Federal Department of the Environment, Transport,
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Strategy and management support
UAS Authorization and Oversight

Schweizerische Eidgenossenschaft
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SUBJECTS OF THE THEORETICAL KNOWLEDGE EXAM FOR UAS OPERATIONS UNDER EUROPEAN STANDARD SCENARIOS (STS-01 and STS-02)

The theoretical examination for remote pilots intending to operate under the conditions of the standard scenarios comprises **40 multiple-choice** questions aimed at assessing the remote pilot's knowledge of the technical and operational mitigations, distributed appropriately across the following subjects.

The **minimum requirement** a remote pilot student must fulfill is the successful completion of the A1/A3 theoretical examination of the open category.

To pass the theoretical knowledge examination, the remote pilot student shall achieve at least **75 %** of the overall marks.

*If the remote pilot holds an A2 certificate, 30 questions will have to be answered

Date	Issue	Revision	Applied changes
01.01.2024	1	0	

010 Aviation Regulations

General elements on the Specific category

- Be familiar with the general elements of the 'Specific' category.
- Be familiar with the conditions to operate in a different country than the Member State of registration.
- Describe the general remote pilot's responsibilities in the 'Specific' category.
- Be familiar with the general operator's responsibilities in the 'Specific' category.

Risk assessment and introduction to SORA

- Be familiar with the risk assessment principle.
- Describe that a risk assessment has already been conducted for standard scenarios.
- Define 'SORA' acronym and be able to briefly explain what it consists of in.
- Be familiar with the concept of PDRAs.
- Be familiar with the list of PDRAs published so far (UAS characteristics, VLOS/BVLOS, overflown area, maximum range from remote pilot, maximum height, airspace).

STANDARD SCENARIOS

Operational declaration concept

- Be able to tell what an operational declaration consists of, and how to proceed.

Standard scenario #1 (STS-01)

- Be familiar with the general provisions applicable to STS-01.
- Be familiar with the operational conditions applicable to STS-01.
- Be familiar with the operator's responsibilities applicable to STS-01.
- Describe the remote pilot's responsibilities applicable to STS-01.

Standard scenario #2 (STS-02)

- Be familiar with the general provisions applicable to STS-02.
- Be familiar with the operational conditions applicable to STS-02.
- Be familiar with the operator's responsibilities applicable to STS-02.
- Describe the remote pilot's responsibilities applicable to STS-02.
- Describe the airspace observer's responsibilities applicable to STS-02.

ADDITIONAL KNOWLEDGE ON AIRSPACE AND AERONAUTICAL INFORMATION

General

- Be familiar with the concept of airspace sovereignty and the overall airspace designations.
- Describe the different airspace classes.
- Describe the operating restrictions in different classes of airspace.
- Explain how segregated airspace is established and managed.

Airspace reservations

- Define danger, prohibited and restricted areas.
- Explain the meaning of these areas for the remote pilot.
- Be able to find information on these areas.

Obtaining and interpreting aeronautical information

- Define 'AIP' acronym (Aeronautical Information Publication) and explain what it consists of.
- Be familiar with the way to access the AIP.
- Define 'AIC' acronym (Aeronautical Information Circular) and explain what it consists of in.
- Define 'NOTAM' acronym (NOtice To AirMen) and explain what it consists of in.
- Be able to obtain and interpret NOTAMs.
- Be able to access and interpret aeronautical maps and charts.

020 Human Performance Limitations

MEDICAL FITNESS

Fatigue

- Be aware that the flight should be conducted within working hours.
- Know about the circadian rhythm and the effect on fatigue.
- Be aware of the influence of work stress on fatigue.
- Be aware of the influence of commercial pressure on fatigue.

Health precautions

- Know that health precautions such as regular sport and healthy nutrition help to stabilize a good mental and physical health status.

HUMAN PERCEPTION

General influences

- Be able to name factors which influence BVLOS.

Situational awareness

- Know about the factors of situational awareness in BVLOS operations.

