Airworthiness considerations for UAVs

A general overview about the approach to a UAV System under current regulations for operation, airspace and certification

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Airborne Systems
Type certification
**Report Documentation Page**

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<table>
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<th>1. REPORT DATE</th>
<th>02 SEP 2003</th>
<th>2. REPORT TYPE</th>
<th>N/A</th>
<th>3. DATES COVERED</th>
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<td>4. TITLE AND SUBTITLE</td>
<td>Airworthiness Considerations for UAVs</td>
<td>5a. CONTRACT NUMBER</td>
<td></td>
<td>5b. GRANT NUMBER</td>
<td></td>
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<td>5c. PROGRAM ELEMENT NUMBER</td>
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<td>5f. WORK UNIT NUMBER</td>
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<td>6. AUTHOR(S)</td>
<td></td>
<td>8. PERFORMING ORGANIZATION REPORT NUMBER</td>
<td></td>
<td>9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)</td>
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<td>10. SPONSOR/MONITOR’S ACRONYM(S)</td>
<td></td>
<td>11. SPONSOR/MONITOR’S REPORT NUMBER(S)</td>
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<tr>
<td>7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)</td>
<td>STN ATLAS ELEKTRONIK Germany</td>
<td></td>
<td></td>
<td>12. DISTRIBUTION/AVAILABILITY STATEMENT</td>
<td>Approved for public release, distribution unlimited</td>
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<td></td>
<td>13. SUPPLEMENTARY NOTES</td>
<td>See also ADM001676, UAV 2002 Conference &amp; Exhibition., The original document contains color images.</td>
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<td></td>
<td></td>
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<td>18. NUMBER OF PAGES</td>
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**Standard Form 298 (Rev. 8-98)**
Prescribed by ANSI Std Z39-18
Airworthiness considerations for UAVs

Customers desires
Performances, Features, Time Frame

Manufacturers ideas
Resources, Location, Budget, Time frame Technical realisation

Certification Authorities experience
Design features, Safety requirements, Existing regulations
Airworthiness considerations for UAVs

Road Map to Airworthiness Requirements

Mission

Airspace

Aerial vehicle

System

Essential aspects for requirement tracing
Airworthiness considerations for UAVs

Mission

Airspace
Aerial vehicle
System

Essential aspects for requirement tracing

"What is the defined mission?"
Airworthiness considerations for UAVs

Possible scenario of a surveillance mission
Airworthiness considerations for UAVs

Questions regarding the specified mission:

What will be the main tasks of the system?

• How long does a mission take?
• Where do we want to operate it?
• Who is going to operate it?
Airworthiness considerations for UAVs

Questions regarding the specified mission:

• Will the UAV be operated beyond national borders?

CHICAGO Article 8, Pilotless aircraft:

No aircraft capable of being flown without a pilot shall be flown without a pilot over the territory of a contracting State without special authorization by that State and in accordance with the terms of such authorization. Each contracting State undertakes to insure that the flight of such aircraft without a pilot in regions open to civil aircraft shall be so controlled as to obviate danger to civil aircraft.
Airworthiness considerations for UAVs

"In what type of airspace will the aircraft be operated?"
Airworthiness considerations for UAVs

For example the German Airspace:
## Airworthiness considerations for UAVs

### Airspace related requirements in Germany

<table>
<thead>
<tr>
<th>Airspace classification</th>
<th>Flight rules</th>
<th>Max. Speed (IAS)</th>
<th>Radio communication</th>
<th>ATC clearance</th>
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<tbody>
<tr>
<td>A</td>
<td>IFR</td>
<td>No speed limit</td>
<td></td>
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<td>B</td>
<td>IFR, VFR</td>
<td>No speed limit</td>
<td></td>
<td>Required</td>
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<tr>
<td>C</td>
<td>IFR</td>
<td>250 kts below FL 100</td>
<td>Permanent stand-by</td>
<td></td>
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<tr>
<td>C</td>
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<td>250 kts below FL 100</td>
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<td>CTR &quot;C&quot;</td>
<td>Same as for airspace “C”, special needs for SVFR(AIP VFR, ENR)</td>
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<td>D</td>
<td>IFR, VFR</td>
<td>250 kts below FL 100</td>
<td>Permanent stand-by</td>
<td>required</td>
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<td>E</td>
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<td>250 kts below FL 100</td>
<td>Permanent stand-by</td>
<td>Required</td>
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<tr>
<td>E</td>
<td>VFR</td>
<td>250 kts below FL 100</td>
<td>Not required</td>
<td>Only for VFR night</td>
</tr>
<tr>
<td>F</td>
<td>IFR</td>
<td>250 kts below FL 100</td>
<td>Not required</td>
<td>Required</td>
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<tr>
<td>F</td>
<td>VFR</td>
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<td>Only for VFR night</td>
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<td>G</td>
<td>VFR</td>
<td>250 kts below FL 100</td>
<td>Not required</td>
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</table>
# Airworthiness considerations for UAVs

