed according to the previously prepared plan in order to verify every aspect of UAV performance.
3. Potential problems before the flight and during the flight should be identified to properly report incidents and organize records of identified incidents for future reference.
4. It is crucial to secure the records and prevent them from loss.
5. It is important to read the records properly to tell the customer what is wrong with the drone and suggest the right procedures of repairing the drone.

Category No: 5 Category Name: Documentation and Communication				
Task 4: Safety regulations and compliance requirements				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate	Complex		
	✓			
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Knowledge of general safety rules, UAV regulations, and legal environment 2. Knowledge of internal company rules, regulations, and procedures 3. Knowledge of health and safety regulations for UAV maintenance, inspection, servicing and law regulations related to UAV service and maintenance 4. Knowledge of workplace-specific health and safety regulations 5. Knowledge of UAV construction, design, and operation 6. Knowledge of compliance requirements for UAV parts and systems 7. Knowledge of the features of materials and substances used in UAV the process of maintenance and servicing 8. Knowledge of health and safety regulations while operating drones and safety equipment, including glasses, overalls, and gloves 9. Knowledge of rules and procedures for filling out documentation 10. Knowledge of OSH documentation and health and safety manuals from the company and manufacturers 11. Knowledge of how to safely test, inspect, and operate drones 12. Knowledge of regulations provided by UAV manufacturers 13. Knowledge of compliance regulations of the drone that is provided by the manufacturer 14. Knowledge of dangerous materials and tools 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Being able to understand and follow rules, instructions, regulations, orders and recommendations 				

2. Being able to apply procedures and follow rules and regulations
3. Ability to understand and apply the health and safety regulations
4. Ability to evaluate documentation and report incidents
5. Being focused while performing work tasks
6. Being able to understand and implement information, recommendations, and procedures provided by a manufacturer
7. Proper drone operation skills
8. Being able to maintain storage properly
9. Being able to operate tools safely and according to the good use practices

Which tools and equipment are necessary for this task?

1. Documents, checklists, guidebooks, and regulations to follow
2. Maintenance Logbooks - PC / laptop/computer for documentation
3. Access to documentation both in paper form and electronic
4. Relevant software
5. Internet access
6. Internal OHS regulations and practice
7. Designated safe place to operate, analyse, test and repair the drone

Additional notes on occupational safety and risks:

1. If safety regulations or requirements of compliance are ignored the drone cannot be operated and -lead to make manufacturer warranty null and void.
2. It is key to perform periodic health and safety trainings in order to maintain high level of awareness of the importance of the OHS rules in the company.
3. It is important to apply safety rules and regulations and comply with the law and internal procedures in order to prevent incidents related to personal health and safety together with property damage.
4. Health and safety regulations are often neglected in the company and it is important to report any incidents of the rules being not followed to the supervisor and other members of the team.
5. Apart of internal OHS regulations it is important to understand that every drone is different and various compliance requirements should be applied apart from the general rules applied in the company.
6. Being able to safely operate the drone that is reported as faulty and / or is suspected to be faulty must be performed in a safe space as it is greatly unpredictable how the UAV will operate.

Category No: 5 Category Name: Documentation and Communication				
Task 5: Standard operating procedures (SOP) and work orders (WO)				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
			✓	
Importance of the task				
Not at all important	Slightly important	Important	Very important	
		✓		
Complexity of the task				
Easy	Moderate	Complex		
	✓			
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Detailed knowledge about system principles of operation 2. Awareness of safety rules 3. Complex knowledge about design and configuration of drones 4. Being familiar with tools and general maintenance and repair procedures 5. Knowledge of design and operation rules of UAV 6. Knowledge of rules and regulation of performing inspection, UAV repair and maintenance 7. Knowledge of rules for using materials and substances used while operating the drones 8. Knowledge of rules regarding using dangerous goods 9. Knowledge of rules being applied in special situations 10. Knowledge of drone documentation, checklists, and preflight 11. Knowledge of electromechanical elements 12. Knowledge of rules and regulations related to certification 13. Knowledge of internal procedures applied in the company 14. Knowledge of the law regulating flight and operating UAV 15. Knowledge of maintenance manuals 16. Knowledge of work order, standard operating procedures, and procedures for testing and fixing drones 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Ability to maintain clear communication with customers and team members 2. Ability to describe technical processes clearly without any space for misinterpretation 3. Ability to read documentation 				

4. Ability to find, analyse, and apply rules and regulations regarding UAV use, maintenance, and operation, including dangerous [goods](#)
5. Ability to create and periodically review and update standard operating procedures (SOP)
6. Being able to apply relevant systems of UAV maintenance and operation, ensuring compliance with applicable laws and regulations
7. The ability to follow procedures while performing inspection / diagnostics / repair and service tasks
8. The ability to perform repairs in order with the internal procedures and rules and regulations
9. Being able to communicate with other team members and technicians
10. Being able to communicate with the management

Which tools and equipment are necessary for this task?

