Virus SW 128
Difference training syllabus – Maintenance

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List of issues and alterations

ISSUE	REASON FOR ALTERATION	PAGES AFFECTED	DATE OF ISSUE
A00	First issue	all	23. 09. 2020
A01	Overall changes to content in collaboration with CAA SI	all	02.12.2020

Referenced documents

DOT-128-00-11-401	Pilot Difference Training Program
AMM-128-00-60-001	Aircraft Maintenance Manual
TS-128-00-89-001	List of tools
SPOH-128-00-40-001	Supplement to Pilot's Operating Handbook
TA-128-00-00-300	Difference Training Agenda
FDO-128-00-00-301	Certificate of Satisfaction Template
DOT-128-00-11-002	Coolant Inspection
DOT-128-00-11-003	Electro portal update and logger readout
DOT-128-00-11-004	Storage procedure
DOT-128-00-11-020	VELIS Electro basic layout
DOT-128-00-11-021	Battery recharging
DOT-128-00-11-022	Cleaning
DOT-128-00-11-023	Pilot conducted maintenance and handling
DOT-128-00-11-026	Propeller pre-flight check
DOT-128-00-11-005	Power controller installation
DOT-128-00-11-006	Cooling system
DOT-128-00-11-007	High voltage battery system
DOT-128-00-11-008	Electric propulsion system checklist
DOT-128-00-11-009	EPSI570C replacement and set up
DOT-128-00-11-010	Harness, contactors and DC-DC troubleshooting and replacement
DOT-128-00-11-011	Main computer replacement
DOT-128-00-11-012	Power lever troubleshooting
DOT-128-00-11-013	Battery shipment preparation
DOT-128-00-11-014	Battery balancing
DOT-128-00-11-015	Power controller removal
DOT-128-00-11-016	Aircraft software update
DOT-128-00-11-017	Charger software update
DOT-128-00-11-018	Electric motor removal
DOT-128-00-11-019	Electric motor installation
DOT-128-00-11-024	Propeller maintenance practices
DOT-128-00-11-025	Junction box maintenance practices
DOT-128-00-11-027	Cowling maintenance practices
DOT-128-00-11-028	Mounts maintenance practices
DOT-128-00-11-029	Electrical Harness maintenance practices
DOT-128-00-11-030	Engine indicating

DOT-128-00-11-031	Batteries limitations
DOT-128-00-11-032	Electrical power
DOT-128-00-11-033	DC generation

Abbreviations

TBD	To Be Defined
N/A	Not Applicable
AMM	Aircraft Maintenance Manual
CBT	Computer Based Training
BMS	Battery Management System
ICE	Internal Combustion Engine
VFR	Visual Flight Rules
MTOM	Maximum Take-Off Mass
POH	Pilot's Operating Handbook
SPOH	Supplement to Pilot's Operating Handbook
NAA	National Aviation Authority
LRU	Line Replaceable Unit

Contents

1 Introduction

The aircraft Virus SW 128 (with commercial name VELIS Electro, used from here onward), purely electrically powered, is the first one to receive EASA TC as an electric aircraft. Therefore, the product and powerplant are considered novel and not all the aspects of maintenance are covered by the current regulation. To fill the current gap in regulations, an exemption is being issued for organisations and persons involved in continuing airworthiness of the VELIS Electro. The rules for continuing airworthiness were established for piston engines and turbine engines, however, the electric engine as a powerplant has not been covered by these rules. This exemption shall cover maintenance organisations approval rating, certifying staff of electrical engines and appropriate Part-66 license categories. In the frame of the exemption, a training syllabus for maintenance personnel represents one of the documents implementing the exemption.

The training consists of the following phases:

1. Theoretical training,
2. Practical training (optional),

which are described in more details in chapter three (3) of this document.

Upon completion of the training, aircraft mechanics will acquire theoretical and (optionally) practical knowledge related to:

- Electric aircraft functional and natural limitations,
- General aircraft handling and performance,
- Familiarisation with hazards related to electric aircraft,
- Safety aspects of novel type of aircraft propulsion and associated systems,
- Maintenance procedures and unscheduled repairs,
- Emergency procedures.