Environmental influences

- Be aware of the influences on vision due to the sun.
- Be aware of influences on vision due to the other meteorological conditions (e.g. snow, heavy rain, volcanic ashes).
- Be aware of the influences on the capability to fly a UAS due to extreme weather (e.g. hot or cold temperatures, wind, icing, precipitation).
- Be able to name consequences of extreme weather on humans to fly a UAS (e.g. hypothermia, frostbite, impairment of fine motor skills, reduced situational awareness, sunburn).

Attentiveness

- Be able to exercise and to explain the visual scan technique of scanning 10-15° each to find other traffic.
- Know that other traffic is often hard to spot visually.
- Be aware that it is vital to eliminate any distraction during flight operation.

030 Operational Procedure

PRE-FLIGHT

Pre-flight actions for STS-01

- Be aware that, in addition to the typical pre-flight actions, the remote pilot shall verify that the means to terminate the flight (e.g. FTS) of the UAS are operational, and that the direct remote identification is active and up to date.

Pre-flight actions for STS-02

- Be aware that, in addition to the typical pre-flight actions, the geo-caging function must be set and operational.

Pre-flight actions common to STS-01 and STS-02

- Be aware that the remote pilot must ensure the adequacy of the controlled ground area defined by the operator.

IN-FLIGHT

Contingency procedures

- Be familiar with the typical actions to be performed by the remote pilot and/or by the persons essential to the UAS operation in case of intrusion of uninvolved persons into the controlled ground area.

Emergency procedures

- Be familiar with the typical actions to be performed by the remote pilot in case the Flight Termination System (FTS) does not work properly.

Emergency Response Plan (ERP)

- Define the acronym 'ERP'.
- Describe what an ERP consists of.
- Be familiar with the typical actions to be performed by the remote pilot and/or by the persons essential to the UAS operation in case the UA flies out of the volume represented by the controlled ground area.

040 Technical Operational Mitigations for Air Risk

GENERAL

- Be familiar with 'risk' and 'air risk' notions.
- Define the following terms: technical mitigations, operational mitigations, strategic mitigations, tactical mitigations.
- Be familiar with the 'see and avoid'/'detect and avoid' principles.

AIR RISK IN STS-01

- Be aware that the air risk posed by an UAS operation conducted in STS-01 is addressed by the VLOS operational mitigation, which allows the remote pilot to maintain a thorough airspace scan of the airspace surrounding the unmanned aircraft to avoid any risk of collision with other aircrafts ('see and avoid' principle).
- Be aware that the remote pilot may be assisted by a visual observer in his 'see and avoid' responsibility, and that, in such a case, clear and effective communication shall be established between them.
- Be aware that the air risk posed by an UAS operation conducted in STS-01 is also addressed by a technical mitigation, which consists in the UAS being equipped with a Flight Termination System (FTS).

AIR RISK IN STS-02

- Be aware that the increased air risk posed by an UAS operation conducted in STS-02 (BVLOS) is addressed by an operational mitigation which consists in the mandatory presence of airspace observer(s) or in the mandatory pre-programmed trajectory for the unmanned aircraft.
- Be aware that this increased air risk is also addressed by another operational mitigation which consists in ensuring a horizontal visibility of 5km or more.
- Be aware that this increased air risk is also addressed by two main technical mitigations, namely the UAS being equipped with a geo-caging function, and the information on the geographical position of the unmanned aircraft.

050 UAS General Knowledge

Common technical knowledge

- Be aware that if an UAS bears a C5 and/or C6 class identification label(s) and is equipped with a geo-awareness function, it must comply with the C3 class geo-awareness function technical requirements.
- Be aware that UAS bearing C5 and/or C6 class identification label(s) must provide the remote pilot with information on C2 link quality, including an alert if the link is going to be degraded/lost, and with an alert if it is lost.

Technical knowledge specific to C5 class marked UAS

- Be aware that the configuration of an UAS bearing a C5 class identification label must be other than fixed-wing, unless tethered.
- Be aware that a selectable low-speed must limit the ground speed to no more than 5 m/s.
- Be aware that the remote pilot must be provided with the height of the unmanned aircraft.
- Be aware that the Flight Termination System (FTS) must be independent from the flight controller.
- Be aware that a means (e.g. parachute) must reduce the unmanned aircraft impact dynamics if the FTS is activated.
- Be aware that a description of the FTS must be included in the UAS user's manual.