1. Word processor, computer graphics toolbox for preparing technical documentation
2. Printer
3. E-book
4. Access to documentation in paper and electronic form
5. Relevant software
6. Internet access
7. Paper documentation

Additional notes on occupational safety and risks:

1. Faulty SOP might impose serious danger to technicians' health and safety and/or property.
2. Any incidents regarding the SOP or WO should be reported immediately and the documents revised according to the health and safety rules and/or technical requirements of UAV servicing and repair.
3. The importance of the WO regarding diagnostics and inspection is crucial. The company should have relevant procedures prepared and followed by all technicians in order to maintain high level of service.
4. It is important to communicate with the supervisors and management regarding internal procedures applied to constantly monitor the quality of performance within the company.
5. The SOP and WOs must be revised regularly by the whole team based on gained experience and the evaluation process must take into account the knowledge, skills and experience given by the technicians.

Category No: 5				
Category Name: Documentation and Communication				
Task 5: Reporting the condition of drones and recommending maintenance				
Frequency of the task				
Never	Rarely	Sometimes	Often	Always
				✓
Importance of the task				
Not at all important	Slightly important	Important	Very important	
			✓	
Complexity of the task				
Easy	Moderate	Complex		
		✓		
Which knowledge is necessary for this task?				
<ol style="list-style-type: none"> 1. Detailed knowledge of drone operations, original state of the UAV, and design, including avionics, mechanics, and radio communication 2. Knowledge of diagnostics, inspection, repairs, and conservation procedures, including how to analyse UAV condition 3. Knowledge of documentation procedures for performed tasks, including reporting isolated faults 4. Knowledge of the frequency of maintenance tasks 5. Knowledge of substances and materials required to perform the tasks 6. Knowledge of the job description and scope of UAV maintenance and repair 7. Knowledge of how to extract flight data from the drone to a data storage device 8. Knowledge of frequently occurring faults in components and UAV systems 9. Knowledge of elements and components that were replaced or fixed in the drone 				
Which skills are necessary for this task?				
<ol style="list-style-type: none"> 1. Being able to isolate faulty conditions of the drone 2. Being able to read log data and report the state of the UAV 3. Being able to extract flight data 4. Being able to inspect physical and technical conditions of the drone and its components 5. Ability to perform tasks such as inspection, repair, maintenance, and conservation 6. Ability to use multimedia devices 7. Being able to communicate clearly 8. Being able to use a computer software and diagnostic tools 				

<ul style="list-style-type: none"> 9. The ability to recognize problems with the UAV and analyse the types of drone malfunction and or damage 10. Being able to run a test of a drone
Which tools and equipment are necessary for this task?
<ul style="list-style-type: none"> 1. Tools for extraction the flight data 2. Dedicated tools for particular UAV maintenance tasks. 3. Mechanical and electric tools that are necessary to inspect the UAV condition 4. Screwdriver kit with different heads 5. Pliers 6. Multimeter 7. Battery tester 8. Propeller balancer 9. Access to documentation 10. Multimedia equipment and devices 11. Relevant software 12. Access to the Internet 13. Office equipment and stationery 14. Laptop, tablet
Additional notes on occupational safety and risks:
<ul style="list-style-type: none"> 1. There are risks connected with symptoms that may be omitted or misinterpreted. 2. Untrained or unskilled staff may provide poor quality report that contains misleading information that leads to time and / or money waste. 3. Drone maintenance should be performed in a designated area and safe workplace with easy access to all required tools. 4. It is important to ensure that all the diagnostic equipment and devices are working properly to avoid misleading diagnostic data. 5. All documents should be secured and back-up performed regularly.

Expected performance Standards

The following document can be used to evaluate the expected performance of the UAV repair and maintenance technician.