The owner of the aircraft will be responsible that continuing airworthiness is managed by appropriate approved MO or CAO with A2 rating and *aircraft type* defined in section *Limitations*. These organisations commit to allow their staff to act as support or certifying staff when conditions to do so are met.

1.1 VELIS electro basic description

VELIS Electro is a two-seat aircraft of composite construction, currently approved for day VFR operations and MTOM of 600 kg. The aircraft is arranged as a high wing monoplane with cantilevered wings and a conventional empennage with a T-tail. It has a tricycle fixed landing gear. Seats are side-by-side with full dual flight controls and joint levers for throttle and flaps control. Access to the cockpit is via two large gull-wing doors. There is no baggage area on the aircraft. A 57.6 kW type certified, electric engine E-811-268MVLC provides power to the aircraft. The electric engine is powered by a 345 V Direct Current (DC) electric system. The aircraft is equipped with two liquid cooled 345 V battery packs installed in a parallel architecture. One battery pack is

located in the forward battery compartment, positioned in front of the cabin. The second battery pack is installed in the fuselage behind the cabin. The aircraft is equipped with the three-bladed composite fixed-pitch propeller P-812-164- F3A made by Pipistrel.

2 Part-66 basic licence differences

The following table summarizes the differences in knowledge topics covered by Part-66 B1.2/B3 licences relative to the specifics of Virus SW 128:

Topic/element/component	Required Difference Training Part-66 B1.2/B3
Propeller Group	NO
Engine Group	***YES***
Firewall Forward Group	***YES***
Battery Group	***YES***
Cabin Group	***YES***
Avionics and software	***YES***
Fuselage and Empennage Group	NO
Wing Group	NO
Landing Gear Group	NO

Difference training related to avionics B2 licensed personnel is not required.

Conditions for the aircraft mechanics enabling them to attend and take part in the training are:

a. Holding a valid Part 66 B1.2 or B3 license with rating in group 3.

The approved or recognized MO/CAO shall issue an organisation authorization entitling subject staff to act as support staff or certifying staff in the aircraft, only when fulfilling the following conditions:

a. An organisation authorisation can be granted to Part-66 license holders to act as support staff and to issue certificate of release to service on behalf of the maintenance organisation, when the aircraft maintenance does not relate to the aircraft powerplant or related systems and within the limits permitted by their Part-66 licenses.
b. An organisation authorisation can be granted to Part-66 license holders with categories B3, B1.2, and C, with rating in group 3, once they have successfully carried out an aircraft differences training, to act as support staff and to issue certificate of release to service on behalf of the maintenance organisation within the privileges assigned to their corresponding license category including the release to service after maintenance on the aircraft powerplant or related systems.

Maintenance activities performed on this model of aircraft are defined in AMM. Binding schedule and practices are described in AMM-128-00-60-001 Aircraft Maintenance Manual; therefore, procedures described within shall be followed.

3 Difference training syllabus

3.1 General knowledge course

This section addresses uncertainties, novelties, and unfamiliarised areas of electric propulsion, as it is essential that the functioning of such system is well understood. Maintenance personnel will be familiarised with the operation of high voltage components, including thermal runaway behaviour, especially focusing on system components such as batteries, inverter, electric motor, BMS, cooling system as well as indications, alerting system and charging procedures.
Given the high novelty of VELIS Electro powertrain and its related characteristics, deep focus will be put on the main VELIS Electro safety aspects, including but not limited to the following topics:

- Battery cooling system correct installation, replenishment and daily checks,
- Battery system protections against thermal runaway,
- Risks connected to unproper battery handling (removal, transportation, storage),
- Correct battery charging procedures.

Additional possible hazards during handling and operating of such components will be addressed, such as first responder procedures, battery shipment (dangerous goods), long term storage, safety precautions and guidance and other. Types of ground hazards, ground operation guidelines and charging guidelines are also described in SPOH-128-00-40-001 Supplement to POH.
This part of the course is theoretical only and the general part of the course is managed through Pipistrel training. The training ends when the training goals are reached with demonstrated satisfactory knowledge.

3.2 Type specific course

Training activities connected to type specific difference program applicable to VELIS Electro are outlined in this section. Optional practical training corresponds to tasks as described in AMM procedures.

