New RPAS training academies: A major step forward for South African aviation

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Abstract

The RPAS industry, is a new exciting sector not only worldwide, but also in South Africa. To feed this growing market, it was necessary to put proper professional training facilities in place to provide world-class pilots for this new industry. In this paper, the focus will be on the structure of these RPAS academies and the required curriculum that has to be completed by a prospective RPAS pilot. Both the theoretical and practical side will be covered in detail, as well as the necessity to create pilots with the necessary level of airmanship. As RPAS pilots will be sharing airspace with manned aviation, there can be no compromises.

Keywords

RPAS, training, aviation, multirotor, aeroplane, helicopter

Introduction

RPAS evolved from the radio control flying sector and has rapidly changed into more sophisticated flying systems that have a lot of commercial applications. This means that more expertise is needed to safely fly these systems. Another factor that pays a role in commercial RPAS operations is the fact that RPAS will share civil airspace with other full-sized aircraft. SACAA and industry realised that there can be no compromises when it comes to the training of the new RPAS pilots. There were no rules and regulations concerning RPAS at that stage, since the industry (technology) evolved more rapidly than legislation. SACAA and industry therefore instituted a workgroup to see how RPAS can be safely incorporated into manned airspace. This has led to the development of the SA-CARS 101 legislation, and the associated Document SA-CATS 101 [1].

This set of rules and regulations not only stipulates how RPAS and RPAS pilots are allowed to operate in South Africa, but also what should be included in the training curriculum [2]. The aim of this paper is not to discuss the legislation in detail, but rather to look at the implications for training in the real-world environment.

Different licenses

An RPAS operator will need a remote pilot license (RPL). There are three categories of RPL: RPL (A) (aeroplane), RPL (MR) (multi-rotor) and RPL (H) (helicopter). Each of these licenses can then be endorsed with the following three ratings [3].

- **VLOS (visual line of sight)**: Under this category a pilot will be able to fly his RPAS up to 500 m away from himself, up to an altitude of 400 ft.
- **E-VLOS (extended visual line of sight)**: This category extends the flight distance from the pilot to 1000 m. Use must be made of an observer who will be stationed 500 m away from the pilot. By making use of two way radios the observer can communicate with the pilot. Communication can vary from general flight updates to warnings in case of a malfunction of the RPAS or an incident like a manned aircraft approaching.
- **B-VLOS (beyond visual line of sight)** [4]: This category allows for long distance flights. Beyond visual line of sight forms part of the next phases of RPAS implementation. This does not mean that SACAA will not allow flights under B-VLOS. Special permission can be obtained from the director of SACAA to operate in this category, as long as the operator can demonstrate that this can be done safely with that specific RPAS.

It is important that the RPAS pilot and operator decide on the needs for their specific operation and ensure that the training is in line with what is required for their operations [4].

Different systems

It must be noted that there are many different systems on the market. Operating these systems is generally very similar. Therefore, most courses provided by training academies are general courses. It is advised that pilots also attend a manufacturer specific training, once they have received their RPL [5].
Training academies

South Africa is in desperate need of proper RPAS training academies with high standards of training and competence. RPAS training facilities will follow the existing flying school structure currently used for manned aircraft where applicable. Training modules were added and amended to be applicable to RPAS. In effect an RPAS Training Academy will need to comply with similar requirements to those found in SA-CAR Part 141 (Approved Training Organisations) [3].

Prospective RPAS flying schools will need the following personnel structure:

![Personnel structure of a prospective RPAS flying school.](image1)

The following facilities will be needed:

![Facilities needed for an RPAS flying school.](image2)

Theoretical and practical training

The required training consists of two parts as prescribed in the SA-CATS 101 documentation [1].

The first part is theory. Some of the theoretical modules are very similar to the theoretical modules as followed during the completion of a private pilot license. The rest of the modules are unique, since RPAS differ from manned aircraft in many aspects. For example an RPAS is flown via a flight control station or radio, something that is not found in a manned aeroplane. Also the electronics found in RPAS can differ greatly from that found in manned aviation.

To ensure that pilots achieve a good understanding of the RPAS, training has to cover material from applicable previously established aviation knowledge and new knowledge as developed by the RPAS industry.
The second part of the training consists of practical flight training. The SA-CATS 101 regulations are very clear on the specific manoeuvres that RPAS pilots should be able to fly. The manoeuvres are specific to the system flown, either multirotor, aeroplane or helicopter. These will be discussed in more detail later in this paper.

Theoretical modules

The theoretical modules (ground school) that the students will have to complete consist of the following:

- **Air law**: Understanding and knowing the laws applicable to the operation of RPAS.
- **Human factors**: Learning how to manage stress and understand the other human factors like vision that can influence RPAS flying.
- **Meteorology**: Knowing the general South African weather patterns and understanding what the weather limitations on RPAS operations are.
- **Navigation**: Gaining basic knowledge of map-reading and use of coordinates as applicable to flight planning.
- One of the following:
  - Construction and flight aeroplane: Basic construction and flight theory for an aeroplane.
  - Construction and flight multi-rotor: Basic construction and flight theory for a multi-rotor.
  - Construction and flight helicopter: Basic construction and flight theory for a helicopter.
- **Radio links**: This module concerns the usage, legal frequencies and limitations of the antennas and wireless links used to fly and receive telemetry of the RPA.
- **Battery procedures**: Maintenance, safety procedures and charging of the different types of batteries used to fly RPAS.

