Virus SW 128
Difference Training Programme

	FUNCTION:	NAME:	DIGITAL SIGNATURE WITH TIMESTAMP:
Prepared:	**DE**	Alberto Favier	Digitally signed by Alberto Favier Reason: FTE Location: Ajdovscina
Verified:	**CVE**	Paolo Romagnolli	Firmato digitalmente da Paolo Romagnolli Reason: CVE Location: Ajdovscina, Slovenia, EU Date: 03/09/2020 11:19 +02'00'
Approved:	**HOA**	Vid Plevnik	Digitally signed by Vid Plevnik Reason: HOA Location: Ajdovscina, Slovenia, EU Date: 2020/09/03 12:48 +02'00'

Document is released when all applicable signatures are applied!

Ajdovščina, 03 September 2020

This page is intentionally left blank.

List of issues and alterations

ISSUE	REASON FOR ALTERATION	PAGES AFFECTED	DATE OF ISSUE
A00	First issue	all	14/07/2020
A01	Structure of the whole training updated	all	23/07/2020
	Minimum content of theoretical course added	6	
	Emergency conditions to be tested in sortie number 3 specified	9	
A02	Elements to be covered during emergency procedure training specified	7	24/07/2020
	Table title corrected	8	
A03	"training provider" defined and used instead of ATOs and DTOs	all	31/07/2020
	Battery fire added among the emergency conditions	6	
	Full flap stalls added in sortie #1	9	
A04	List of abbreviations updated	3	03/09/2020
	Mission planning item 3.9 added among topics to be covered by theoretical training	6	
	Possibility of combining the training elements into less than 4 sorties added	9	
	Fifth sortie (solo traffic pattern) removed	11	

Abbreviations

CAS	Crew Alerting System
CBT	Computer-based Training
HMI	Human Machine Interface
IAS	Indicated airspeed
KIAS	Indicated airspeed in knots
LAPL(A)	Light Aircraft Pilot Licence (Aeroplane)
POH	Pilot's Operating Handbook
PPL(A)	Private Pilot Licence (Aeroplane)
PNR	Point of no return
RFT	Remaining Flight Time
SEP(L)	Single Engine Piston (Land) Rating
SOC	State of charge
SOH	State of Health
SPOH	Supplement to Pilot's Operating Handbook

Useful definition

Training provider	The training provider is either the organisation or the individual flight instructor that provides the applicant with the difference training.

Contents

1 Introduction

This document outlines the flight training syllabus for the difference training programme with the Pipistrel Virus SW 128 (VELIS Electro).
The training consists of the following phases:

1. Theoretical training:
   - If available, the Pipistrel theoretical CBT programme, which provides for both general knowledge about electric aircraft and specific notions about the Virus SW 128 design.[1]
   - Training provider's material. In case Pipistrel CBT programme will not be available, the training provider should prepare the training material which must cover, as minimum, the topics listed in section 2.1
2. Aircraft POH content
3. A practical training, consisting in at least four sorties with a Flight Instructor of around 40 minutes block time each, plus at least 15 minutes for both pre-flight briefing and post-flight debriefing. A fifth sortie is foreseen for solo traffic patterns.

After completion of the training, the pilot should have acquired theoretical knowledge and practical experience in the operation of the aircraft in terms of:

- Electric aircraft functioning and natural limitations
- Pre-flight checks, flight planning, endurance and range management
- General aircraft handling and performance
- Knowledge of the electric propulsion system and its pilot interfaces
- Charging and storing procedure
- In-flight range and RFT management
- Management of abnormal situations and emergency procedures

Conditions for the pilot to take part in the training are:

- holding a PPL(A) or LAPL(A) (or higher) with valid SEP(L) rating and

Additional conditions for the pilot to start the flying activity with Pipistrel Virus SW 128 (VELIS Electro):

- having sufficient knowledge about the aircraft and procedures from POH and SPOH and, if available, having completed Pipistrel CBT theoretical training[1].

