NATIONAL AVIATION UNIVERSITY
SCIENTIFIC AND PRODUCTION CENTER OF UNMANNED AVIATION 'VIRAZH'

"CONCEPTUAL BASES FOR CERTIFICATION OF TWO-ENGINED UNMANNED AERIAL VEHICLES" (for example Complex UAV the M-7-V5 "NEBESNYI PATRUL»)

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Doc. AHAE.M-7-B5.790100.010.ФВМ

EASA-SAAU Airworthiness Convergence Project
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KYIV 2019

www.uav.nau.edu.ua

JUSTIFICATION OF THE BASIC IDEA OF THE UNMANNED COMPLEX M-7-V5

1. Reduction cost of flying hours of the UAV M-7-V5 compared with the aircraft of the class 750 kg (NARP-1; NAU data 2013-2014)
2. The main direction of application M-7-V5 - the airline with the admission A4 - the implementation of aviation works
3. From the point of view of the systemic external task, this is a "process of rearming the fleet of existing aircraft to new ones"

№	Type of aircraft index	NARP-	M-7-V5
		Costs, UAH	
1	Direct material expenses	271,9	76,5
2	Direct labor costs	339	339
3	Contributions to the Pension Fund	122,54	122,54
4	Contributions to compulsory state social insurance in connection with temporary incapacity for work	5,08	5,08
5	Contributions to compulsory state social insurance against unemployment	4,4	4,4
6	Contributions to compulsory state social insurance against accidents at work	1,69	1,69
7	Depreciation deductions from the cost of fixed assets	1,65	1,65
8	Costs for all types of repairs, technical inspection and maintenance of aircraft fleets	0,016	0,016
9	Total expenditures	123,6	83,08
10	Environmental tax	0,97	0,27
11	Collection to the State Innovation Fund	16	16
12	One-time tax on ownership of an aircraft when purchased	0,93	0,25
13	Airport Costs	37,8	10,8
Total		925,54	661,276
The cost of lg. without VAT, coefficient. profitability - 1.3		1203,2	859,7

Conclusion: reducing the cost of the flight hour by 29,6%

PREVIOUS WORK OF SPCUV "Virazh" NAU BEFORE CERTIFICATION

One of the important problems: how to define this UAV?

1. Air Code of Ukraine. Section 1. Item 23. Unmanned aerial vehicle is an airplane intended for non-pilot flight on board, the flight control of which is carried out by means of a special control station located outside the airplane.

2. Definition of UAS by EASA/ Doc. Airworthiness Certificates for Unmanned Aerial Systems (UAS) E.Y013-01
The unmanned aeronautical system (UAS) consists of separate elements, such as "unmanned aerial vehicles", "control station" and any other elements of the system necessary to provide the flight, i.e. "Command and control" and "start and restore elements." There may be several control stations in the UAS, control and communication and control the startup and restore of elements in the UAS.

The second important problem: how to classify this UAV?

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CONCEPT OF THE STATE AVIATION ADMINISTRATION OF UKRAINE: large with weight more than 150 kg. To be certified as an aircraft type.

Code	Name	MTOV, кг	Range , км	Flight height, m	Flight time, hours
MRLE	Medium Range and Long Endurance	150 - 500	≥500	8000	10-18
Classif, UKR DSTU B 73.71: 2013 - average UAV 100 – 1000кг; operational tactical 80-300 км; long flight time 12-24 hours					

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Analysis of UAV class 200 kg projects from different producer countries for the period 1982-2010

№	Project name	The Year manufacturing	Country
1.	Xian 104/105	1992	China
2.	Xian ASN - 206	1996	China
3.	Xian ASN - 209	2010	China
4.	Soyka	1990	Czech Republic
5.	Sagem Sperver A	1990	France
6.	Reynmetall KZO	2004	Germany
7.	ЕАДС 3 Сігма	2000	Greece
8.	Aerostar C	2003-2006	Israel
9.	Innocon mini Falcon 2	2001	Israel
10.	IAS Raffaello	2007	Italy
11.	Selex Galileo Falco	2006	Italy
12.	Night Intruder 300	1991	Korea
13.	CTRM Aviation Aludra	2006	Malaysia
14.	ACES Eagle EyeP11	2008	Pakistan
15.	Satuma Flamingo	2009	Pakistan
16.	Denel Seecer	1982-1988	South Africa
17.	INTA SlvA	1990-1993	Spain
18.	RUAG Ranger	1988- 1990	Switzerland
19.	ATS Yabhon	2007	U A Emirates
20.	AAI RQ-7 Shadow 200	1999	USA
21.	AAI Shadow 400	1999	USA
22.	AAI Shadow 600	2000	USA
23.	L- 3 BAI Viking 400	2005	USA

Results of statistical processing and receiving the value of the main design parameters UAV M-7-V5

№	Parameter	Value
1	Wingspan, m	6
2	Length, m	4,5
3	Height, m	1,3
4	Wing area, m^2	3,2
5	MTOW, kg	200
6	Weight of payload, kg	до 70
7	The mass is empty, kg	110
8	UAV coefficient of gravity	0,5
9	Specific power, hp / kg	0,2
10	Specific mass, kg / hp	4
11	Fuel mass, kg	60
12	Load per unit area, kg / , m^2	до 80
13	Max speed, km / h	240
14	Cruising speed, km / h	200
15	Stall speed, km / h	70
16	Working speed, km / h.	180
17	Engine power, hp	2x25
18	Battery Type	-
19	Working heights, m	1500 - 3000
20	Ceiling, m	6000
21	Max flight time, h	12
22	Max radius of action, km	100