The following Table 1 defines ATA chapter specific subjects where difference training is needed to complement knowledge gap between conventional ICE Group 3 airplane and VELIS Electro. For successful training completion, candidates will have to demonstrate familiarity with tools being used for maintenance performed on VELIS Electro aircraft, as defined in TS-128-00-89-001.

ATA	Subject	Training document	Training time [min]
00-00	Introduction General constructional principles of an airplane electrical propulsion Cautions and precaution handling HV Batteries	DOT-128-00-11-004 DOT-128-00-11-007 DOT-128-00-11-008 DOT-128-00-11-013 DOT-128-00-11-020 DOT-128-00-11-022	230

		DOT-128-00-11-023 DOT-128-00-11-024 DOT-128-00-11-026	
04-00	Batteries limitations	DOT-128-00-11-014 DOT-128-00-11-021 DOT-128-00-11-031	100
24-00	Electrical Power	DOT-128-00-11-003 DOT-128-00-11-005 DOT-128-00-11-007 DOT-128-00-11-025 DOT-128-00-11-032	90
24-30	DC generation	DOT-128-00-11-033	20
24-60	DC electrical load distribution	DOT-128-00-11-011 DOT-128-00-11-025	20
24-80	DC battery cooling system	DOT-128-00-11-006	20
71-00	Power Plant	DOT-128-00-11-005 DOT-128-00-11-008 DOT-128-00-11-009 DOT-128-00-11-015 DOT-128-00-11-024	50
71-10	Cowling	DOT-128-00-11-027	30
71-20	Mounts	DOT-128-00-11-028	30
71-50	Electrical Harness	DOT-128-00-11-010 DOT-128-00-11-029	20
72-00	Electric Motor	DOT-128-00-11-018 DOT-128-00-11-019	50
75-00	Power Plant Cooling	DOT-128-00-11-002 DOT-128-00-11-006	70
76-00	Motor Controls	DOT-128-00-11-012	20
77-00	Engine Indicating	DOT-128-00-11-030	40
77-40	Integrated Engine Instrument Systems	DOT-128-00-11-009 DOT-128-00-11-011 DOT-128-00-11-016 DOT-128-00-11-017	100

Table 1

This part of the course is theoretical, with practical demonstration.

3.3 Exemptions in maintenance activities

As per beforementioned exemption issued individually by NAAs, maintenance activities may be performed on aircraft type VELIS Electro if conditions to do so are met. Maintenance activities not covered by this training will be performed by Pipistrel. These activities involve work performed inside the batteries and maintenance of components. Authorised maintenance personnel is allowed to perform removal of LRUs, preparation for shipping and reinstallation of new

components. Maintenance of LRUs is not foreseen to be performed by maintenance personnel authorised in accordance with the exemption issued by NAA.

4 Training organisation

Theoretical part of the training will be performed at Pipistrel d.o.o. premises, where Pipistrel d.o.o. will be responsible for sharing the knowledge covering differences between VELIS Electro and similar Group 3 ICE engine aircraft, focusing on electrical propulsion system and associated elements. Complete training material which relates to theoretical part of the training is provided in Table 2, as well as target groups.

