Test Project

Module 1 – UAS Assembly and Manual Flight Test

4 hours

Unmanned Aerial Systems

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1 Introduction to Test Project

Competitors are required to assemble a UAS that operates efficiently in customized environments for real-world scenarios or tasks. In accordance with the WorldSkills Occupational Standards (WSOS), the main test project is divided into multiple modules. Competitors are expected to identify the primary set of performance requirements by analyzing the information provided in this document:

As an assembly technician your organization has purchased a new quadcopter for general use, and you are tasked with completing the mechanical and electrical assembly of the UAS. Following the assembly, you will also complete the following procedures:

Software Setup

Initial Calibration

Setup of Flight Modes and Parameters

Conduct First Flight Preparation

This module evaluates overall competency in UAV mechanical assembly, electrical wiring, software configuration, and basic flight testing. Using the provided materials and standards, competitors must complete the assembly and commissioning of one 3-hour build of a WS500 UAV, bring it up to safe-flight requirements, and finish the specified manual flight test.

2 Description of project and tasks

The time allocated to the Installation and Commissioning of the UAS is 240 minutes, plus assessment.

Module 1 is based on the inspection of UASs assembled by Competitors and the completion of several simple core tasks, conducted by a panel of three Experts.

2.1 Assessment Criteria

Module 1 will be scored by Experts during the Competition. Information about specific tasks and required tests will be provided to Competitors in the morning briefing.

Competitors should complete all tasks independently within the time allocated to the Module.

First, prepare according to requirements.

Second, complete the tasks listed below

Note: During operations, strictly adhere to the operation safety rules and carry out the tasks in order.

Lastly, after all tasks listed in this Test Project are completed, Competitors should clean and organize their work area and submit the relevant materials and Record Sheets to the Experts.

Workplace safety procedures and protocols must be always demonstrated.

If you are advised of a safety infraction during this module, there will be a percentage of marks deducted for each infraction. On the 3rd infraction, the Competitor will be stopped, and the evaluation will be based on work already completed.

Experts will not intervene unless there is a safety concern.

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2.2 Module Task

For C-2, Familiarization Day

Preparations

Before starting the tasks, Competitors need to analyze all tasks and count and check equipment, tools, materials and documents in the workstation. In the case of any problem, Competitors need to solve it immediately.

1. Read carefully this Test Project to understand the operation tasks;
2. Count and check all equipment, tools, materials and documents in your workstation area. If any equipment, tools, materials or documents are found to be missing or damaged, inform the Experts for replacement;

Task # 1 – Material and Tools Inventory (To be completed on C-2, familiarization day)

Using the "Kit Contents Inspection Checklist" and the "Tools/Consumables List," carefully verify every part's model, specifications, and quantity. Inspect each item's appearance to ensure there's no damage or missing pieces. Once confirmed, sign off on the checklist.

Call Expert to view your results. **Expert Initials:** _____

Beginning in C1

Task #2 – Complete any Soldering Requirements

Solder any required items for the power distribution board, Electronic Speed Controls, Motors, and Receiver. Solder joints must be strong, smooth, and clean, with no defects such as shorts, cold joints, or bridged solder.

Assessment Evaluation Point 1

After finishing the soldering, stop work and raise your hand to signal the expert for evaluation.

Task #3 – Assemble the Drone (Without the Drone CAP, Raspberry PI, Lidar, and Camera)

Complete the Assembly Process to install the frame, motors, landing gear, flight controller, and other key components.

- Quality standards:
- Ensure all screws are tight
- Mount the flight controller correctly
- Mount the Optical Flow sensor correctly
- Mount the receiver correctly
- Wiring requirements as per the supplied documentation (less drone cap and RP5, lidar, camera)

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Task #4 -Using Mission Planner complete the Calibration, Setup and Tuning

Drone Tuning & Setup Objective: Connect to the ground station, correctly configure the flight controller firmware and parameters, complete system calibrations and function checks, and get ready for safe flight.

This Includes:

- Firmware Installation (V4.6.3 or 4.7) competitor choice)
- Frame Calibration
- Radio Calibration
- Accelerometer Calibration
- Compass Calibration
- ESC Calibration
- Motor Test and Direction
- Setup parameters for Spin armed and Minimum Throttle
- Battery Monitor Setup (correctly set for your supplied battery)
- Set a three-position flight mode switch on SB and assign, in order: `Stabilize` (Stabilized), `AltHold` (Altitude Hold), `Auto` (Auto Mode). Confirm the ground station displays the mode changes correctly. Competitors can setup any other flight modes and switches as required.
- Setup Arm switch with Special Functions –Set Switch SA as the ARM switch and set it to play a track that days ARMED.
- Failsafe (Failsafe): Set the transmitter failsafe action to `Auto Land (Land)`.
- Failsafe (Failsafe): Set the battery failsafe action to `Auto Land (Land)`

Task #5 UAS Flight Testing (Competitor Check, not assessed)

First Flight Preparation and testing can be completed by booking that flight area at any time before the 4 hours ends.