The justification of choosing the aerodynamic scheme of the UAV M-7V5

The most commons one-engine UAV

MAIN ADVANTAGES OF TWO-MOTOR UAV M-7-V5 «NEBESNYI PATRUL» BEFORE ANALOGS

№	The technical decision M-7-V5	Obtained advantage
1	Application of two engines	1. Permission of flights over populated areas 2. Reduced probability of interruption of flight due to engine stop (flight will continue on one engine)
2	Transverse arrangement of engines (in front of the wing, on the center-plate with the blow-up of the latter)	1. Reducing the effect of vibrations on the REE and the target load located in the fuselage gondola 2. Significant increase of lifting force, which allows to sharply increase the take-off characteristics of the UAV; in particular, exploitation in high altitudes or high temperatures
3	Application of wing profiles with the highest aerodynamic quality ratings at cruising Re	Allows you to significantly reduce fuel consumption in cruising mode and thereby obtain an increased flight time without refueling - up to 10-15 hours.
4	Application of a wing with a high / medium degree of mechanization	The use of slit flaps and flapperons adds a significant (up to 1.5 times the growth of Cy)
5	Multi-section flaps and flappers	1. The Increase the reliability of the control bodies 2. Ability to get an expanded range of configurations UAV
6	Application of slit "inverted" profile of horizontal tail unit	Enhancing the efficiency of UAV control on modes with large angles of attack (especially on landing).
7	Application of UAV modular design (detachable gondola and the airplane itself)	Allows you to quickly receive modifications to the UAV
8	Tail bar, which "breaks" forward in a turning mode by 180 degrees	1. Significant decrease in the size of the UAV in the transport position 2. Significant reduction of time for carrying out a transfer operation from a worker to a transport position

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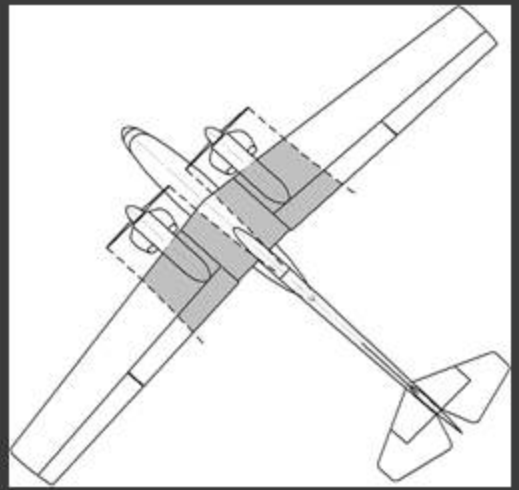
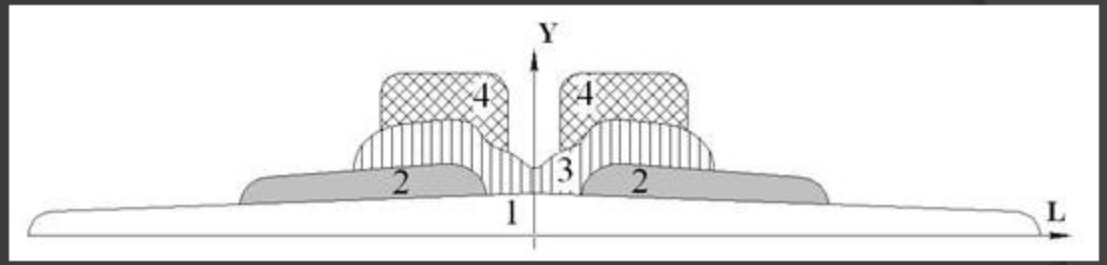
The to substantiates the main advantage of a two- engined transverse chain: the growth of the elevator in relation to blowing air part of the wing



Projection of the M-7D plane with the image of wings, that are blown by a power plant



The distribution of lift along the wing span L of an unmanned M-7D aircraft, where: 1- is the force created by the wing, 2 -by flaps, 3 -by blowing wings, 4 - is the vertical component of the thrust of the power plant.

Conclusion: when flying in an airplane M-7D, the flow from the power plant is 36.8% of the wing wing gain. Lifting force from blowdown was 25%.

M. Matiychyk, M. Makarchuk. The blowing as a way to improve the flight characteristics of unmanned airplanes // Materials of the scientific and practical conference "Actual problems of the development of aviation engineering". - Kyiv, July 5 - July 6, 2012; p. 56

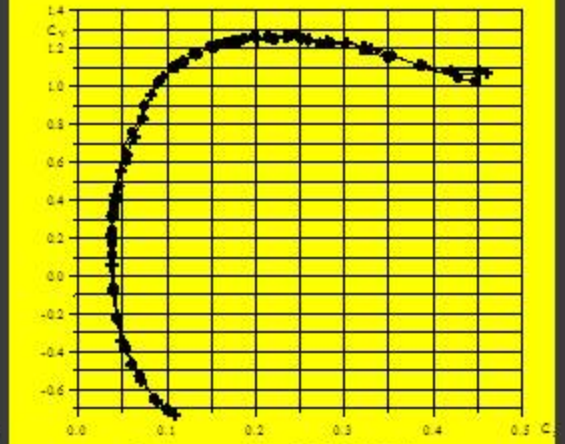
As for the choice of the main prototype M7

M-7A
2005 - 2009 / 50-70 kg
Patent Ukr. No.39777

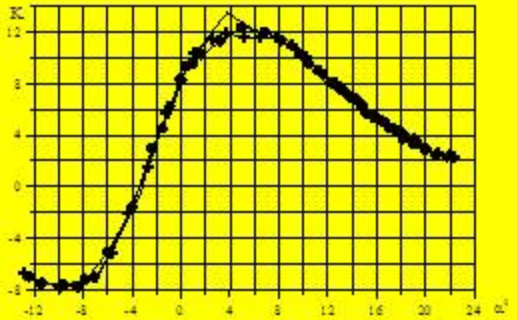
M-7D / 2010 - 2011 / 150kg
Patent Ukr. No. 40288