Technical knowledge specific to C6 class marked UAS

- Be aware that the ground speed of the unmanned aircraft in level flight must not exceed 50 m/s.
- Be aware that the remote pilot must be provided with the height, speed and geographical position of the unmanned aircraft.
- Be aware that a geo-caging function must prevent the unmanned aircraft from exiting the operational volume.
- Be aware that the FTS must be independent from the flight controller and the geo-caging function.
- Be aware that a description of the FTS and the geo-caging function must be included in the UAS user's manual.
- Be aware that the distance most likely to be travelled by the unmanned aircraft in case of FTS activation must be included in the UAS user's manual.

ADVANCED UAS GENERAL KNOWLEDGE

Flight Termination System (FTS)

- Be familiar with the FTS operating principle.
- Describe the main objective of an FTS.

Geo-caging function

- Be familiar with the geo-caging function operating principle.

Advanced knowledge on batteries

- Describe the main battery parameters (Ah, voltage, charge and discharge rates).
- Describe the battery configurations (parallel and series).

Sensors

- Define the acronym 'IMU' (Inertial Measurement Unit) and its operating principle.
- Describe the difference between indicated and true airspeeds.
- Be familiar with altitude/height measurement principles for unmanned aircraft.

060 Meteorology

WEATHER EFFECTS ON THE UAS

Wind

- Be able to interpret given wind directions on a wind rose.
- Know about different wind speed units and their conversion (kt, km/h, m/s, Beaufort).
- Be able to explain the influence of surface friction on wind direction.
- Be able to forecast the approximate change in wind direction and speed compared to layers free from friction.
- Be able to name the influence of different surface types / friction on wind.
- Be able to determine different forms of turbulence (e.g. frictional, convective, orographic, obstacles).
- Be able to detect typical zones with turbulence (e.g. below forming Cumulonimbus clouds).
- Be aware of reasons for turbulence close to the ground (e.g. when approaching; rows of trees; heating of surfaces).
- Be aware of dangers that arise from wind phenomena (e.g. turbulences, gusts) during UAS operations.

Temperature

- Be able to state the vertical temperature distribution in the troposphere.
- Know about different units and their conversion (°C, °F, K).
- Know about diurnal and annual temperature changes.
- Be able to determine effects of temperature on batteries and flight performance.
- Be able to name dangerous effects of low temperatures and icing.

Atmospheric pressure

- Be able to define 'atmospheric pressure'.
- Be able to define 'high' and 'low' pressure areas.
- Be able to list the common units of measurement of atmospheric pressure in aviation (hPa, inHg).
- Know about the relationship between pressure and altitude (air pressure halves every 5,500 m).

Visibility

- Be able to name radiation and advection fog as the most common types of fog.
- Know about the preconditions of fog formation.
- Be able to estimate the development of radiation and advection fog.
- Be able to name factors influencing visibility (e.g. fog, mist, haze, sunlight, pollution, precipitation).
- Be able to name options to assess the visibility on the spot (e.g. reference objects).
- Be able to differentiate fog from mist in terms of visibility.

Density

- Know about the relationship between pressure, temperature and density (e.g. what happens to the density if the temperature rises, and pressure remains constant).
- Know that the density decreases with altitude.
- Be aware that a change of density influences lift at rotor blades.

Regional weather effects

- Be able to explain the diurnal course of land and sea breeze.
- Be able to name effects of land and sea breeze.
- Be able to name dangers when flying in or near mountains (e.g. strong downwind, low density).

- Be able to name dangers in desert regions (e.g. dust, diurnal course of temperature, strong wind).

OBTAINING WEATHER INFORMATION

Weather report resources and briefing

- Be aware of the duty to obtain weather information for a pre-flight briefing.
- Know about the most influencing weather factors (wind, extreme temperature, strong precipitation).
- Be able to explain and interpret the term 'UTC'.
- Be able to name options to obtain weather information (e.g. national weather service).
- Interpret simple weather charts and reports.