Accuracy		
Successful Repair	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Compliance with Specifications	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Minimal Impact on Other Systems	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Efficiency		
Timeliness	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Minimal disassembly	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Optimal Resource Use	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Safety		
Following protocol	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Risk Assessment	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Quality Control	<input type="checkbox"/> Yes	<input type="checkbox"/> No

EVIDENCE GUIDE

This section is designed for evaluating the skills and knowledge of UAV repair and maintenance technicians. It outlines various methods for assessing a technician's competency in different areas which are important for UAV production, piloting and service companies' recruitment and employment sustainability processes.

1. Practical Assessments:

Simulated Repair Tasks:

Evaluating a technician's ability to perform repairs like component assembly and disassembly, mechanical and electrical repair, or emulating real-world repair scenarios, within a controlled environment.

Examples of Evaluation Scenarios

a. Component Assembly and Disassembly:

- **Objective:** Evaluate the technician's ability to correctly assemble and disassemble UAV components.
- **Task Description:** Technicians will be provided with a UAV motor and asked to disassemble it, identify each part, and then reassemble it correctly. This task will test their manual dexterity and understanding of component functions.
- **Evaluation Criteria:**
 - Correct identification of components
 - Proper use of tools
 - Accuracy in reassembling the motor
 - Time taken to complete the task
- **Assessment Tool:** Performance evaluation form, checklist.

b. Electrical System Repair:

- **Objective:** Assess the technician's skills in diagnosing and repairing electrical faults in UAVs.
- **Task Description:** Technicians will be presented with a UAV with an electrical fault. They must use diagnostic tools to identify the problem, such as a short circuit, and then repair the fault.
- **Evaluation Criteria:**

- Accuracy in diagnosing the fault
 - Proper use of diagnostic equipment
 - Quality of the repair work
 - Safety measures taken during the repair
- **Assessment Tool:** Practical exam, performance evaluation form

Flight Performance Analysis:

Assessing a technician's understanding of how different repairs or maintenance procedures can affect an UAV's flight performance. To determine this, technicians need to know how to analyse data or troubleshoot malfunctions related to flight characteristics.

Example of an Evaluation Scenario

a. Flight Performance Analysis:

- **Objective:** Test the technician's ability to analyse flight performance data and troubleshoot related issues.
- **Task Description:** Technicians will receive flight data logs from a UAV with reported performance issues. They must analyse the data to identify the problem and suggest corrective actions.
- **Evaluation Criteria:**
 - Ability to interpret flight data
 - Correct identification of performance issues
 - Appropriateness of suggested solutions
 - Documentation of analysis and findings
- **Assessment Tool:** Flight data analysis report, performance evaluation form

2. Interviews:

Technical Knowledge

Utilising interview questions to evaluate a technician's understanding of UAV systems, their function, and how to diagnose/repair problems

Assessment Tool: Technical knowledge interview questions, evaluation form.

Troubleshooting Skills

Utilising interview questions that focus on how the technicians approach troubleshooting issues by employing their problem-solving skills and ability to identify the root cause of malfunctions

Assessment Tool: Troubleshooting interview questions, evaluation form

Communication Skills

Utilising interview questions that evaluate how effectively the technicians can communicate technical information which is important for working with clients, other technicians, and documenting repairs.

Assessment Tool: Communication skills interview questions, evaluation form

3. Observations

Workplace Behaviour

Assessing the technician's professionalism, safety practices, communication and collaboration with others and work ethic while performing tasks in a simulated or real-world environment.

Assessment Tool: Observation form, behaviour assessment checklist

Problem-Solving Approach

Observing how the technician tackles problems, identifies solutions, and implements them effectively.

Assessment Tool: Observation form, problem-solving assessment checklist

4. Portfolio Reviews:

Previous Repair Work

Reviewing documentation or examples of the technician's past work on UAV repairs.

Assessment Tool: Portfolio review form, evaluation of previous work

Certifications and Training:

Assessing the technician's commitment to professional development by reviewing their certifications, conference or other relevant event participations, and encouraging them to improve their skills

Assessment Tool: Certification and training evaluation form, professional development assessment checklist.

5. Technical Knowledge Tests and Online Exams

Written or online exams and case studies to assess understanding of the theoretical knowledge about UAV components, electronics, software, and aviation regulations.

Assessment Tool: Written Exams, Case Studies

6. Software Proficiency

Firmware and Software Updates

Evaluating the ability to perform firmware and software updates accurately and troubleshoot any issues that arise

Flight Data Analysis

Evaluating data from flight logs to assess the impact of maintenance on performance and reliability.