7

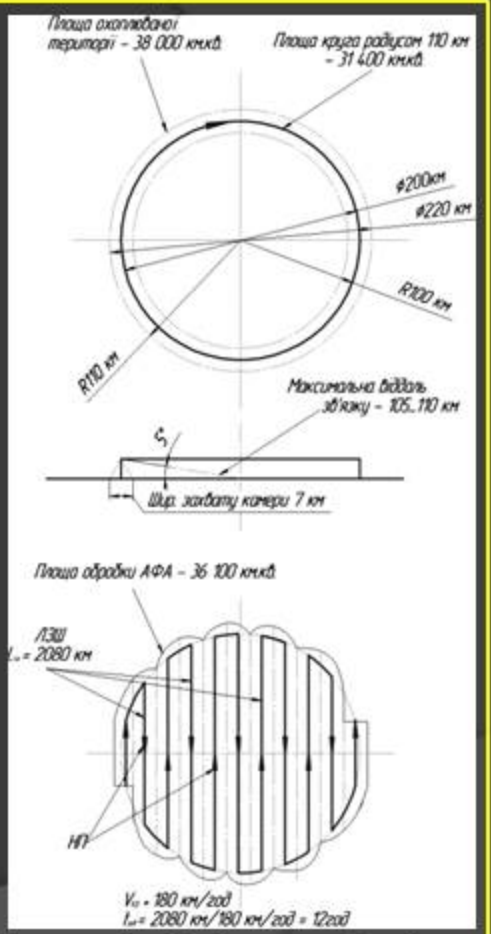
M-7-V5
2011-2018 / 200kg
Patent Ukr. No. 62629



Polar model of M-7-V5 in
Flight configuration δz = 0



Aerodynamic quality of the M-7-V5 model
Flight configuration δz = 0



Scheme to justify the range of action communication range and performance
Aerial photography of M-7-V5

Work moments and some blowout results
models M-7-V5 in the aerodynamic tube TAD-2 NAU

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Determination of the main components of the Complex UAV the M-7-V5 “NEBESNYI PATRUL»

UAV M-7-V5 “NEBESNYI PATRUL»

Transportation trailer for storage and transportation of UAV M-7-V5

Telemetry and video communication antennas with the device the tracing

Ground control station NSC M-7-V5

Basic trailer car

BACKGROUND ON THE DEFINITION OF COMPLEX UAV THE M-7-V5 “NEBESNYI PATRUL”

1. Purpose: the complex of an unmanned aerial vehicle (CUAV) M-7V5 " Nebesnyi patrul" is intended for carrying out aviation works in the interests of the branches of economy and other economic entities.
2. Served by CUAV by external crew of not less than 3 persons.
3. CUAV M-7V5 consists of one twin- engined M-7-V5 " Nebesnyi patrul" aircraft, a ground control station (NSC M-7-V5), communication lines and associated vehicles.
4. CUAV M-7V5 comes in the form of: UAV M-7V5 " Nebesnyi patrul" on a transport trailer and NSC M-7-V5 in the form of the corresponding set + documents for the installation of the Ground control station NSC M-7-V5 onboard the base car.

Basic tactical and technical characteristics UAV complex the M-7-V5 "NEBESNYI PATRUL"

Max radius of action, km 100
The slope of communication with the NSC (for video and telemetry), km ... 105
Max route range, km.....1500-1600
Ceiling, m.....6000
Minimum composition of the external crew, persons 3
Time of deployment in working position, min. 60
Average aerial imaging performance, km ^{2}/h (*Vc* - 180 km/ h)..... 1260
Max flight time, h.....8 - 10
Operating conditions of the UAV..... on all types of runway, including ground

Weight data of vehicles UAV complex

Max total weight of the car, kg 2700*
Max full weight trailer, kg 750
Max total weight of the automobile train, kg .....3500 *
Max Fuel weight for the UAV on the trailer, kg 100
Length of the automobile train, m .....8,9 *

** May be changed depending on the brand of the car*

About the choice of basis of certification basis CUAV M-7-V5

1. CS-VLA

What here is not present?
- two engines;
- NSC;
- communication lines;
- how the interaction between the elements of the KBPS and the like is organized.

Not accepted!

2. CS-23 (AP-23)

What here is not present?
- NSC;
- communication lines;
- how the interaction between the elements of the KBPS and the like is organized.

But there are 2 motors!

Therefore, they were originally taken as the basis!

3. STANAG 4671 designed by based on CS-23 as well :

JAA Eurocontrol UAV Task Force – Final Report 05/2004
Airworthiness standard for Unmanned aerial vehicles,
RAI-UAV – Ente Nazionale Aviazone Civile – **(Italy)**
1999
Design standards UAV - Civil Aviation
Safety Authority (Australia) 05/2000
Design and airworthiness requirements for UAV systems – DEF STAN 00- 970 Part 9 **(UK MOD)**
05/2002
USICO (Unmanned Safety Issues for Civil Operations)– WP 2400 –
Certification review item (CRI) "stall demonstration"
01/2004
AC23.1309-1C – Equipment, Systems, and Installations in Part 23 Airplanes – FAA. **(USA)**
03/1999
TSO C23d – Minimum Performance Standards for Parachute assemblies and Components, Personnel **(USA)**
07/1992
Special Conditions ; Ballistic Recovery Systems
Cirrus SR-20 Installation – 14 CFR Part 23 – **FAA (USA)**
10/1997

STANAG 4671 finally taken as the basis of CB M-7-V5

No "special technical requirements" and "Environment"

MAIN WORK OF SCIENTIFIC AND PRODUCTION CENTER OF UNMANNED AVIATION ‘VIRAZH’ NAU ON CERTIFICATION

1. The actual text of the application is in accordance with the form provided by the SAA Ukraine
2. Brief technical description of CUAV M-7-V5
3. Project Certification Program АНАЕ.М-7- В5.790100.012.ПрС
4. Certification basis АНАЕ.М-7-В5.790100.013.СБ
5. Flight manual АНАЕ.М-7-В5.790106.001. ЛК
6. Other technical documents

