# UAV OPERATOR TRAINING – BEYOND MINIMUM STANDARDS

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***Abstract:*** *Unmanned Aerial Vehicle (UAV) operators are key element of the Unmanned Aircraft Systems (UAS). Any technical system even UAS can fail if operating staff is not prepared well-enough to that proper level of skills ensuring safe operation of UAVs. There are many initiatives both for UAV military and civil operators to find minimum levels of training ensuring safe flight and ground operations. However, guidance available for the Military still not ratified by many NATO member-countries. Some of the NATO-members made their reservations related to frame regulations and guidance to clarify their standpoints in the training and education organizations responsible for training of designated UAV operators. This paper will combine basic principles of the guidance available in the field of military regulations with the civil regulations defined by appropriate EASA PART volumes.*

***Keywords:*** *UAV, UAS, Designated UAV operator, UAV operator training.*

## 1. INTRODUCTION

Present days there are many ideas and initiatives about UAV designated operator training. Common feature here is that those available both military and civilian guidelines are defining training minimums and there are no upper limits in any means of it.

The training itself means to train UAV operators being educated in secondary grammar schools, in vocational training or in higher education institutions. The basic idea of the training is to train UAV operators able to handle UAVs safely both in flight and in ground operations.

In-spite of the existing guidelines being military or civil many countries made their reservations allowing taking into consideration experiences gained from operating UAVs in national airspaces under supervision of the national authorities.

## 2. LITERATURE REVIEW

The UAV airworthiness certification is analyzed in deep details in reference works of the author in [4, 5, 6, 7]. These papers are dealing only with many possible measures of compliance of the UAVs proposed by the author. Secondly, measure of compliance can be determined with that of pre-defined ones available in standards, guidelines, and handbooks.

Of course, to fly UAV safely it is necessary to own an educated and well-trained team being responsible for the flight safety, in general. There is a long lasting argue whether UAV operator is a pilot with its means. The military regulation goes far ahead to that of the civilian one, so this paper will analyze thoroughly two basic guidelines and regulations, which are the NATO STANAG 4670 [1] and The Joint Minimum Training

Standards of the Joint Staff [3]. As a rule any NATO standard can be serve as national rule if it is ratified by lawmakers. Due to sensitivity of the problem of the UAV operators' training still many NATO-member countries are in debt with ratification of the basic NATO document titled STANAG 4670/ATP–3.3.7 [2]. In close to that of STANAG 4670/ATP–3.3.7 principles goes The Joint Minimum Training Standards of the Joint Staff. These two basic documents derive guidelines for the principles of the training systems, and derive the syllabus in general. What is important, the basic norms are defined for the minimum levels of the skills of the operators, and, there are no formal upper limits for the syllabi of the training systems.

## 3. THE NATO STANAG 4670/ATP–3.3.7 TRAINING GUIDANCE

The first and basic document of NATO STANAG 4670 PFP(NNAG-JCGUAV)D(2006)001-Rev2 was issued with request of ratification 13 September 2006, till 1 December 2006. There are many years had flown by, and still, a UAV designated operator training is a matter of argue between many organizations. The latter version of this regulation is called as NATO STANDARD ATP-3.3.7 (Edition B, Version 1) from 22 April 2014.

The ATP-3.3.7 standard has some records of specific reservations, including those that were recorded at time of the promulgation, and are as follows below:

1) Belgium:
    a. will continue to deliver own training syllabi;
    b. will implement elements of BUQ Levels III and IV.
2) Canada:
    a. will not use term UAS;
    b. the UAV classification of CDN is not consistent with scheme used by NATO;
    c. will implement STANAG 4670 directed to training for the equivalent Canadian classification of the UAS.
3) Estonia: will use in dependence of UAS/UAV capabilities.
4) France:
    a. will not apply to class I drones;
    b. French Navy will apply as it receives the training equipment needed for the implementation;
    c. French Army will not apply because it departs too much from its practices and equipment.
5) Great Britain:
    a. reservation due to metrics;
    b. reservation to special regimes i.e. Stall Recovery, Dead Reckoning Navigation, Precision Radar Approaches;
    c. reservation due to classification of the UAVs.
6) Italy: will recognize Basic UAS Qualifications in accordance with this document.
7) The Nederland:
    a. will mutually recognize UAS operators' training;
    b. recognition and accreditation of qualifications issued by foreign authorities will be done by NLD Military Aviation Authority (MAA NLD);
    c. possible fly under Visual Meteorologic Conditions (VMC).
8) USA:
    a. UAS bases its training on CJCSI 3255.01 document [3];

b. some subject knowledge requires higher standards than existing requirements of the USA.

From the list of reservations given above easy to understand that still there are many differences between UAV manufacturers and UAV users, and sometimes it is cannot be bridged, the only possibility is to keep reservations in the given fields differing much.

The NATO STANAG 4670/ATP-3.3.7 training guidance based upon three documents, namely:

1) Chairman, CJCSI 3255.1, Joint Unmanned Aircraft Systems minimum training standards, originally dated 17 July 2009, Change 1, dated 31 October 2011, current version as of 4 September 2012;
2) AAP-03, Edition J, Version 1, dated November 2011;
3) AAP32)A), Change3, dated January 2002.