[1] NOTE: At the time the issue A01 of this document is published, the CBT programme is still under development. In case the training portal is not available, the training provider should provide the students with adequate content about electric aircraft and the Virus SW 128 type by covering, as minimum, the topics listed in section 2.1.

2 Theoretical course

Electric aircraft are a technological innovation most of the pilots are not familiar with. If the macroscopic functioning of an electric aircraft is not different from a normal aircraft, the way the powertrain generates thrust differs significantly from standard ICE. Getting familiar with the main powertrain parameters and understanding their functioning is the first key element to increase the safety of the flight.

2.1 Minimum content and recommended structure of the theoretical training

The theoretical training aims to provide the pilot with knowledge about both the functioning of an electric aircraft and the specific design of Virus SW 128 (VELIS Electro). Table 2.1 lists the minimum topics that the theoretical training must cover. The list applies to both Pipistrel CBT and training material by the training provider.

Table 2.1: Minimum content of Virus SW 128 theoretical training

1. General Knowledge	
1.1	High voltage batteries
1.2	Electric Engine
1.3	Virus SW 128 architecture
1.4	Avionics and cockpit arrangement
1.5	EPSI570, Annunciator and battery LEDs
2. Limitations of the Virus SW 128	
2.1	Mass and balance
2.2	Airspeed and manoeuvre limits
2.3	Operational limitations
3. Flying the Virus SW 128	
3.1	Charging and pre-flight inspection
3.2	Taxi
3.3	Take-off and climb
3.4	Cruise and manoeuvring
3.5	In-flight energy management (SOC and RFT)
3.6	Approach to stall and recovery (stall warning)
3.7	Descent and landing
3.8	Traffic pattern training
3.9	Mission planning and effects of battery SOH
4. Emergencies on the Virus SW 128 (VELIS Electro)	
4.1	On ground emergency and use of aircraft SPOH
4.2	Complete power loss in long final and in downwind
4.3	Landing out
4.4	Powertrain failures and related CAS messages - Single battery disconnection - Engine coolant pump failure - Engine overtemperature - Battery overtemperature - Loss of EPSI570C display - Low SOC and No go-around - Battery coolant pump failure - Power level loss - Battery fire

In addition to the Pipistrel CBT programme, the training provider may support the training with any additional material that will help the students to get familiar with Virus SW 128 (VELIS Electro) type.

2.2 Virus SW 128 (Velis Electro) training challenges

The training should focus on the main challenges a holder of SEP(L) rating will encounter as well as on the areas that pose new risks the pilot is not yet familiar with. These are described in the following paragraphs.

1. Electric powerplant systems and HMI
   The POH and CBT describe all powerplant systems of the Virus SW 128 extensively, including their construction, installation, functioning and modes of failure. The HMI present in the cockpit is also described in the POH and CBT and will be demonstrated before the first flight by the Flight Instructor, emphasising the importance of the main powerplant parameters that must be monitored in flight.
2. Energy and endurance management
   The limited endurance of the Virus SW 128 poses a challenge to the average SEP(L) pilot. Experience shows the main difficulty is inferring the available flight time from a battery SoC and SoH values, under different atmospheric conditions and flight operations. The correct procedure for using the Remaining Flight Time indication is explained and demonstrated. These two points will also be covered by the Flight Instructor before flight and in flight. Refer to POH sections 5.9, 5.11 and 5.12 for information about energy and endurance.
3. Emergency procedures
   The introduction of a new technology comes also with new way of failures. The possible failures of Virus SW 128 and the related emergency procedures are described in the Pilot's Operating Handbook and CBT as well as included in the practical difference training programme. The familiarisation training should focus on the possible failure conditions, the functions of the aircraft CAS, the way the pilots interacts with the CAS and the corrective actions to take when a failure is detected. Before pilots start the flight activity, they should be familiar with the use of the CAS and the corrective actions following caution and warnings.
4. The charging processes
   The charging process is described thoroughly in the POH and SPOH and will be performed with the Flight Instructor. The correct procedure will have to be demonstrated by the pilot who will become familiar with the possible risks to the operator performing the charging procedures as well as to the aircraft or its electrical system. The pilot also has to familiarise with managing possible errors during charging and consequent procedures.