Submitting an Application and Receiving the Order of the State Aviation Administration

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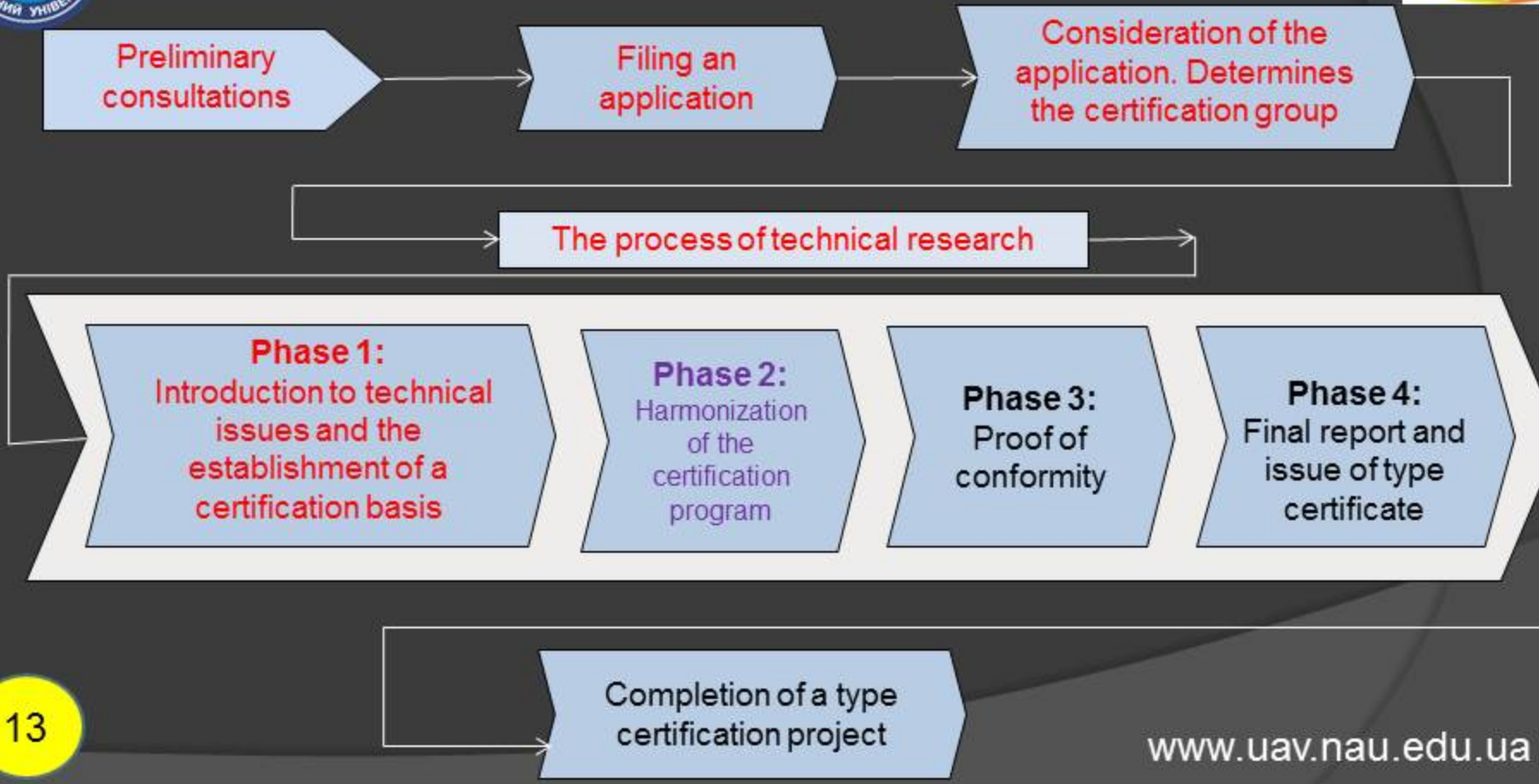
Application from SPCUA "Virazh" NAU for certification of type CUAV M-7V5 " Nebesnyi patrul" registered by the State Aviation Administration of Ukraine on January 25, 2018 under No. 1167

The result of consideration of the application No. 1167- Order of the State Aviation Administration of Ukraine № 164 dated February 27, 2018 "On the certification of a typical design Complex Unmanned Aircraft M-7-V5 " Nebesnyi patrul"

Sending with **SAA of Ukraine** a list of questions, based on the application and agreeing on the date of the first technical meetings to get acquainted with technical issues and establish a certification basis. The date of the meeting was agreed on 02.08. 2018

Flowchart of certification process type CUAV M-7-V5
(recommendations of State Aviation Administration)



Phase 1 - Technical Reviews and Establishments Certification basis (recommendations SAA Ukraine)

The purpose of phase 1 is to provide technical information about the project to the group's specialists for the identification and approval of the original Certification Basis. The typical design claimed must be defined. Requirements for determining the typical design are contained in paragraph 21.A.31 of APU-21 (Part-21).

Requirements to the content of the Certification Basis are contained in paragraph 21.A.17 of APU-21 (Part-21). The Primary Certification Basis may require changes to continue the certification process. The final Certification Basis is determined by the results of a set of certification works. The certification basis is recorded in the CRI-A1 Certification Examination Protocol.

For special conditions, adopted equivalent levels of security, variances and exemptions, a separate Certification Review Item (CRI) protocol is issued.