The basic idea of the STANAG 4670 regulation is to segment four levels of basic UAS qualifications (BUQ). The trend here is when it is feasible and applicable the knowledge, skills and abilities (KSA) requirements bring closer to that of International Civil Aviation Organization (ICAO) requirements defined for manned aircraft of the civil aviation.

There are many initiatives to classify UAVs and UASs leading to the diversity of available classification [8]. To understand levels of BUQ [2] gives detailed classification of the UAS (see **FIG. 1.**).

**NATO UAS CLASSIFICATION**

| Class | Category | Normal Employment | Normal Operating Altitude | Normal Mission Radius | Primary Supported Commander | Example Platform |
|---|---|---|---|---|---|---|
| Class III (> 600 kg) | Strike/ Combat* | Strategic/National | Up to 65,000 ft | Unlimited (BLOS) | Theatre | Reaper |
| | HALE | Strategic/National | Up to 65,000 ft | Unlimited (BLOS) | Theatre | Global Hawk |
| | MALE | Operational/Theatre | Up to 45,000 ft MSL | Unlimited (BLOS) | JTF | Heron |
| Class II (150 kg - 600 kg) | Tactical | Tactical Formation | Up to 18,000 ft AGL | 200 km (LOS) | Brigade | Hermes 450 |
| Class I (< 150 kg) | Small (>15 kg) | Tactical Unit | Up to 5,000 ft AGL | 50 km (LOS) | Battalion, Regiment | Scan Eagle |
| | Mini (<15 kg) | Tactical Subunit (manual or hand launch) | Up to 3,000 ft AGL | Up to 25 km (LOS) | Company, Platoon, Squad | Skylark |
| | Micro ** (<66 J) | Tactical Subunit (manual or hand launch) | Up to 200 ft AGL | Up to 5 km (LOS) | Platoon, Squad | Black Widow |

*Note: In the event the UAS is armed, the operator should comply with the applicable Joint Mission Qualifications in ATP-3.3.7 (STANAG 4670) and the system will need to comply with applicable air worthiness standards, regulations, policy, treaty, and legal considerations.

**Note: UAS that have a maximum energy state less than 66 Joules are not likely to cause significant damage to life or property, and do not need to be classified or regulated for airworthiness, training, etc. purposes unless they have the ability to handle hazardous payloads (explosive, toxins, chemical/ biological agents, etc.).

**FIG. 1.** NATO UAS Classification.

The ATP-3.3.7 using MTOW data defines three UAS classes, which are important whilst to derive BUQ for four levels leaning on KSA–requirements.

In [1, 2, 3] a rating scale for UAS operators' skills was established to make difference between BUQ levels of the operators. Appropriate and certified BUQ levels provide strong foundation for the UAS operations both in military or civil applications. The Basic UAS Qualification include basic understanding of the weather, aerodynamics, human factors, operational risk management, and finally, flight regulations for the type of the airspace in which the UAS operates.

Before to start with BUQ Qualification levels' definitions it is important to understand and be familiarized with the airspace classification (see **FIG. 2.**)

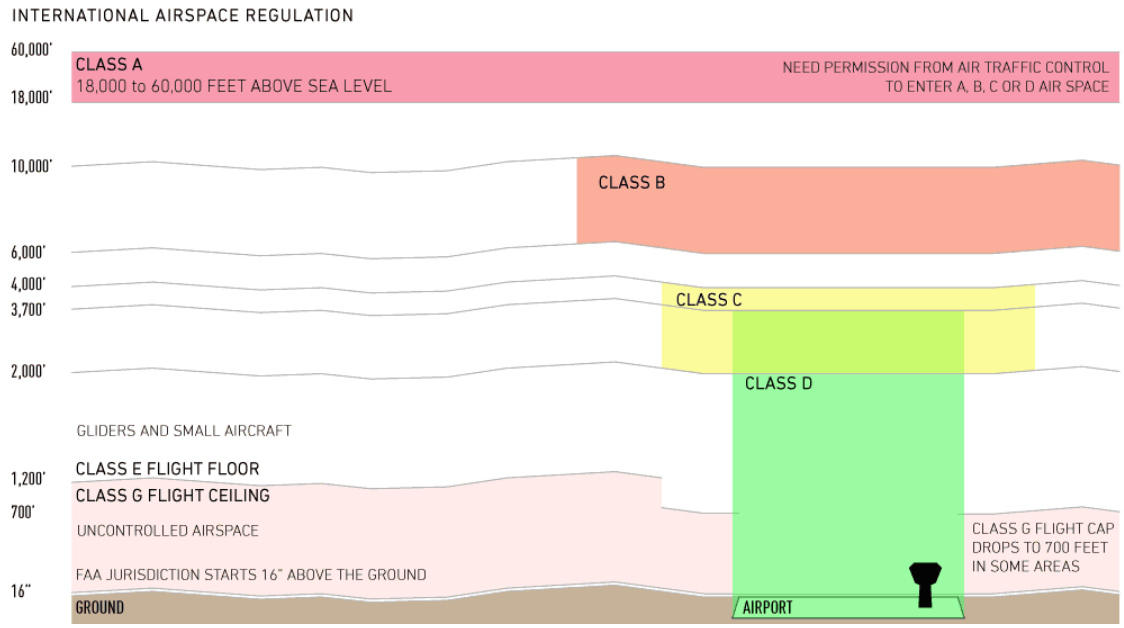


**FIG. 2.** International Airspace Classification (Accessed at: www.google.com)

References [1, 2, 3] define following four BUQ levels as they defined below:

