UAV SAFETY OBJECTIVES
&
WEIGHT CATEGORIES

UAV2002
Paris June 11th
# UAV SAFETY OBJECTIVES and WEIGHT CATEGORIES

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**Limitation of Abstraction:** UU

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The Dassault Aviation Paris, France has developed safety objectives and weight categories for unmanned aerial vehicles (UAVs) to enhance their operational safety. The report outlines specific guidelines and considerations necessary for the safe integration of UAVs into the airspace, focusing on weight categories to ensure compliance with regulatory standards. This approach helps in minimizing the risk of accidents and maintaining the integrity of the aviation system. The document is approved for public release, allowing for widespread dissemination among stakeholders in the aviation industry.
NAVDROC

- NAVDROC
  Study to check "pertinence" of each JAR VLA, 23 & VLR paragraph for UAV application
  EuroUVS was in charge of the NAVDROC study with the following subcontractors:
  - Dassault-Aviation JAR 23
  - SAGEM JAR VLA
  - THALES JAR VLR

- NAVDROC CONCLUSIONS & RECOMMENDATIONS
  UAV SAFETY OBJECTIVES & WEIGHT LIMITATIONS
  ADAPTATION OF "JAR OPS" TO UAV
  GROUND STATION & COMMUNICATIONS
  UAV INSERTION IN THE FUTURE ATM
  JAR LUAV & UAV REGULATIONS
UAV SAFETY OBJECTIVES & WEIGHT LIMITATIONS

- NAVDROC DISCUSSION
  Difficulty to write some "regulation paragraphs" due to the lack of UAV safety objectives
  Need for a UAV "AC FAR 23-1309-1C" (oriented to protect on ground people)
  Weight limits of JAR regulations are not adapted to UAV
  UAV safety objectives must provide a protection consistent with the protection provided by the civil or military aircraft.

- ON GROUND CRASH VICTIMS
  Determination of lethal surface
  Experience of civil and military aircraft crashes

- WEIGHT LIMITS
  Determination of weight limits for each certification category
## CIVIL REGULATIONS

### CIVIL AIRCRAFT

#### JAR / FAR REGULATIONS

<table>
<thead>
<tr>
<th>JAR VLA</th>
<th>JAR 23</th>
<th>JAR 25</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Single Engine &amp; Dual Single Engines</td>
<td>Multi Engines</td>
</tr>
<tr>
<td>FAR 23</td>
<td>Light Aircraft</td>
<td></td>
</tr>
<tr>
<td>2 700 kg</td>
<td>6 000 lbs</td>
<td></td>
</tr>
<tr>
<td>750 kg</td>
<td>1650 lbs</td>
<td></td>
</tr>
<tr>
<td>5 670 kg</td>
<td>12 500 lbs</td>
<td></td>
</tr>
<tr>
<td>8 618 kg</td>
<td>19 000 lbs</td>
<td></td>
</tr>
</tbody>
</table>

*Note: The image includes a diagram with different categories and weights for civil aircraft regulations. The diagram is not described in the text.*
# CIVIL AIRCRAFT

<table>
<thead>
<tr>
<th>AIRCRAFT CATEGORIES</th>
<th>Catastrophic failure</th>
<th>Aircraft loss Technical</th>
<th>Aircraft loss Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAR 25 Aircraft</td>
<td>1E-09</td>
<td>1E-07</td>
<td>3E-07</td>
</tr>
<tr>
<td>FAR 23 Commuters</td>
<td>1E-09</td>
<td>1E-07</td>
<td>1E-06</td>
</tr>
<tr>
<td>FAR 23 &gt;6000 lbs reciprocating</td>
<td>1E-08</td>
<td>1E-06</td>
<td>5E-06</td>
</tr>
<tr>
<td>FAR 23 &lt;6000 lbs turbine</td>
<td>1E-07</td>
<td>1E-06</td>
<td>1E-05</td>
</tr>
<tr>
<td>FAR 23 &lt;6000 lbs reciprocating</td>
<td>1E-06</td>
<td>5E-06</td>
<td>2E-05</td>
</tr>
<tr>
<td>Military Aircraft</td>
<td>1E-07</td>
<td>1E-05</td>
<td>5E-05</td>
</tr>
</tbody>
</table>