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List and codes of some documents for CUAV M-7-V5, which are being developed by the SPCUA "Virazh" NAU for certification procedures of the type of CUAV M-7-V5

№ з/п	Title of documents	Symbolic designation	Availability
1	**WORKING CONSTRUCTION DOCUMENTATION**		
1.1	Specification	АНАЕ.М-7-В5.790100.001.СП	+/-
1.2	Drawing details	АНАЕ.М-7-В5.790100.002.СЧ	+/-
1.3	Dimensional drawing	АНАЕ.М-7-В5.790100.003.ГК	+
1.4	Assembly drawings (including packaging)	АНАЕ.М-7-В5.790100.004.СК	+/-
1.5	Electrical scheme	АНАЕ.М-7-В5.790410.001. ЕС	+/-
1.6	Technical conditions	АНАЕ.М-7-В5.790104.001. ТУ	+/-
1.7	A record of purchased items	АНАЕ.М-7-В5.790107.001. ВП	+/-
1.8	List of purchased elements (materials, parts, components) of foreign production	АНАЕ.М-7-В5.790107.002. Д1	+/-
2	**STATEMENT OF OPERATIONAL DOCUMENTS**	АНАЕ.М-7-В5.790103.001. ВЕ	+
2.1	CUAV Form	АНАЕ.М-7-В5.790100.005. ФО	-
2.2	Passport to CUAV	АНАЕ.М-7-В5.790100.006. ПС	-
2.3	Labels on completing products	АНАЕ.М-7-В5.790103.002. ЕТ	-
2.4	Flight manual	АНАЕ.М-7-В5.790106.001. ЛК	+
2.5	Maintenance Manual	АНАЕ.М-7-В5.790106.002. КТО	+
2.6	Technical Operation Guide	АНАЕ.М-7-В5.790106.003. КТЕ	+/-
2.7	A list of spare parts, tools and accessories	АНАЕ.М-7-В5.790103.003. ЗІП	+
2.8	Instructions for installation, adjustment and start-up	АНАЕ.М-7-В5.790106.004. ІМ	-
2.9	The consumption rate of spare parts per 100 hours of operation	АНАЕ.М-7-В5.790106.005. НЗЧ	+
2.10	Material consumption standards for 100 hours of operation	АНАЕ.М-7-В5.790106.006. НЗМ	-
3	**SOFTWARE**		
3.1	Technical description DSTU2851/DSTU 2853	АНАЕ.М-7-В5.790100.007.ОПЗ	+
3.2	Instructions for using the software	АНАЕ.М-7-В5.790106.007.ІЕПЗ	-
4	**TECHNICAL DOCUMENTS**		
4.1	Acts on the results of previous tests	АНАЕ.М-7-В5.790100.008.АВ	-
4.2	Materials of tests (calculations) concerning reliability, durability, resistance to mechanical and climatic factors, etc.	АНАЕ.М-7-В5.790100.009.МВ	+/-
4.3	Фото, відео матеріали	АНАЕ.М-7-В5.790100.010.ФВМ	+/-
5	**MATERIALS WHICH PROTECT THE COPYRIGHT OF MANUFACTURER**		
5.1	The list of patents	АНАЕ.М-7-В5.790100.011.ППат	+
6	**REPAIR DOCUMENTATION**		
6.1	Recommendations for repairing the glider UAV	АНАЕ.М-7-В5.790106.008.РРП	-
7	**CERTIFICATION DOCUMENTS**		
7.1	Certification Program	АНАЕ.М-7-В5.790100.012.ПрС	+
7.2	Certification basis	АНАЕ.М-7-В5.790100.013.СБ	+
7.3	Design test plan	АНАЕ.М-7-В5.790100.014.ВК	+
7.4	Ground test plan	АНАЕ.М-7-В5.790100.015.НВ	+
7.5	Flight Test Plan	АНАЕ.М-7-В5.790100.016.ЛВ	+
7.6	Matching tables	АНАЕ.М-7-В5.790100.017.ТС	+

What areas of refinement for the submitted documents Applications, recommended SAA?

➢**REGARDING THE DEFINITION OF THE TYPE DESIGN CLAIMED:**

For the document defining the typical design, recommend using DSTU 3321: 2003 and GOST 2.102.

➢**REGARDING THE CERTIFICATION BASIS:**

According to the current APU, apply the applicable airworthiness requirements valid at the time of application, namely STANAG 4671 Ed.2

Taking into account the design features of the UAV and the peculiarities of its types of operation, it is necessary to develop a special technical requirements on the following issues: cooling off engine and screw (AP-33, AP-35, etc.); line of data transmission; requirements for the approval of the components; ground control station (taking into account the hardware part); Emergency parachute system;

➢**REGARDING THE CERTIFICATION PROGRAMS:**

To amend the draft MPS Certification Program M-7-B5 in accordance with the requirements of Part-21 in accordance with the comments received during the presentation:

Adapt the project of the Certification Program to the peculiarities of the developer organization and complete all its items;

Include in the form of an appendix to the Certification Program a checklist of correspondence with the indication of the Imethods for determining compliance, the methods and the participation of the specialists of the SAA for each item of the Certification Basis. In the relevant sections of the program, provide links to project units of the organization-developer .

➢**OTHER DIRECTIONS OF WORK:**

In order to approve the components of the aircraft, which were developed by other organizations, the SPCUA "Virazh" take steps to deepen the interaction with the developers of these components to ensure their approval in the complex of an unmanned aircraft.

Eliminate the discrepancies found in the technical documentation of the CUAV M-7-VB5.

NAU to provide a regulatory document of the National Aviation University regarding the structure and responsibilities of the staff of the Virazh Center.

Submit registration changes to certification and technical documentation, which indicates the reasons for making changes and the date they were made; speed work to get approval from the developer organization; accelerate the permission to receive Radio Frequencies that are not intended for use by an aircraft

Phase 2: Approval of the certification program (current for today)

Measures the SPCUA "Virazh" taken to eliminate deficiencies, according to SAA recommendations

➢ DEVELOPED "STANDARD SPECIFICATION" DOCUMENT AHAE.M-7-B5.790100.001.CC according to which the following models (performance) of CUAV M-7-V5 «Nebesnyi patrul» will be issued:

1. 7B5.791100.100000 - without anti-icer
2. 7B5.791100.100001 - with anti-icer.