Diagnostic Software Use

Assessing proficiency in using diagnostic software tools for troubleshooting and maintenance.

Assessment Tools: Performance-Based Assessments

7. Documentation and Reporting

Record Keeping

Checking the accuracy and completeness of maintenance logs and reports.

Incident Reporting

Evaluating how well the technicians' proficiency in documenting and reporting incidents or issues encountered during maintenance.

Assessment Tools: Writing Assignments

8. Adherence to Standards and Safety Procedures:

Ensuring compliance with safety protocols and procedures, minimising risks during maintenance and operations.

Assessment Tools: Compliance Audits, Checklists and Inspections

NATIONAL QUALIFICATIONS FRAMEWORK

Existing Regulations

National Qualifications Framework and Existing Regulations

The rapid development and widespread adoption of Unmanned Aerial Vehicle (UAV) technologies necessitate the training of competent technicians in this field. In this context, it is crucial to define the competencies of UAV maintenance and repair technicians and to outline these competencies within the national qualifications' framework. Below, a detailed assessment considering existing regulations and country-specific adjustment needs are provided.

Existing Regulations and Training Standards

International standards set for UAV maintenance and repair technicians play a critical role in enhancing the quality and reliability of training in this field. The standards developed and adopted by ASTM International's F38 committee specify the criteria to be considered in the education and certification processes of UAV maintenance technicians. For instance, ASTM F3266-19 standard details the knowledge, skills, and competencies required for UAV maintenance and repair technicians.

The Federal Aviation Administration (FAA) regulations defined under 14 CFR Part 147 outline the scope and requirements for airframe maintenance training. However, these regulations have not undergone a comprehensive update for over 50 years, which makes them insufficient for modern UAV technologies. The adoption of new training standards along with the FAA's new Mechanic Airmen Certification Standard (ACS) is a significant step towards updating the education in this area.

Country-specific Adjustments

Adjustments in Cyprus

UAV repair and maintenance technicians in Europe, including Cyprus, must adhere to the **European Union Aviation Safety Agency (EASA)** regulations. The EASA plays a significant role in setting regulations and training standards for UAV (Unmanned Aerial Vehicle) repair and maintenance technicians. These regulations are influenced by broader

aviation and UAV-specific regulatory frameworks, and cover the rules for operating UAVs in the European Union, including provisions for the design, manufacture, and maintenance of UAVs. Cyprus follows these regulations through its Department of Civil Aviation, ensuring compliance with both national and EU standards.

The EASA Regulations that should be taken in consideration in forming the national qualifications framework are:

Regulation (EU) 2019/947 that outlines the rules for the operation of UAVs in the European Union. Key aspects include:

- **Categories of Operations**
Defines three categories based on risk – Open, Specific, and Certified. The Open category is for low-risk operations, Specific for medium-risk, and certified for high-risk operations.
- **Operational Authorizations**
Operators in the Specific and Certified categories must obtain authorizations from the relevant aviation authorities.
- **Remote Pilot Competency**
Specifies the training and certification requirements for remote pilots.

Regulation (EU) 2019/945 that focuses on the technical requirements and product standards for UAVs. Key aspects include:

- **Design and Manufacture**
Standards for UAV design, manufacturing, and environmental protection.
- **Certification**
Certification processes for UAVs, including requirements for airworthiness and safety.

Part-145 that is crucial for organizations involved in the maintenance of aircraft, including UAVs. It ensures that maintenance organizations meet stringent safety and quality standards. While Part-145 is not specifically designed for UAV (UAV) maintenance, certain principles and practices from this regulation can be applied to UAV maintenance to ensure safety and reliability. Key elements include:

- **Quality System**
Organizations must have a robust quality system to oversee maintenance activities.

- Personnel Requirements
Maintenance staff must have the appropriate qualifications and training.
- Facilities and Equipment
Adequate facilities and equipment must be available to perform maintenance tasks.
- Maintenance Procedures
Clear and documented procedures for performing maintenance, including record-keeping and reporting.

Regarding the training standards EASA promotes competency-based training and assessment for aviation maintenance personnel, including UAV technicians. This ensures that individuals have the necessary skills and knowledge to perform maintenance tasks safely and effectively. In addition, training programmes must be conducted by EASA-approved organizations, ensuring that the curriculum meets the regulatory requirements and industry standards.