Weather reports

- Be able to explain the difference between current weather reports and forecast data.
- Be able to obtain and extract useful data from a METAR report.
- Be able to obtain and extract useful data for a SPECI report.
- Be able to obtain and extract useful data for a TAF report.

Weather charts

- Be able to interpret radar and lightning images.
- Be able to interpret satellite imagery.
- Be able to interpret surface weather charts.

Local weather assessments

- Know how to evaluate the current local wind direction and speed.
- Be aware of weather changes and their probable meaning (e.g. sudden gusts, cloud development).
- Know about the possible difference between local weather and weather reports.

070 UAS Flight Performance

TYPICAL OPERATIONAL ENVELOPES

- Be aware that each unmanned aircraft has an approved flight envelope within which safe flight, under normal, abnormal and emergency conditions, and emergency recovery capabilities, are demonstrated.
- Know that UAS operating limitations must always be observed.
- Be aware that different UAS types (rotorcrafts, fixed wings, hybrid configurations) may have different approved flight envelopes and different operating limitations, especially due to their design, and that oneself should take the necessary time to self-appropriate these limitations.

MASS AND BALANCE & CENTRE OF GRAVITY

- Define and explain the meaning of 'MTOM' and be aware that MTOM is a structural limitation.
- Define and explain the meaning of 'CG'.
- Be familiar with the effect of CG on fuel consumption.
- Explain the reasons for having an adequate tie-down of payload components.
- Be aware that, due to their differences in characteristics, payload components may impact the stability of the flight.
- Be aware that each type of unmanned aircraft has a different CG position and be able to explain why.
- Describe the relationship between CG position and stability/controllability of unmanned aircraft.
- Describe the consequences if the CG is in front of the forward limit.
- Describe the consequences if the CG is behind the aft limit.

PAYLOAD SECURING

- Be aware that payload components must be well secured before take-off to ensure the safety of the flight.

BATTERIES

- Be familiar with battery technology to help prevent potential unsafe conditions.
- Be familiar with the existing different battery types, such as Li-Po, Li-ion, NiMH and Pb types.
- Be familiar with the terminology used for batteries, such as memory rate, capacity and c-rate.
- Be familiar with the charging, usage, danger and storage processes of a battery.

080 Technical operational mitigations for ground risk

DEFINITIONS AND RESPONSIBILITIES

- Define the term 'ground risk'.
- Define the term 'controlled ground area'.
- Describe that the controlled ground area comprises the 'flight geography area', the 'contingency area' and the 'ground risk buffer'.
- Describe that the UAS operator may protect the controlled ground area by means of fencing or using other methods, as appropriate, considering the population density.
- Define the terms 'flight geography' and 'flight geography area'.
- Define the terms 'contingency volume' and 'contingency area'.
- Describe the minimum external limits of the contingency area for STS-01 and/or STS-02 operations.
- Define the term 'operational volume'.
- Define the term 'ground risk buffer'.
- Be aware that, as a general responsibility, the remote pilot shall ensure that the operating environment is compatible with the declared limitations and conditions, including the controlled ground area defined by the operator.
- Be able to find and to determine the minimum distance to be covered by the ground risk buffer (untethered unmanned aircraft in STS-01).
- Describe the radius dimension of the controlled ground area (tethered unmanned aircraft in STS-01).
- Describe the distance to be covered by the ground risk buffer (STS-02).

GROUND RISK IN STS-01

- Explain why the intrinsic ground risk posed by UAS operations in STS-01 is higher than the one posed by UAS operations conducted in the 'Open' category, and the purpose of the controlled ground area in this matter.
- Be aware that the Flight Termination System (FTS) is a technical requirement also used to mitigate the ground risk (in addition to mitigating the air risk).

GROUND RISK IN STS-02

- Explain why the intrinsic ground risk posed by UAS operations conducted under STS-02 is higher than the one posed by UAS operations conducted in the 'Open' category, and the purpose of the controlled ground area in this matter.
- Be aware that the controlled ground area being entirely located in a sparsely populated environment is an operational requirement used to mitigate the ground risk.
- Be aware that the launch and the recovery of the unmanned aircraft being required to be performed in VLOS is also an operational requirement used to mitigate the ground risk.