The specified UAV are included in the list of executions of the entire complex of unmanned complex M-7-V5 «Nebesnyi patrul» .
The main difference in performance is the restriction of BPS M-7V5 in version 7B5.791100.100000 on flights in difficult meteorological conditions.

➢ DETERMINATION OF THE TYPICAL CONSTRUCTION OF CBPS M-7-B5 «NEBESNYI PATRUL» (list of documents)

№	Title of the document	Document Code
1	Standard specification on CUAV M-7-V5	AHAE.M-7-B5.790100.001.CC
2	Technical conditions (TC) for control, acceptance and delivery CUAV M-7-V5	AHAE.M-7-B5.790101.001.ТУ
3	Flight manual CUAV M-7-V5	AHAE.M-7-B5.790106.001. ЛК
4	Technical Operation Guide CUAV M-7-V5	AHAE.M-7-B5.790106.003. КТЕ
5	Maintenance Manual CUAV M-7-V5	AHAE.M-7-B5.790106.002. РТО

➢ **The revised certification basis of CB CUAV M-7-V5 «Nebesnyi patrul» consists of two sections and includes the following requirements:**

1. Airworthiness requirements of CUAV M-7-V5 «Nebesnyi patrul»
1.1. Requirements Standard STANAG 4671 (Ed.2), which apply to **CUAV M-7-V5**
1.2. Special technical requirements
1.2.1. Requirements for the location of the GCS M-7-V5 in the base vehicle compartment
1.2.2. Requirements aviation rules AP-33, which apply to engines UAV M-7-V5
1.2.3. Requirements aviation rules AP-35, which propagate on air screws UAV M-7-V5
1.2.4. Requirements aviation rules AP-23, which apply to UAV M-7-V5
1.2.5. Cooling conditions CUAV M-7-V5
Requirements of aviation rules which do not apply to CUAV M-7-V5
1.2.6. Standard STANAG 4671 requirements that do not apply to the UAV M-7-V5
1.2.7. Requirements AP-33 aviation rules that do not apply to UAV M-7-V5 engines
1.2.8. Requirements AP-35 aviation rules that do not apply to propellers UAV M-7-V5
2. Requirements for environmental protection

Note 1: The section on environmental protection is regulated by the Convention on International Civil Aviation (ICAO). Annex 16. Protection of the environment. TOM 1. Airborne noise. Chapter 10. Screw planes weighing not more than 8618 kg.
Note 2: The total volume of the SB-M-7-V5 document АНАЕ.М-7-В5.790100.000025.СБ is 187 sheets of A4

SPECIFIC THE METHODS FOR DETERMINING COMPLIANCE (AMC) THE PROGRAM CERTIFICATION AND CERTIFICATION BASIS OF CUAV M-7-V5 «NEBESNYI PATRUL»

AMC according to STANAG 4671

PART A - GENERAL

AMC.17. Spectrum of design use

PART B – FLIGHT

AMC.21. Proof of compliance
AMC.55. Interrupted takeoff distance
AMC.171. Correspondence of longitudinal and lateral stability
AMC.235. Operation on soil surfaces
AMC.283. Terms of steering, take-off and landing on the ground surfaces.

There are AMC descriptions available for most sections of the CB, namely A.B.C.D.E.F,G H I

AMC and GM - STATE AVIATION ADMINISTRATION OF UKRAINE

AMC **and** GM до АПУ-21(Part-21)).

GM 21.A.16B Special conditions
AMC 21.A.20(b) Certification Program
GM 21.A.20(b) Updated certification program.
AMC 21.A.20(c) Evidentiary documentation
GM 21.A.20(d) Final conclusion
GM 21.A.33 Inspections and tests
GM 21.A.35 Flight tests as well GM 21.A.35(b)(2) ; GM 21.A.35(f)(1); GM 21.A.35(f)(2) ;AMC 21.A.263(b)(1) **and AMC and GM to chapters P and Q Part-21**

AMC WITH REGARD TO AP-33 (Regarding motor UAV M-7-V5)

1.Use of society of automotive engineers (SAE) Class Hil Bolts. AC No: 20-127. Initiated by: ANM-110 Chance// Date: 7/8/87
2.Instructions for Continued Airworthiness. Initiated by: ANE-110. AC No. 33.4-1.Date: 8/27/99.
3.Engine System and Component Tests. Initiated By: ANE-111. AC No: 33.91-1. Date: 12/9/10.
4. Aircraft Engine Type. Certification Handbook. AC No: 33-2B Initiated By: ANE-110// Date: 06/30/93.
5. Instructions for continued Airworthiness; Aircraft Engine high intensity radiated Fields (HIRF) and Lightning protection features.Initiated By: ANE-111.AC No: 33.4-3 Date: 9/16/05

SPECIFIC THE METHODS FOR DETERMINING COMPLIANCE (AMC), THE PROGRAM CERTIFICATION AND CERTIFICATION BASIS OF CUAV M-7-V5 «NEBESNYI PATRUL» (continuation)

AMC WITH REGARD TO AP-35 Parts for a UAV M-7-V5 propeller

1. Certification of Propellers AC No: 35-1A. Initiated By: AIR-6A0. Date: 10/11/2018
2. Use of society of automotive engineers (SAE) Class Hil Bolts. AC No: 20-127. Initiated by: ANM-110 Chance// Date: 7/8/87
3. Propeller Instructions for Continued Airworthiness. Initiated By: ANE-110. AC No: 35.4. Date: 11/3/03
4. Propeller Critical Parts. Initiated By: ANE-111. AC No: 35.16-1. Date: 1/17/13
5. Propeller Fatigue Limits and Evaluation. Initiated By: ANE-111. AC No: 35.37-1B. Date: 3/24/11