2.3 The aircraft POH

The aircraft POH is structured to provide sufficient knowledge about the aircraft operation, the use of the HMI and the management of powertrain failure conditions. The pilot should be familiar with the content of the POH and SPOH before transitioning to the last phase: the flight activity.

3 Flight training syllabus

This section outlines the practical training activity. The training is structured into four mandatory sorties, whose elements are specified in the following subsections. However, depending on the applicant performance and considering his previous experience as PIC on Pipistrel aircraft, the flight instructor can combine the elements of the training into fewer sorties. However, none of the elements may be skipped.

The pilot who takes part in the difference training will be allowed to advance to the next sortie of the training only if the Flight Instructor deems the proficiency shown in the last sortie satisfactory. The training ends when the training goals are reached.

3.0 Charging

Before performing pre-flight inspection, instructor will acquaint the student with charging procedure and charger HMI. If the aircraft is already charged to sufficient SOC for flight, charging procedure can be explained after the flight.

GROUND	
1	Charging procedure
2	Charger interface and EPSI570 charging page
3	Charging errors

3.1 First sortie

The first sortie will consist of the following training activities:

PRE-FLIGHT	
4	Pre-flight inspection
5	Cockpit familiarization (standard avionics, EPSI570C, annunciator, battery overheat indication)
6	Endurance management and mission planning
IN-FLIGHT	
7	Taxi and before take-off checks
8	Take-off
9	Establish level flight at a minimum altitude of 3000ft AGL; general flying to establish pitch sights and turns for coordination
10	Cruise flight at normal performance (30 kW), then at lower airspeed 55-60KIAS (required power increases)
11	Familiarisation with SOC and RFT
12	Steep turns (40 kW). Minimum altitude 3000ft AGL
13	Approach to stall and activation of the stall warning (aural+tactile)
14	Stalls: clean and full flap, IDLE and 75%MCP power. Minimum altitude 3000ft AGL.
15	Stall and full power to simulate pitch-up on go-around. Minimum altitude 3000ft AGL.
16	Practice of approach and landing procedure and traffic patterns with the remaining energy
17	Charging procedure
18	Post-flight debriefing
19	Discussion of energy management rules of thumb and reserve

20	Parking & storage

3.2 Second sortie

The second sortie will consist of the following training activities:

IN-FLIGHT	
21	Circuit patterns with standard configuration
22	Short-field approach
23	Approach without flaps
24	Approach with sideslip[2]
25	Engine failure drill on long final
26	Engine failure drill on downwind
27	Recovery from a long landing
28	The danger of three-point landing and bounce off the runway
29	Debrief and discussion on energy management for possible low-state-of-charge go-around and SoC derating conditions

3.3 Third sortie

The third sortie allows the pilot to further familiarise with the emergency procedures. This mission consists of two parts: an on-ground demonstration of powertrain failures and an in-flight simulation of the emergency procedures

ON GROUND	
30	Engine coolant pump failure
31	Engine power derating due to overtemperature
32	Battery coolant pump failure(s)
33	Loss of EPSI display

IN-FLIGHT	
34	Partial loss of power (simulated derated power due to battery disconnect)
35	Emergency landing in case of battery fire
36	Go-around before flare height
37	Power level loss simulation
38	Circuit patterns with remaining energy
39	Go-around with 30% SoC
40	Debrief and discussion on performed emergency procedures

[2] Average private pilots may not be familiar with approach with sideslip. The decision to proceed with item 24 is left to the flight instructor, depending on the capabilities and the confidence of the student pilot.

3.4 Fourth sortie

The fourth sortie is a flight to a suitable near-by airfield with focus on cross-country flying on an aircraft with limited endurance. SoC predictions are made along with the calculation of the PNR.

IN-FLIGHT	
41	Cross-country flight to a near-by airfield
42	Energy management for cross-country flight
43	Approach with go-around
44	Flight back to the base airfield
45	Circuit patterns with remaining energy
46	Debrief and discussion on energy management for possible low-state-of-charge go-around