The development of a specialized curriculum for UAV maintenance technicians should align with the EASA regulatory requirements and the Cypriot national standards. The curriculum must cover a broad range of topics to ensure comprehensive training and competency in UAV maintenance and repair. It is extremely important to include training on safety standards, protocols and regulations to ensure safe handling and maintenance of UAVs in accordance with the EASA regulations.

As regards to certifications, upon completion of the training program, technicians should receive certification from the approved training organization. This certification indicates that the technician has met the required competency standards for UAV maintenance.

Adjustments in Türkiye

SHT-IHA Aerial Vehicle Systems Instructions were published by the Turkish Directorate General of Civil Aviation (SHGM) in 2020

(https://web.shgm.gov.tr/documents/sivilhavacilik/files/mevzuat/sektorel/talimatlar/2020/SH-T-IHA_Rev-04.pdf). In this instruction, the Aircraft Maintenance Manual (AMM) and Maintenance Programme Document (MPD) are the basic documents related to maintenance. Maintenance and repair requirements are stated under Article 9.

The most striking point in the regulation is that all responsibility for maintenance is given to the UAV pilot. ***“The UAV pilot is responsible for the maintenance and repair of the UAV and its systems in accordance with the manuals published by the manufacturers.”***

For UAV0 and UAV1 classes, maintenance and repair must be performed by certified individuals. The UAV pilot ensures compliance with manufacturer standards. All activities and purchase documents for replaced parts are recorded and kept for three years. Replaced parts must be certified per manufacturer standards.

For UAV2 class UAVs, in addition to UAV1 rules, the following apply:

- Tools and equipment used in maintenance must be tested and calibrated as per regulations.
- Service bulletins and directives from the designer, manufacturer, or General Directorate are implemented.
- Life-limited parts are monitored and replaced timely.
- A maintenance programme is established by the operator/owner/pilot to ensure airworthiness.

For UAV3 class UAVs, in addition to UAV2 rules, the following apply:

- Maintenance and repairs are conducted by a General Directorate-authorized organization.
- A Maintenance Release Certificate is issued by the organization, confirming adherence to manufacturer standards and procedures.
- Records of technicians, tools, equipment, and parts used are kept for at least three years by both the organization and UAV pilot.

The use and maintenance of UAV technologies must be adapted to the regulations and needs of each country. In Türkiye, the standards set by the Directorate General of Civil Aviation (DGCA) should be considered in forming the national qualifications framework. Key factors to consider in this process include:

1. Curriculum Development and Certification:

Curriculum Development

A curriculum that aligns with the country's aviation regulations and training standards should be developed. In Türkiye, a specialized curriculum for UAV maintenance technicians should

be prepared in accordance with the standards set by DGCA(SHGM). For example, the curriculum should include topics such as component assembly, electrical system repairs, and flight performance analysis or practical lessons should be provided to technicians to equip them with the skills to perform motor assembly and disassembly on a UAV.

Certification Programmes

National certification programs that validate the competencies of UAV maintenance technicians should be established. These certifications should be internationally recognized documents that verify the knowledge and skills of technicians. Certification programmes should include practical and theoretical exams to comprehensively evaluate the competencies of technicians. As an exemplary practice, we suggest that technicians should gain experience by performing UAV maintenance and repair applications for a certain period and then receive certification based on the assessment.

Adjustments in Poland

The most important institution in Poland regulating aviation, including Unmanned Aerial Vehicles (drones), is the Civil Aviation Office (ULC). ULC is responsible for the regulation, supervision, and development of civil aviation in Poland. This institution deals with the implementation of regulations, registration of drones, operators, training, certification and supervision.

Poland's regulations regarding UAVs are consistent with both European Union regulations and national law. All EU regulations regarding drones are implemented in Poland in national regulations or applied directly.

The most important national regulations include: Aviation law. The Ordinance of the Minister of Infrastructure and Construction of August 8th, 2016 on unmanned aircraft and flying models. The Ordinance of the Minister of Infrastructure of April 20th, 2020 on detailed technical and operational conditions for unmanned aircraft systems.

In terms of categories of operations, classification of drones, registration of drones, their certification, certification of operators, certification of operational permits, in Poland the provisions of the European Union and national regulations of 2016 apply.

In Poland, all drones weighing over 250 grams must be registered with the Civil Aviation Office (ULC).