ALSO, THE FOLLOWING GUIDANCE DOCUMENTS ARE APPLIED TO CONFIRM COMPLIANCE:

1. JCGUAV- «STANAG 4671 ON UNMANNED AERIAL VEHICLES SYSTEMS AIRWORTHINESS REQUIREMENTS // USAR», reference: PFP (NNAG-JCGUAV) WP (2007) 0001 dated 28 March 2007)
2. Composite Aircraft Structure. AMC 20-29 Effective: 26/07/2010. Annex II to E Decision 2010/003/R of 19/07/2010.
3. Прийнятні методи відповідності та керівний матеріал для сертифікації повітряних суден, пов'язаних з ними виробів, компонентів та обладнання, а також організацій розробника та виробника (АМС та GM до АПУ-21(part-21))//наказ ДАСУ від 15.08.2014. № 557
4. Методы определения соответствия ФАП «Экземпляр воздушного судна. Требования и процедура сертификации», приказ Минтранс РФ от 16 мая 2003г. №132.
5. Руководство 23-29.605. по методам определения соответствия технологии изготовления образцов ВС требованиям Авиационных правил (п.605). М:- 2000г.
6. Standard Test Method for Tensile Properties of Polymer Matrix Composite Materials. Designation: D 3039/D 3039M – 00e1.

➢DETERMINATION OF SUBCONTRACTORS ON THE PROJECT

1	Volz Servos GmbH & Co. KG (Germany) Critical components are not approved for CA	Steering cars (on-board servo drives):DA15, DA22, DA26, DA30, DA30HT. The manufacturer directly participates in the approval of components in the CUAV and maintains their suitability throughout the declared resource of the aircraft.
2	Embention Sistem as Inteligentes SL (Spain) Critical components are not approved for CA	1. Airborne control system - Autopilot Veronte 2. Components of the ground control station 3. Components of the target loading of the board UAV The manufacturer directly participates in the approval of components in the CUAV and maintains their suitability throughout the declared resource of the aircraft.
3	ZDZ ENGINES s.r.o. (Czech Republic) Critical components are not approved for CA	Engine ZDZ 250cm^3 The manufacturer directly participates in the approval of components in the CUAV and maintains their suitability throughout the declared resource of the aircraft.
4	HellermannTyton Data Ltd (GB) CA approved components	Electrical and electronic aviation components The manufacturer directly participates in the approval of components in the CUAV and maintains their suitability throughout the declared resource of the aircraft.
5...	List of companies to provide approved components CA	LLC "Company" Leader "(Ukraine), composite materials; Keeppower Ukraine, Li-Po batteries and other companies....

Note: With subcontractors producing critical components - autopilot, servomotors and engines installed official relations and an official consent to participate in the certification of an aircraft type, where their components will be certified in the warehouse of CUAV M-7-V5. Copies of letters of consent are sent to the ***STATE AVIATION ADMINISTRATION OF UKRAINE.***

EMPLOYEES OF SPCUA "VIRAZH" WHO ARE INVOLVED IN THE CERTIFICATION PROCES CUAV M-7-V5 «NEBESNYI PATRUL» AND THEIR SPHERES OF RESPONSIBILITY (CVE)

№	Full name	Current position in NAU	Experience in design work	Responsibility Sphere (CVE) - Engineer matching
1	Matiychyk Mykhailo Petrovych	Chief designer of Unmanned Aircraft Systems. Candidate of Technical Sciences., Associate professor,	15 years	Chief designer responsible for the design part and suitability for the CB of samples of **CUAV**, FTH UAV, FM, air screw
2	Mikhatsky Olexlyi Yuriyovych	Candidate of Technical Sciences, Senior Research Fellow	6 years	Aviation equipment systems and control system
3	Fuzik Mikhailo Igorovych	Candidate of Technical Sciences, Leading Researcher	4 years	Radio electronic equipment of the board and the NSC, instructions on maintaining the airworthiness of the **CUAV**
4	Rybalchenko Oleksandr Sergiyovych	Researcher	8 years	Lighting system, technological processes
5	Matiychyk Denys Mykhailovych	Leading engineer of the ANS Department of NAU	6 years	Engine, power plant systems
6	Koval Kateryna Vasylivna	Junior Research Fellow	4 years	Engineer for verification of compliance, documentation of project processes
7	Bilokon Yaroslav Sergiyovych	Engineer of the ANS Department of NAU	2 years	Control system (mechanical systems), noise, cabin safety (NSC)
8	Alexeyev Oleg Mykolayovych	Candidate of Technical Sciences, Senior Research Fellow	4 years	Technical Operation Guide , Maintenance Manual and other certication documents
9	Babenko Andrey Evgenievich	Candidate of Technical Sciences, Senior Research Fellow	1 year	Strength of design of the sample **CUAV**

➢Improvement of regulatory provision of the organization - the developer of aviation engineering

