

ICAO RPAS 2022

Certifying RPAS and Their Components

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Hermes[™] 900 StarLiner | Overview



Civil Aviation Authority

Heavy Fuel **Engine version** of the Hermes 900 with extended capabilities

1600 kg

Features (Final Product)





רשות התעופה האזרחית Civil Aviation Authority

Certified Category

Type certification:

- UAS Type Design Standard CofA
- Restricted limitations according to the use case
- Certification standards:
 - STANAG 4671 Adapted from CS-23
 - Not all the requirements are fully developed
 - Not all the AMC are fully developed



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STANAG 4671

In line with the JAA-Eurocontrol Taskforce recommendations, the following areas are not covered by this airworthiness code:

- Control station security,
- Security of the command and control data link from wilful interference,
- ✤ Airspace integration and segregation of aircraft (including "sense and avoid"),
- The competence, training and licensing of UAS crew, maintenance and other staff,
- Approval of operating, maintenance and design organizations,
- The type of operation,
- Vehicle Management and Navigation requirements,
- Frequency spectrum allocation,
- Noise, emission, and other environmental certification,
- Launch/landing equipment that is not safety critical and which does not form part of the Type Certification Basis,
- Operation of the payload (other than its potential to hazard the aircraft),
- Carriage and release of weapons, pyrotechnics and other functioning or non-functioning stores designed for release during normal operations,
- Non-deterministic flight, in the sense that UAS flight profiles are not pre-determined or UAS actions are not predictable to the UAS crew,
- ✤ Sea-basing,
- Piloting from an external or internal control box,
- Supersonic flight



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RPA

- Aircraft certification:
 - It's an Aircraft!
 - Automation
 - Envelope protection
 - Validation of computerized tools
 - No pilot = Instrumentation in the certification phase
 - Airworthiness Approval of Parts/Articles process



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RPS - Certification

RPS Boundaries

HMI – cockpit certification

New concepts:

- Mission oriented (Automated flight) Vs Piloting
- COTS equipment



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Command and Control

- No standards e.g. Performance criteria, Latencies...
- ✤C2 networks ₩AN, LAN

Combination of C2 systems (RLOS, Satcom)





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Certification Basis

Restricted Category

Certification for Restricted Type Certification for the special purpose of aerial survey in accordance with Israeli CAAI Air Navigation Regulations (ANR), Procedures for Certification of Aircraft and Aircraft Parts, 1977, regulation 10.

AEP 4671 Edition A Version 1 (see CAAI Issue paper G-1).

Exemptions:

Exemption AWD-137-2020 dated April 2020, display of sideslip angle (Issue Paper HF-6)

Time limited exemption AWD - 524-2021 dated 26/12/2021, GCS faults visual indicator design (Issue Paper HF-7), expires on 26/12/2023.

Time limited exemption AWD - 525-2021 dated 26/12/2021, UNICON (Issue Paper HF-8), expires on 26/12/2023.

Equivalent Level of Safety Findings:

USAR 1351(c)(3) - means to disconnect each electrical power generating devices from the battery	Issue Paper E-6
USAR 1331(a) - means to measuring devices using a power source	Issue Paper E-7
USAR 1835 - Airspeed data	Issue Paper HF-
USAR 1843 - Fuel quantity indication	Issue Paper HF-
Airspeed data - Flaps Operating Range	Issue Paper HF-
USAR 733(a) - NLG Tire	Issue Paper M-1
Alternate Air induction Override capability	Issue Paper P-2
USAR.965(a) - Fuel Tank	Issue Paper S-2
USAR 1304 - Navigation Architecture	Issue Paper E-8

Special conditions:

Airworthiness Approval of Articles under CAAI ANR Chapter 14	Issue Paper C-1
Requirements for AlPstar RPAS Cyber security	Issue Paper E-2
Operation in the High-intensity Radiated Fields (HIRF) Environment	Issue Paper E-4
Protecting FC & Nav Systems from External sensors failure detriment	Issue Paper E-5
Static Port Calibration	Issue Paper F-1
High Speeds Definition with Envelope Protection System	Issue Paper F-3
Human Factors Considerations & Compliance methods for Unmanned	Issue Paper HF-
Aerial System	
Flight Envelope	Issue Paper L-1
Unintended Flight into Icing Conditions	Issue Paper L-2
Lithium ION Batteries	Issue Paper S-5
Fuel Controls in the Ground Control Station	Issue Paper S-6
Ground Gusts Conditions V-tail Monoblock Considerations	Issue Paper S-7

aper C-1 aper E-2 per E-4 aper E-5 aper F-1 aper F-3 iper HF-1

Issue Paper HF-3 Issue Paper HF-4 Issue Paper HF-5 Issue Paper M-1

Issue Paper E-8

Noise Certification: ICAO Annex 16 Vol. 1, Ch. 10

СААІКЛІ

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Requirements for Alpstar RPAS Cyber security