FAR 23 AC23-1309-1C
## UAV VERSUS JAR 23 AIRCRAFT

### Fatal Crash Probability

**one victim per million of flight hours**

<table>
<thead>
<tr>
<th>Category</th>
<th>Weight (kg)</th>
<th>W/S (kg/m²)</th>
<th>Lethal S. (m²)</th>
<th>Crash Victims</th>
<th>Crash Prob</th>
<th>FAR JAR 23 Equivalent Aircraft</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCAV</td>
<td>25000</td>
<td>400</td>
<td>1293</td>
<td>0.2586</td>
<td>4E-06</td>
<td>1E-06 FAR 23 Commuter</td>
</tr>
<tr>
<td>HALE</td>
<td>20000</td>
<td>200</td>
<td>702</td>
<td>0.1404</td>
<td>7E-06</td>
<td>5E-06 FAR 23 Single engine</td>
</tr>
<tr>
<td>HALE</td>
<td>8600</td>
<td>200</td>
<td>400</td>
<td>0.0800</td>
<td>1E-05</td>
<td>1E-05 FAR 23 &lt; 6000 lbs turbine</td>
</tr>
<tr>
<td>MALE</td>
<td>5700</td>
<td>100</td>
<td>192</td>
<td>0.0383</td>
<td>3E-05</td>
<td>2E-05 FAR 23 &lt; 6000 lbs reciprocating</td>
</tr>
</tbody>
</table>

Population density corresponding to two times France population density

*Figures are for information only*
WEIGHT LIMIT TARGET

CIVIL AIRCRAFT REGULATIONS

JAR VLA
JAR 23
JAR 25

Single & Dual Single
Multi Engines
Multi Engines

Light aircraft
2000 kg ?
750 kg
2700 kg
2000 Kg ?
5700 kg
8600 kg
25 000 kg ?

Weight extension
Spécial Conditions
Single & Dual Single

Weight extension
Spécial Conditions
Multi Engines

JAR LUAV
JAR UAV
JAR 25 UAV

UAV REGULATIONS

Figures are for information only
### JAR UAV CATEGORIES

<table>
<thead>
<tr>
<th>JAR LUAV</th>
<th>JAR UAV</th>
<th>JAR 25 UAV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single and Dual Single engine</td>
<td>Weight extension</td>
<td>Spécial Condition</td>
</tr>
<tr>
<td>Multi Engines</td>
<td>Weight extension</td>
<td>Spécial Condition</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weight extension</th>
<th>Spécial Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 000 kg to 5 700 kg</td>
<td>5 E-05</td>
</tr>
<tr>
<td>5 700 kg to 8 600 kg</td>
<td>1 E-05</td>
</tr>
<tr>
<td>8 600 kg to 20 000 kg</td>
<td>5 E-06</td>
</tr>
<tr>
<td>20 000 kg to 25 000 kg</td>
<td>1 E-06</td>
</tr>
<tr>
<td>&gt; 25 000 kg</td>
<td>3 E-07</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Uncontrolled Crash</th>
<th>2 E-05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global technical failure</td>
<td>5 E-06</td>
</tr>
<tr>
<td>Catastrophic Failure</td>
<td>1 E-06</td>
</tr>
</tbody>
</table>

*Figures are for information only*
PURPOSES OF THE NEW STUDY

- DEFINE SAFETY OBJECTIVES
  - Enough conservative to provide protection to on ground people
  - Not too much conservative to allow UAV development
  - Consistent with civil & military aircraft safety objectives
  - Might be a function of population density (operational limitations)

- DETERMINE WEIGHT LIMITS OF UAV CATEGORIES
  - JAR LUAV
  - JAR UAV
    - Single Engine
    - Multi Engines