Remember the following:

Hardware Checks

- Props secured and correct orientation
- Motors spin freely
- Battery charged and secured
- All connections tight
- Radio link established

Software Checks

- Correct firmware version
- All calibrations complete
- Flight modes configured
- Failsafe enabled

Arming Procedure

1. Place quadcopter on level ground
2. Ensure throttle at minimum
3. Arm Vehicle
4. Motors will spin at idle
5. Check for error messages

First Hover

1. Start in Stabilize mode
2. Slowly increase throttle
3. Hover at 1.5 meters
4. Make small control inputs
5. Land if any issues

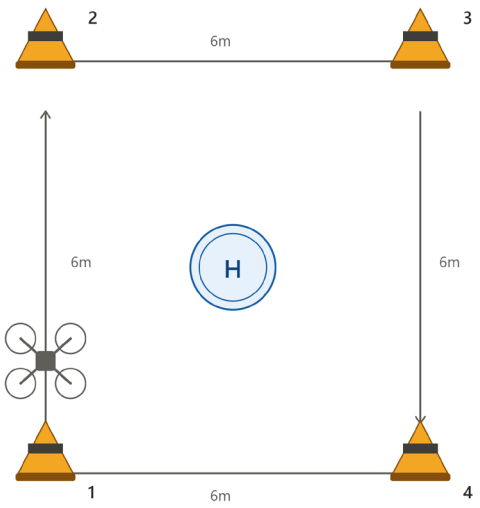
Tuning After First Flight

- Note any oscillations
- Check log files for errors
- Adjust PIDs if needed
- Verify failsafe's work

Task # 6 – Basic Flight (Begins are the build phase) - Box Pattern Movement (Assessed by Experts)

Requirement 1: Install the propellers, battery and perform a real-world flight test to verify the drone's stability and handling.

1. In `Stabilize mode, manually fly the drone straight up to a height between of 1.5 and 2 meters. This should be at a consistent speed and even throttle. Hover for 30 seconds and observe whether it remains stable, with no obvious drift, wobble, or unusual vibration (must remain within the .5m distance).
2. Manually pilot the drone and in the simple pattern shown below. Hover for about 3 seconds at each corner, then make a 90-degree turn. There should be no noticeable drift during flight, and the flight path must be straight from corner to corner.
3. Take Off and Land in the designated home location.
4. Flight Altitude: Maintain 1.5 - 2 meters throughout.
5. Safe Landing



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Requirement 2: Install the propellers, battery and perform a real-world flight test to verify the drone's stability and handling.

1. In `Altitude Hold mode, manually fly the drone straight up to a height between of 1.5 and 2 metres. This should be at a consistent speed and even throttle. Hover for 30 seconds and observe whether it remains stable, with no obvious drift, wobble, or unusual vibration.
2. Manually pilot the drone and in the simple pattern shown below. Hover for about 3 seconds at each corner, then make a 90-degree turn.
3. Take Off and Land in the designated home location.
4. Flight Altitude: Maintain 1.5 - 2 meters throughout.
5. Safe Landing

3 Instructions to the Competitor

3.1 Competition Requirements

Each competitor will receive the following for this module:

1. 1X WS500 UAV Quadcopter Kit
2. 1 X Supplied Laptop
3. All components as per the Infrastructure List

Instructions

1. Competitors should not bring any device irrelevant to the Competition to the workstation.
2. Tools, electrical components and materials for the Skill are all provided at the workstation or in the shared work area for Competitor access.
3. During the Competition, for matters irrelevant to the Competition contents, such as use of the washroom, or report of equipment, facilities, tooling, or tool faults, Competitors can seek help from the Experts.
4. Competitors may refer to the reference documents for the Skill provided.

Operation Safety Rules

1. Put on proper personal protective equipment according to operation requirements;
2. Take site safety protection measures and confirm them;
3. Before performing operations with power off, confirm that batteries are disconnected;
4. Before performing operations with power on, connect the battery after confirming that no safety hazards exist;
5. Do not operate in an unsafe manner;
6. All the tools or materials used during any task should be stored safely when not in use.

Note: If a competitor fails to comply with the safety rules and is considered to have operated in a dangerous manner or has caused a safety hazard in the workplace, or equipment damage or personal injuries, marks will be reduced until his/her right to participate in the Competition is cancelled.

4 Equipment, Machinery, Installations, and Materials Required.

4.1 Equipment Provided by the Competition Organizer

One laptop installed with core programming tools including but not limited to:

- Mission Planner
- Raspberry PI Imager
- VS Code
- Drone OS Image
- WS500 Documentation
- WinSCP

All equipment, tools, and materials listed in the Infrastructure List –see the WorldSkills Forum and Technical Description;

Personal Protective Equipment (PPE) and tools must be provided by Competitors.

Testing equipment for fault finding module;

Objects required for manipulation during the performance and testing.

Test arena for the performance evaluation tasks

UAS with faults and instructions for the fault-finding module.

Common UAS and components for the design and prototyping module.

Parts and tools required to complete the design and prototyping modules.

4.2 Equipment and Materials not Permitted

Non – Supplied laptops or portable computers.

Tablets, such as Android, IPAD, etc.

Memory stick /digital storage devices.

Portable radios/ Music players.

Electronic organizers/diaries.

Wireless communication devices, including mobile phones.

Any power tools.

Any other software not provided by the Competition Organizer without the approval of Experts.

Pre-programmed Raspberry Pi images not approved; teams will be required to delete any images under the supervision of Experts during the familiarization period and will then receive a pre-approved version.

Equipment that is similar or operates similarly to the equipment provided. For example – if the Competition Organizer provides a metal-cutting saw, no team may bring their own metal-cutting saw.

All raw materials, components, parts, purchased items, tools, and equipment not permitted in the Technical Description and the List of Material Allowed and Not Allowed of the skill.

During the Competition, no tools, equipment, stationery, components, parts, raw materials, manuals, drawings, electrical devices, or digital storage devices may be taken out of or brought into the Competition venue without the approval of the Skill Competition Manager.

4.3 Items to be Provided by Teams

Each team must provide and wear team identification indicating their region. These must be always worn during the Competition.

Appendix A: Checklists

Kit Contents Inspection Checklist

Drone Commissioning Report