Operations

Each drone flight in Polish airspace should take place after informing the Polish Air Navigation Services Agency of the intention to fly via the IT system specified by the Agency.

The UAV operator is fully responsible for the operation performed and, before performing it, must check the availability of airspace via the DroneMap website (providing the parameters of the planned flight). In some cases, consent from the manager of the airspace (or place) may be required.

In the Open category (low risk), there is no need to submit declarations or obtain permits from the Civil Aviation Office. In this category, operations can be performed within the visual range of the pilot or with the assistance of an observer (VLOS), with drones weighing less than 25 grams, at a distance of no more than 120 meters from the nearest point of the earth's surface. Registration in the System is required for UAV operators who have drones weighing over 250 gram or are equipped with a data collection sensor (e.g. camera).

In the Special category (medium risk), the execution of the operation will require verification and, in some cases, consent of the Civil Aviation Office. When performing operations in a special category, UAV operators must be registered in the System. In the special category, SUAV operations can be performed after the selected variant is met:

- a. submitting a declaration of an operation consistent with the standard scenario (STS - Standard Scenarios) or the national standard scenario (NSTS - National Standard Scenarios);
- b. receipt of authorization for operations in a special category;
- c. obtaining the ULC certificate.

In the certified (high risk) category, operations require UAV certification under Regulation (EU) 2019/945.

Respecting Flight Zones

Drones are prohibited from flying in certain areas without prior authorization. These areas include: proximity to airports, populated areas and strategic and protected locations.

Maximum Flight Altitude

Drones cannot fly higher than 120 meters (400 feet) above ground level. This limit is imposed to minimize the risk of collisions with aircraft operating at higher altitudes.

Insurance

For commercial flights, drone operators must have liability insurance. This covers damage caused by the drone to third parties, ensuring that victims of potential accidents are adequately compensated.

Privacy Protection

Drone operators must comply with data protection laws and avoid invading the privacy of others. This is particularly important in the case of drones equipped with video cameras that can record images without the consent of the people being filmed [Regulation (EU) 2016/679, GDPR, Art. 5, principles of personal data processing].

Registration and Licensing of Operators

Registration of Unmanned Aircraft Systems Operators is free of charge and available at drony.gov.pl. The following are subject to registration: UAV operators who perform operations in the "open" category, with certain exceptions. Anyone wishing to fly a drone weighing 250g or more must complete training and pass an online test before flying. Pilots who want to fly in a special category must undergo training and pass an examination conducted by authorized institutions.

[Adjustments in Romania](#)

Legal Regulations on UAVs in Romania

In recent years, the use of UAVs has significantly increased, both for recreational and commercial purposes. This rapid expansion has necessitated strict regulations to ensure airspace safety, privacy protection, and security compliance. In Romania, these regulations are managed by the Romanian Civil Aeronautical Authority (AACR) and are aligned with the directives of the European Union Aviation Safety Agency (EASA).

1. Classification of UAVs

UAVs are classified based on their weight and intended use. The main categories are:

- Under 250 grams: These UAVs are considered less dangerous and have more relaxed regulatory requirements.
- Between 250 grams and 25 kilograms: These UAVs require registration and, in some cases, specific authorization.

- Over 25 kilograms: The use of these UAVs is strictly regulated and requires special authorizations, generally for commercial or industrial purposes.

2. UAV Registration

In Romania, all UAVs exceeding 250 grams must be registered with the AACR. The registration process involves providing information about the UAV and the operator, and obtaining a registration certificate. This measure allows authorities to monitor UAV usage and intervene in case of incidents.

3. Authorization Requirement

To operate UAVs in Romanian airspace, an authorization from the AACR is required, especially for commercial flights or those conducted in restricted areas. The authorization is granted based on risk assessment and compliance with safety standards. For example, flights near airports, military bases, or other strategic sites require special approvals.

4. Adherence to Flight Zones

UAVs cannot fly in certain areas without prior authorization. These areas include:

- Proximity to airports: To prevent interference with commercial air traffic.
- Populated areas: Flights over crowds are strictly regulated to prevent accidents.
- Strategic sites and protected areas: To ensure security and environmental protection.

5. Maximum Flight Altitude

Generally, UAVs must not fly higher than 120 meters (400 feet) above ground level. This limit is imposed to minimize the risk of collision with aircraft operating at higher altitudes.

6. Insurance

For commercial flights, UAV operators must have liability insurance. This covers damages caused by the UAV to third parties, ensuring that victims of potential accidents are compensated.