## Airspace related ATS

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<th>Type of airspace</th>
<th>Flight rules</th>
<th>Possible ATS</th>
<th>Separation by ATC</th>
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<tr>
<td>A</td>
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<td>ATC</td>
<td>All Aircraft</td>
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<tr>
<td>B</td>
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<td>IFR, VFR</td>
<td>ATC</td>
<td>All Aircraft</td>
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<tr>
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<td></td>
<td>IFR</td>
<td>ATC</td>
<td>IFR/IFR, IFR/VFR</td>
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<tr>
<td></td>
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<td>VFR</td>
<td>ATC, FIS (VFR/VFR)</td>
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<td>D</td>
<td>Controlled Airspace</td>
<td>IFR</td>
<td>ATC, FIS about VFR traffic</td>
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<td>VFR</td>
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<tr>
<td></td>
<td></td>
<td>VFR</td>
<td>FIS if possible</td>
<td>No separation</td>
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<td>IFR</td>
<td>In flight AIS if possible</td>
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<td>FIS</td>
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<tr>
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<td></td>
<td>Only VFR</td>
<td>FIS</td>
<td>No separation</td>
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</tbody>
</table>
Airworthiness considerations for UAVs

Summary of airspace related equipment:

• A safe communication link between aircraft and GCS

• Depending on the airspace, a safe communication link between ATC and GCS

• Minimum equipment according to national laws for chosen flight rule and weather conditions (On board sensors for ground based indicators of flight and navigation instruments, radio, sense and avoid devices, transponder)
Airworthiness considerations for UAVs

Summary of airspace related procedures:

• To maintain or change a (given) flight path
• To maintain or change an (given) altitude
• To maintain or change a given airspeed (horizontal and vertical)
• To perform known standard procedures
Airworthiness considerations for UAVs

Summary of airspace related features:

- To identify the current position
- To communicate with ATC or FIS
- To detect other objects (sense and avoid)
- To react autonomously, or remotely controlled by the GCS
Airworthiness considerations for UAVs

“What are the differences with manned systems?”
Airworthiness considerations for UAVs

Specific needs for an “unmanned” system:

• A safe command and control-link; if needed, redundant

• A safe communication-link; if needed, redundant

• A flight control-system; if needed, redundant

• A qualified and accepted emergency plan and system
Airworthiness considerations for UAVs

Additional “normal” aircraft compliance capabilities:

• A navigation system
• A detection system
Airworthiness considerations for UAVs

Specific “unmanned” features:

• The ability to make on-board decisions based on the collected data

• The ability to command special functions from the GCS, if the on-board intelligence is not sufficient

• The possibility to re-task the aircraft, to start emergency procedures, or to fly the aircraft actively, if requested in near “real time”.
Airworthiness considerations for UAVs

"Pre-design of the aircraft"
## Airworthiness considerations for UAVs

Aircraft specified by the mission definition, airspace- and system -requirements

### Technical Data:

<table>
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<tr>
<th>Specification</th>
<th>Value</th>
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<tr>
<td>Endurance</td>
<td>&gt;30 h</td>
</tr>
<tr>
<td>Altitude</td>
<td>&gt;45000 ft</td>
</tr>
<tr>
<td>Speed</td>
<td>~200 kts</td>
</tr>
<tr>
<td>Payload</td>
<td>&gt;300 kg</td>
</tr>
<tr>
<td>Equipment</td>
<td>&gt;250 kg</td>
</tr>
<tr>
<td>Engine, Turbo Prop</td>
<td>~ 500 shp</td>
</tr>
<tr>
<td>Fuel</td>
<td>~1500 kg</td>
</tr>
<tr>
<td>Span</td>
<td>~25,0 m</td>
</tr>
<tr>
<td>Length</td>
<td>~10,0 m</td>
</tr>
<tr>
<td>Height</td>
<td>~4,0 m</td>
</tr>
<tr>
<td>Take off 50 ft.</td>
<td>~1000 ft</td>
</tr>
<tr>
<td>Runway</td>
<td>~1500 ft</td>
</tr>
<tr>
<td>MTOW</td>
<td>~3000 kg</td>
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Airworthiness considerations for UAVs

Size and location of the payload and operationally related equipment
Airworthiness considerations for UAVs
Airworthiness considerations for UAVs

§ Identification of legal demands and project related requirements §

§ Military or civil operations lead to:
§ The responsible Authorities (CAA, military)
§ The related regulations (civil, military)
§ National / international law (ICAO convention)

§ Identified airspace leads to:
§ ATC procedures (clearances)
§ Flight rules and regulations (IFR, VFR)
§ Necessary equipment and abilities

§ The aircraft leads to:
§ Its related airworthiness requirements (FAR, JAR, others)
§ Its required safety levels
§ Proven design features

§ The specified system will help define:
§ For ground based components its associated regulations and requirements
§ Requirements for the emergency procedure
§ Personnel requirements for the operators
Airworthiness considerations for UAVs

Announcing the project to the responsible authority will start the following processes:

- Defining the overall certification envelope for the system
- Searching applicable requirements for UAVs
- Defining or creating applicable safety levels
- Defining and fixing the way to prove the requirements
- Creating and fixing the certification schedule with the authority
- Defining and fixing the form of the records

Seeking support and co-operation from the authorities
Airworthiness considerations for UAVs

Flow chart of a “typical” certification process

Start → Pre-design of the UAV System → Identification of legal demands

Create your certification schedule

Announcing the project to the responsible authority

Identification of project related requirements

Harmonizing the certification schedule with the responsible authority

Fixing the certification schedule together

Certification process

Type certification

Recording

End of certification
Airworthiness considerations for UAVs

Getting your “Type Certificate”:

- Is the final step to go into operation in civil airspace,
- Will be needed for the individual aircraft flight certificate

Is the end of my presentation,
Thank you!