Protecting FC & Nav Systems from External sensors failure detriment

Human Factors Considerations & Compliance methods for **Unmanned Aerial System**

Certification challenges

New certification professionals are needed:

- Systems engineering
- Networks specialists
- Remote pilot station
- Cyber protection
- C2



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Ground Control Station

- Allow full civil airspace integration
 - Detect and Avoid system
 - Near aircraft detection & display
 - TAWS
- Civil routes integration
 - IFR
 - Navigation database
- Certification & Safety
 - Certified PFD
 - Certified dual redundant flight system
 - Real Time Hardware (DAL B)
- Human Factors
 - Human Factors Certification
 - Approved Single Pilot
 - CAAI Approved AFM





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Main Standards Compliance

Subject	Standard	Remarks
Certification Basis	NATO STANAG 4671 edition 2	Certified by CAAI, Equivalent to CS-23
Engine	CS-E & FAR-33	Certified by EASA, FAA and CAAI
Propeller	FAR-35	Certified by EASA
Safety	SAE-ARP-4761	
Software	RTCA-DO-178C	Up to DAL B
Firmware & Hardware	RTCA-DO-254	Up to DAL B
Cyber Security	RTCA-DO-326	
Environmental Conditions	RTCA-DO-160 & MIL-STD-882	
Electromagnetic Environment Effects	RTCA-DO-160 , MIL-STD-461 , MIL-STD-464, MIL-STD-704, ANSI C63.14, SAE-ARP-1870, SAE-ARP-1972	
High Intensity Radiated Field	FAA AC 20-158A, ARP5583	
Lightning Strike	EUROCAE ED 81, ED-84A1, ED-105A2, SAE-ARP-5415, ARP5416	
Noise Level	ICAO Annex 16	Up to 85 dB
Bird Strike	ASTM F330	
Fire proof	TSO-C11e - Fire detection sensor FAA certified to SAE AS 8028	Engine compartment is fire proof IAW FAR/CS 23 and STANAG 4671 requirements.
Human Machine Interfaces & Human Factors	FAA AC 1523, DOT/FAA/CT-96/1, DOT/FAA/TC-16/56 and DOT/FAA/AM-05/24	



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Ground Certification Testing

HIRF



EMI/EMC RIG 🗹



Structure Lightning 🧹





Wing Ultimate Test



Engine Truss ULT 🛛 🜱



Sloshing Test



MLG Drop Test – 🗹



Fatigue Test 🧹



 \checkmark

Bird Strike Test



Firewall 🗹



Tail ULT 🧹



Fuselage ULT 🧹



Lights





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Flight Tests

- ~60 certification flights
- V_D High speed for structure and flutter free substantiation
- V-min-demo Low speed below the flight envelope protection at 4 C.G. extremities of 1.09
 V-stall
- HMI flight tests by 6 different pilots
- General controllability meets design requirement
- ATOL performance meets design requirement s (meets the performance indicated in the AFM)
- Flight envelope protection meets design requirement
- RTO meets the performance indicated in the AFM with good safety margins
- Landing gears, tires and braking system satisfactory
- Climb performance meets the performance indicated in the AFM
- Pitot calibrations Airspeed calibration showed an accuracy of 0.2-1.6 which is less than the 2kts required by regulation
- 50 ft clearance take off performance meets the performance indicated in the AFM
- UAS data link performance satisfactory
- Acoustic Nosie measurement test Meets ICAO requirement of 85dB



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Certification extent

- Number of regulations 312 + 12 Special Conditions
- 106 Flight Safety LRU's:

Catastrophic	Hazardous	Major	Minor	No Safety Effect (mission)	Total
31	11	19	45	40	146

• Hardware , Firmware and Software LRUs Design Assurance Level

No. of CSCIs	DAL B	DAL C	DAL D
Software DO-178	15	1	5
Firmware DO-254	12	-	3

- 46 airborne LRUs qualification + Ground system full scale QUAL (GCS, ATOL, Datalink)
- 32 conformity audit in factories in Israel and 12 audits in factories worldwide
- 436 certification report not including qualification and SW/FW reports
- 50 ground tests
- 60 flight tests
- 130 manpower effort for more than 7 years of development and certification



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Thank you!

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