Airworthiness Certification of Unmanned Aerial System

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Introduction to ROK UAV Military Airworthiness Certification Procedure

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ROK Military Airworthiness System

- Airworthiness Elements & Infrastructure

  Law
  - Law-12903 (30/03/17) (4th edition)
  - DAPA regulation-405 (20/03/17)

  Organization
  - A/W Authority
  - A/W Engineering Center
  - A/W Engineering Agencies

  Process

  Criteria
  - Part 1: MIL-HDBK-516C
  - Part 2: STANAG 4671
  - Part 3: STANAG 4703

Part 0: MIL-HDBK-516C
Part 2: STANAG 4671
Part 3: STANAG 4703
ROK Military Airworthiness Standard

- Standard Airworthiness Certification Criteria
  - ✔ STANAG -4671 & 4703
  - ✔ ROK Military SACC
  - ✔ Korea SACC

SACC : Standard Airworthiness Certification Criteria
Case Study

- Case of STANAG-4671 tailored for Korea Army UAV A/W Criteria

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<th>Not apply for Korea’s Lightweight UAV</th>
<th>Restrictions</th>
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<td>Different Configuration and Functions</td>
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<td>Retracted-type Landing Gear</td>
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<td>Parachute landing</td>
<td>Emergency Parachute</td>
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<tr>
<td>Hydraulic System</td>
<td>Not exist</td>
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<tr>
<td>Balked landing</td>
<td>Application is impossible for Operation Concept (Engine is shutdown before landing)</td>
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Restricted application Items for Light UAV
* Icing, Lightning, Bird Strike, etc.
Lessons Learned

- **UAV Airworthiness Development Plan**
  - UAV category must be Subdivided in detail
    - STANAG-4671: 150Kg ~ 20,000Kg
    - STANAG-4703: 66J (49 ft-lb) ~ 150Kg
  - Experiences of ROK AW Authority
    - Corps level UAV, Division level scout UAV, MUAV, HUAV etc
  - Collaboration Work
    - Amendment of STANAG
Part I

Military lightweight UAV Developed by KAL
(Project Name : RQ-102)

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KAL UAV Development Milestone

- **Korean Air Line offers a comprehensive range of UAS**

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<th>02 Secure high-tech.</th>
<th>03 Innovative tech. development</th>
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<td>- KUS-7 / K-9</td>
<td>- Light UAV</td>
<td>- Tilt-Rotor UAV</td>
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- **Close-range KUS-7 ('04~'07)**
- **Close-range KUS-9 ('07~'09)**
- **KUS-FT Develop**
- **Prototype ('15~'16)**
- **Multicopter KUS-HD**
- **Small UAV**
- **Tactical UAV** (Fixed wing)
- **Tactical UAV** (Tilt rotor)
- **Tactical UAV** (Rotary wing)
- **HALE/MALE**
- **UCAV**

- **Tailless flight control**
  - T.D, KUS-8X ('07~'08)

- **RPV (1981)**
- **N/Grumman KD2R-5 fuselage (1986)**

* RPV(Remotely Piloted Vehicle), KD2R – target drone
What is RQ-102?

RQ-102 = Lightweight Military UAV developed by Korea (Currently operating)

Reconnaissance

Radio Controlled Drone

Aircraft (Serial) Number
RQ-102 Development Process

- Airworthiness Verification & Validation Step

**Development Phase**
- Contract
- PDR
- CDR
- FFRR
- First Flight
- Defense Specification
- Combat suitability
- Mass Production

**Airworthiness Certification**
- Airworthiness Certification Pre-Plan
- TACC Approval
- SOF examination
- SOF Review
- Airworthiness examination
- Type Certification
- Production Validation & Audit
- Each Airworthiness Certificate

- Nov. 2013
- Oct. 2014
RQ-102 Specification

- **General Characteristic**

  - **Size**: 3.7m (L) x 4.5m (W) x 0.9m (H)
  - **MTOW**: 150 kg
  - **Power Plant**: 35hp Rotary Engine
  - **Take-off**: Launcher (Automatic)
  - **Landing**: Arrest hook & net

- **Performance**

  - **Max. Speed**: TAS 000 km/h
  - **Max. Altitude**: 0 km
  - **Endurance**: 0 hrs
  - **Operation Range**: 000 km (In clear day, LOS)
A tactical UAV for ISR mission

- 24-hour of Continuous reconnaissance operation
- Autonomous operation: Take off, Mission flight & Landing
- Designed for moving forces not requiring a runway
- Designed to aid mobile operations in mountainous regions
RQ-102 UAV System (2/2)

System Composition

- 4 Air-vehicles
- 2 Ground Control Station (LRS, GCS)
- Ground Vehicle Transporter
- Ground Support Equipment
- Launcher & Recovery net
- Precision Location Tracker
- Airvehicle Test Equipment
- Ground Relay Station

- 2nd Arresting Cable
- 1st Arresting Cable

Defense Acquisition Program Administration
RQ-102 Operation Concept

- LRS/GCS controls UAVs directly or using GRS
- 24hrs mission available by controlling two UAVs simultaneously
RQ-102 Features (1/2)

- Dually redundant flight critical equipment
- Remote engine start system
- Mid-air engine restart capability
- Automatic landing with precision location tracking technology
- Multiple recovery methods: Arresting hook, net, parachute deployment
- Designed for mobility: Simple Disassembly of wings from fuselage for moving/storage
RQ-102 Features (2/2)

- Capable of performing deep dive and following Steep landing Profile
- No external pilot required
  - Designed for operations at night & under inclement weather conditions (fog/rain/wind)
  - Accurate positioning information available through PLT technology
  - Short stopping distance of 30m when using arresting hook

![Landing Path](image)
RQ-102 Safety

- **Meet safety requirements**
  - Safety requirements met STANAG-4671
  - ROK Certifying Authorities has approved the safety requirements of RQ-102 UAV

- **Safety requirements of RQ-102** = \(?\times10^{-0}/\text{FH},\)

  ※ In conclusion, **RQ-102 Safety Met for STANAG-4671**
Ground Test

Wind Tunnel  Static Load  GVT  Landing Gear Drop

Intra EMC  EMI  Temperature  Rain
Flight Test

- About 200 flights during development period

“Watch the RQ-102 Video”
RQ-102 Reliability

- **Certified by Republic of Korea**
  - 1st Military type certificate awarded in UAV

- **Dualization of flight critical equipment**
  - Flight control computer
  - Navigation system
  - GCS & LRS
  - Primary and secondary datalink

- **Recovery plan**
  - Use auxiliary battery when generator fail
  - Remote engine restart
  - Datalink recovery flight when link-loss
  - Parachute deployed for safe recovery of air vehicle for emergency

STANAG-4671 / Military type