Prospective RPAS pilots will also need a Restricted Radio Telephony license. The reasoning behind this is to assist pilots in monitoring manned aviation activity in the area flown. During RPAS operation the pilot should be in possession of a functioning air band radio [1]. This allows the RPAS pilot to communicate with manned aviation and prevent mid-air collisions.

In the case of RPAS operations taking place within 10 km radius of an airport the RPAS pilot will also have to communicate with the tower, to receive flight clearance. (Note: Permission from the director of SA-CAA will also be needed in this case.)

An English proficiency certificate level 4 or higher is also required for RPAS Pilots [3]. Both the Restricted Radio Telephony license and English proficiency tests can be done at RPAS training academies that employ the necessary personnel.

Practical flight training

The practical flight training consists of five sections:

- **Simulation flight**: During simulation flight, a student pilot will practice the required manoeuvres by making use of simulator. This allows the student to work in a safe environment, without the danger of flying into someone else or him/herself and without the danger of damage or loss of equipment.
- **Buddy box flights**: During this section the student pilot will start flying the RPA with the assistance of an instructor. The instructor will have a master radio while the student will fly with a slave radio. This allows the instructor to take control of the RPA in the case of a student pilot losing control. This ensures not only the safety of the RPA but also that of the student and instructor. During this phase pre-flight and post-flight checks are also implemented.
- **Solo flights**: Students will only be allowed to start on solo flights once the instructor feels that the student pilot can fly the RPA safely without requiring assistance. The student will then fly the RPA and complete the required manoeuvres.
- **Waypoint flying**: In this section the student will learn to fly the RPA by making use of flight control software on a RPS (Remote Pilot Station). Waypoints are being used to programme the complete flight beforehand. The student will then complete a few flights with the help of the instructor and then on their own.
• **Emergency procedures**: Emergency procedures forms the core of the training. All the previous training focussed on scenarios where nothing goes wrong. Unfortunately real operations have proved that emergency situations can arise at any point during the operation. Pilots need to be trained how to handle these situations effectively and professionally to prevent damage to property, damage to the RPA or injury to persons. It is advised that at least one day of the course should be spent on practicing emergency procedures and manoeuvres. A few examples of emergency situations are:

  - **Loss of data link**: In this situation the pilot loses the signal between the RPS and RPA.
  - **Loss of radio link**: Here the signal between the remote radio and RPA is lost.
  - **Low battery**: In case the RPA is running low on power and might not have enough fuel (battery) to return to base.
  - **Incoming manned aircraft**: A manned aircraft might be approaching and evasive manoeuvres must be performed to prevent possible mid-air collisions.
  - **Motor failure**: The failure of a motor might force a pilot to glide, restart the motor or deploy a parachute, depending on the system.
  - **Instability in the earth’s magnetic field**: This is a lesser-known scenario, but probably the cause of most RPA incidents and accidents. This is caused by solar flares which create fluctuations in the magnetic field. This in turn destabilises the compass on board the RPA and results in the RPA veering off course or spinning out of control completely.

These are just a few of the possible emergency scenarios. But for each situation the pilot should be trained to a point where the pilot reaction to these situations becomes second nature.

**General training options**

Training can be done via a few different options to cater for the needs of the industry. They can either complete the full course (±3 weeks) at an accredited RPAS flying academy or complete the ground school (theory) as a self-study course and then complete the practical and flight school (±1,5 weeks) at an accredited RPAS academy. If the self-study option is followed, the student will still need to attend the flying school for in-house exams and theory checks, since the flight school has a responsibility to ensure that the student pilot has a good understanding of the principles of flight, civil airspace and flight planning. Initially, the final theory exam and practical skills test will be conducted at the flight school, but in the future these will be done by SACAA [7]. A complete signed record of the students training must be kept by the flight school. This is done to ensure a proper record of each student is available in the case of an aviation incident.

**Conclusion**

It must be noted that, although a lot of the RPAS available on the market can be flown with the “press of a button”, students still need to complete the flight training. The first reason for this is that although a remote pilot might start on small simple systems, they might upgrade to more sophisticated RPAS that will require manual take-off and landing in the future. The second reason is that in the case of a system failure the remote pilot should be able to fly and land the RPAS manually.

One of the key tasks of RPAS training academies are to instruct students on emergency procedures. A real danger during RPA flight is mid-air collisions with other aircraft. (By law RPAS should always give way to full-sized aircraft.) RPAS training academies can simulate this situation in a safe environment. This way, students can learn how to react with quick, safe, decisive action. This will be practised continuously to ensure that the right actions to take in such a case will become second nature to students.

RPAS will share civil airspace with other full size aircraft. For this reason RPA pilots should have the right attitude when it comes to flying. RPA pilots must have the same airmanship mentality as their counter parts in full size aviation. This goal can be achieved by setting up RPAS flying academies at full size airports. An example of this is RPAS Training Academy that is based at Wonderboom Airport in Pretoria. This allows the students to feel part of the full size aviation industry by visiting ATC-towers, etc.

South Africa and in particular SACAA have taken huge leaps toward ensuring a safe RPAS industry. This puts us in a leading position worldwide. The rest of Africa and other countries in the world are looking at the example set by SACAA concerning RPAS operations.
References


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