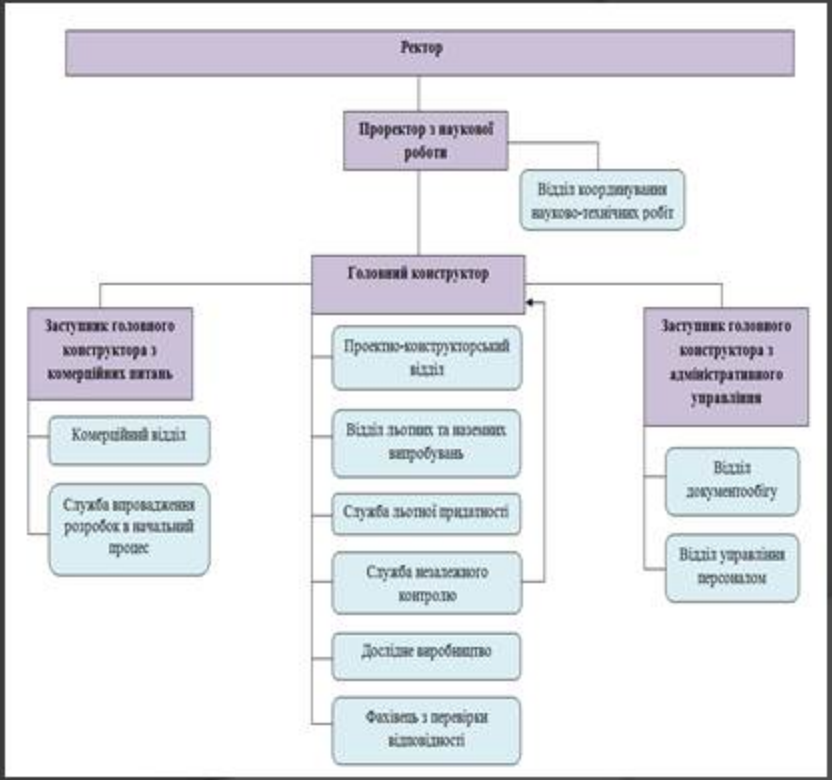
EXCERPT FROM SECTION – GENERAL (a new Statute of the SPCUA "Virazh" approved by the NAU Rector April 23, 2019)

P.1.2. The **SPCUA "Virazh"** is a structural subdivision of the state institution - the National Aviation University as part of the Research Part created by the order of the rector of NAU №247 / unit of October 26, 2010.

P. 1.3. The main purpose of the activity of the Center Virazh is the development, Certification and industrial small-scale production of unmanned aerial vehicles and its application in the interests of the economic sectors Ukraine and other Customers.

In addition, it will allow to create in NAU the modern material and technical base of researches and developments in this field, to widely involve the faculty members, talented students and graduate students in research work, to familiarize students with advanced achievements of science and technology.

www.uav.nau.edu.ua



IMPROVED ORGANIZATIONAL STRUCTURE SPCUA "Virazh" NAU (from 23.04.2019 years)

Participation of the State Aviation Administration of Ukraine in certification type of CUAV M-7-V5

During phase # 1 - participates of technical review and establishment of the certification basis:

•in defining and agreeing the initial Certification Basis (21.A.17 АПУ-21(Part-21);
•in determining the claimed typical design (21.A.31 АПУ-21(Part-21);
•in agreeing on special conditions;
•in agreeing the equivalent safety levels;
•in accounting for new applied technologies, introducing changes in the design, identifying hazardous conditions or results of demonstration of compliance;
•in agreeing the Protocol on Certification Issues CRI-A1.

During Phase 2 - Approval of the Certification Program

The SAA participates in the approval of the Certification Program, the content of which is specified by the paragraph 21.A.20(b) АПУ-21(Part-21) in terms of
- regarding approval of the involvement of the Customer in the project of other organizations;
- clarifies the proposed methods for establishing compliance with the Certification Base;
- clarification of the actions of the developer regarding the project;
- clarification of documents for certification of conformity;
- clarification of the schedule of the certification works.

During Phase 3 - Demonstration of Conformity

•clarification of materials and processes that adequately meet the specifications of the declared model design;
•clarification of parts of products adequately correspond to the drawings of the declared standard design;
•clarification of production processes for the design and assembly of the product, which adequately respond to those that are defined in the stated typical design; and clarification of the list and composition of test equipment and measuring equipment used for testing, adequate to the types tested and calibrated accordingly;
• clarification of the program and methods of flight and ground tests of the complex.

Also, the competent authority together with the Developer performs a set of certification work on the qualification of equipment and software.

During certification work to bring compliance in accordance with the Certification Program, members of the SAA certification group take part in these works in accordance with the provisions of paragraphs 21.A.33(c), (d) and (e) АПУ-21(Part-21).

In the process of certification work, members of the certification team together with the Applicant draw up Protocols for the examination of Certification Review Item – CRI and Certification Action Items – CAI.

During Phase 4 - Final Report and Edition of Certificate Type

- together with the Applicant, draw up a final report and prepare a draft Type Certificate and List of Certificate Type data;
-approves the Flight Manual and the airworthiness limitations section in the airworthiness instructions as defined by applicable airworthiness requirements;
-- decides on the issuance of a Type Certificate;
- issue certificate type.

CONCLUSIONS

1. **In the certification process, the Applicant must obtain regulatory documents from all possible and available sources: documents of international organizations, documents of other countries and approved domestic ones.**

2. For UAV developers, it is advisable to produce regulatory materials (for example, methodological recommendations were turns from SAA Ukraine are provided) recommendations were given that would significantly speed up the preparation of an appropriate package of documents for the Developer, especially regarding the formation of CB and AMC

3. It is necessary to bring the certification of an aircraft of "unknown design" - an civili unmanned aircraft, to the certification framework of manned aircraft adopted in CA; this opens the way to certification of the UAV type and their respective movement into the aviation market.

4. The weight category UAV less than 500 kg MTOW is complicated for certification, because engines of 0.3-0.5 liters have no approval for CA anywhere in the world. Accordingly, this raises the need to complicate the UAV type approval procedures due to the inclusion of additional requirements for the engine in the CB and their further implementation by the Applicant. Accordingly, the UAV category with a weight of more than 500 kg is easier to certify due to the presence of engines approved in CA, for example, “Rotax - 912/914”.

5. An important issue is the willingness of manufacturers of critical components - autopilot, servo drives and engines for participation in certification procedures; today, very few manufacturers have the desire to do this.

6. Undesirable, from our point of view, is the “simplification” of UAV certification procedures, since today the risk of an accident of UAV operation is much higher, as for a manned planes, despite the cost-effectiveness of UAV

The report is complete. Thank you!