1) BUQ Level I: knowledge and skills required to operate under Visual Flight Rules (VFR) in ICAO Classes E, F, and G, and Restricted/Combat airspace below 3000 ft above ground level (AGL). NATO Class I, Micro and Mini UAS operators are to be trained to BUQ Level I.
2) BUQ Level II: knowledge and skills required to operate under VFR in ICAO Class D, E, F and G, and Restricted/Combat airspace below 5000 ft AGL. NATO Class I, Small UAS operators must be trained to BUQ Level II.
3) BUQ Level III: knowledge and skills required to operate under VFR in all ICAO airspace except Class A below 18.000 ft AGL or Flight Level (FL) 180. NATO Class II, Tactical UAS operators must be trained to BUQ Level III.
4) BUQ Level IV: knowledge and skills required to operate under VFR and Instrument Flight Rules (IFR) in all airspace. NATO Class III UAS, MALE/HALE and Strike/Combat UAS operators must be trained to BUQ Level IV.

The BUQ levels given above are cumulative ones. Therefore, to meet higher requirements, operators must meet all the requirements of the lower levels as well.

The general aeronautical knowledge content is defined by following areas:

1) Airspace structure and operating requirements;
2) ATC procedures and rules of the air;

3) Aerodynamics;
4) Aircraft systems;
5) Performance;
6) Navigation;
7) Meteorology;
8) Communication procedures (Aeronautical English, ICAO Level 4)
9) Mission preparation.

The basic guideline followed by rulemakers is that the achieved level of competence of the UAS operators must be maintained, its currency and proficiency must be adequate to that existing national minimum standards and requirements. The principle of expiration is followed: all operators must subjected to periodic theoretical, practical and medical examination of the designated military examiners [1, 2, 3].

The basic aeronautical module is not explained yet, and its content belongs to those training organizations leading theoretical and practical training syllabi in UAS operator training.

The UAS operator training programs target to train UAV operators having pre-defined skills are divided into three main areas as follows:

1) Subject knowledge;
2) Task knowledge;
3) Task performance.

In these categories subcategories are defined with attributes to measure compliance to the given level of skills and knowledges of the UAS operators [1, 2, 3].

## 4. THE USA DoT FAA CIVIL REGULATIONS

Besides military training syllabi of UAS designated operators worth to mention the civil regulations. Of course, the national training programs may differ, but the FAA regulations are in the focus of attention of training organizations and experts not depending of its feature.

In 2015 a set of new norms were issued and published by FAA, which deals with UAS operators training and operators' responsibility, too. The UAV being flown is supposed to have wet weight less than 25 kgs (55 lbs), with no lower weight limits. These basic principles defined by FAA are as follows [8]:

1) UAV operators must be at least 17 years old;
2) Pilots of small UAV would be considered for "operator" instead of "pilot" widely applied and used;
3) UAV operators would be required to:
    a. pass an initial aeronautical knowledge test at an FAA–approved knowledge test center;
    b. be vetted by the Transportation Security Administration;
    c. obtain an unmanned aircraft operator certificate with a small UAS rating (like existing pilot airman certificates, never expires);
    d. pass a recurrent aeronautical knowledge test every 24 months;
    e. make available to the FAA, upon request, the small UAS for inspection or testing, and any associated documents/records required to be kept under the proposed rule;
    f. report an accident to the FAA within 10 days of any operation that results in injury or property damage;

g. conduct a preflight inspection, to include specific aircraft and control station systems checks, to ensure the small UAS is safe for operation.

It is easy to point out that there are many common points between military and civilian standpoints. As for the military training organizations, for the civil approved training organizations there is no strict regulations about aeronautical knowledge, and secondly, how it will be examined after 24 months.

## CONCLUSIONS

The UAS operator training is a crucial point of the modern UAS systems. The flight safety assured by him/her, effectiveness of the flight mission execution depends on him/her. There are many regulations defining framework of the training system, however, many open items being investigated latter are remaining still. In many planned training syllabi the module of the aeronautical sciences still not defined, however, there are effective methods, tools and experiences gained from the conventional training systems of the manned aircraft used by EASA PART 66, for instance. The future work will be devoted to the comparison of the existing civil and military training syllabi by the module of Aeronautical sciences. Moreover, the minimums are defined without upper limits, and, there is an arising question how to find constraints for upper limits, if it is worth to be investigated.

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