7. Privacy Protection

UAV operators must comply with data protection laws and avoid invading the privacy of others. This is crucial when using UAVs equipped with video cameras, which can record images without the consent of the individuals being filmed.

8. Operator Licensing

To operate UAVs in certain categories and purposes, operators must hold a license issued by the AACR. Obtaining this license requires completing a training course and passing an exam that certifies the necessary skills for safe UAV operation.

9. Safety Rules

Safety is a priority in UAV operations. Operators must follow best practices, such as maintaining a direct visual line of sight with the UAV during flight and avoiding flights over crowds. Additionally, operators should check the technical condition of the UAV before each flight to ensure all systems are functional.

GLOSSARY

Airframe: The main structure of a UAV, supporting all other components like motors, propellers, and payload.

Battery Management System (BMS): Electronic system that monitors and manages the battery in a UAV, ensuring its safe and efficient operation.

Calibration: The process of adjusting sensors and other components in a UAV to ensure accuracy and optimal performance.

Communication Link: The method used for transmitting and receiving data between a UAV and its ground control station.

Component: An individual part within a UAV system, such as a motor, propeller, or flight controller.

Data Logging: Recording flight data from a UAV, including information like altitude, position, and battery status.

Electromagnetic Interference (EMI): Disturbance caused by electrical or magnetic fields that can interfere with the electronic systems of a UAV.

Federal Aviation Administration (FAA): The US government agency responsible for regulating UAV operation in the United States.

Flight Controller: The onboard computer that controls the flight of a UAV, receiving inputs from sensors and sending commands to motors and other components.

Global Navigation Satellite System (GNSS): A system of satellites that provides position and timing information, used by UAVs for navigation.

IMU (Inertial Measurement Unit): A sensor that measures a UAV's acceleration, orientation, and rotation.

LiDAR (Light Detection and Ranging): A technology that uses lasers to measure distance and create 3D maps. Used in some UAVs for applications like surveying and mapping.

Maintenance: Routine tasks performed on a UAV to ensure its proper function and safety, such as cleaning, inspections, and software updates.

Payload: The cargo carried by a UAV, which can include cameras, sensors, or other equipment.

Pre-flight Inspection: A visual and functional check performed before each UAV flight to identify any potential issues and ensure safe operation.

Propeller: A rotating blade that generates thrust to propel the UAV forward.

Regulations: Rules and guidelines established by government agencies or industry organisations that govern the operation of UAVs.

Repair: The process of fixing a malfunctioning component or system within a UAV.

Sensor: A device that detects and measures physical or environmental conditions, providing data to the flight controller.

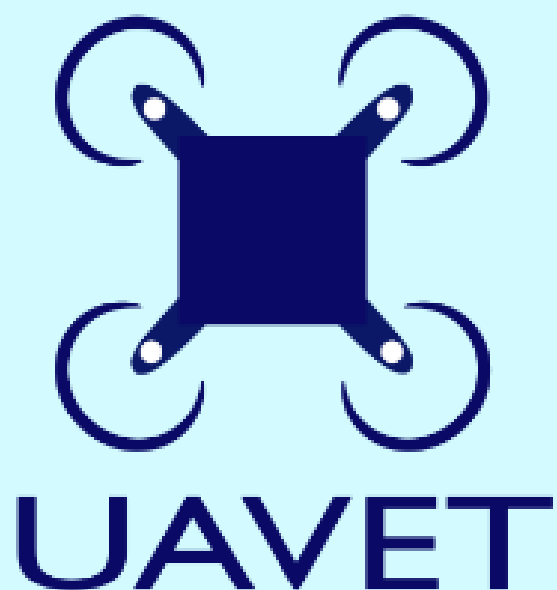
Software: The computer programmes that control the operation of a UAV's various systems.

Telemetry: The transmission of data from a UAV to its ground control station, providing information about flight status and other parameters.

Troubleshooting: The process of identifying and resolving problems with a UAV that is not functioning properly.

UAV (Unmanned/Uncrewed Aerial Vehicle): Another term for a drone; an aircraft operated without a human pilot on board.

Visual Line of Sight (VLOS): The ability of a UAV operator to maintain unaided visual contact with the UAV while it is flying.



DEVELOPING VOCATIONAL SKILLS OF ELECTRO-MECHANICAL TECHNICIANS FOR UAV
MAINTENANCE AND REPAIR

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