Name	Target group	Training Material
Coolant Inspection	Pilot-owner & MP	DOT-128-00-11-002
Electro portal update and logger readout	Pilot-owner & MP	DOT-128-00-11-003
Storage procedure	Pilot-owner & MP	DOT-128-00-11-004
VELIS Electro basic layout	Pilot-owner & MP	DOT-128-00-11-020
Battery recharging	Pilot-owner & MP	DOT-128-00-11-021
Cleaning	Pilot-owner & MP	DOT-128-00-11-022
Pilot conducted maintenance and handling	Pilot-owner & MP	DOT-128-00-11-023
Propeller pre-flight check	Pilot-owner & MP	DOT-128-00-11-026
Power controller installation	Maintenance personnel	DOT-128-00-11-005
Cooling system	Maintenance personnel	DOT-128-00-11-006
High voltage battery system	Maintenance personnel	DOT-128-00-11-007
Electric propulsion system checklist	Maintenance personnel	DOT-128-00-11-008
EPSI570C replacement and set up	Maintenance personnel	DOT-128-00-11-009
Harness, contactors and DC-DC troubleshooting and replacement	Maintenance personnel	DOT-128-00-11-010
Main computer replacement	Maintenance personnel	DOT-128-00-11-011
Power lever troubleshooting	Maintenance personnel	DOT-128-00-11-012
Battery shipment preparation	Maintenance personnel	DOT-128-00-11-013
Battery balancing	Maintenance personnel	DOT-128-00-11-014
Power controller removal	Maintenance personnel	DOT-128-00-11-015
Aircraft software update	Maintenance personnel	DOT-128-00-11-016
Charger software update	Maintenance personnel	DOT-128-00-11-017
Electric motor removal	Maintenance personnel	DOT-128-00-11-018
Electric motor installation	Maintenance personnel	DOT-128-00-11-019
Propeller maintenance practices	Maintenance personnel	DOT-128-00-11-024
Junction box maintenance practices	Maintenance personnel	DOT-128-00-11-025
Cowling maintenance practices	Maintenance personnel	DOT-128-00-11-027
Mounts maintenance practices	Maintenance personnel	DOT-128-00-11-028
Electrical Harness maintenance practices	Maintenance personnel	DOT-128-00-11-029
Engine indicating	Maintenance personnel	DOT-128-00-11-030
Batteries limitations	Maintenance personnel	DOT-128-00-11-031
Electrical power	Maintenance personnel	DOT-128-00-11-032

Table 2

Note: pilot training syllabus and detailed description is provided in DOT-128-00-11-401 Virus SW 128 Difference Training Programme.

The training is conducted per training agenda TA-128-00-00-300, where the location is defined in details. Trainees are expected to attend at least to a 90% of classes and acquire appropriate knowledge during lessons. Execution is planned to last five working days, with total of six hours per day, as defined in training agenda TA-128-00-00-300. Complete training is conducted in English language. Questioning form is as defined by examination standard of Appendix III to Part 66 and it is defined in TA-128-00-00-300 Difference Training Agenda. Time deviation in courses is not predicted, however, in extraordinary cases up to 30% more time of initial scheduled time is allowed. After completion of the lectures, attendees are given the written exam, where successful passing grade is defined as 75% of total questions answered as correct. After successful completion of training, granted certificate of satisfaction is considered valid and recurrence training is recommended every two years, from the day of completion. The certificate of satisfaction is issued in digital form, which is defined by a template certificate of satisfaction FDO-128-00-00-301. Records of training, issued certificates of satisfaction and relevant documentation related to issuance of the certificate of satisfaction are kept archived for an unlimited period after the issuance of the certificate of satisfaction. Training material, not provided to participants in explicit form, is confidential and is kept internal to EASA.21J.524 Design Organisation. Pipistrel Vertical Solutions d.o.o. reserves all rights and unless specifically defined, any reproduction or disclosure of the offered training material, knowledge, and other corresponding intellectual property to third parties is not permitted.

Practical training , organised by Pipistrel, is surveyed by CAA inspector, dedicated for maintenance personnel training. Following chapters of AMM are in the applicable scope:

05-20 SCHEDULED MAINTENANCE checks
- Engine Group
- Firewall Forward Group
- Battery Group

05-50 UNSCHEDULED MAINTENANCE checks
- Battery compartments & Cooling system
- Exceeded speed limit of Propeller and Engine
- Lightning strike inspections on Power Plant and Electrical Systems
- Power Plant components overheating

12-10/20 REPLENISHING & SCHEDULED SERVICING
- Draining/Replenishing the coolant of the Engine/Battery Cooling system

24-30 DC GENERATION
- Removal/Installation of the Battery Box + Disconnection/Connection of the Battery Box

24-60 DC ELECTRICAL LOAD DISTRIBUTION
- Removal/Installation of the Junction box + Inspection/check
- Removal/Installation of the Charging port (CP)

24-80 BATTERY COOLING SYSTEM
- Removal/Installation of the Coolant Pumps + Inspection/check
- Inspection of Cooling Fans

71-00 POWER PLANT

- Removal/Installation of the Power Controller

72-20 ELECTRIC MOTOR

- Removal/Installation of the Electric Motor

75-20 LIQUID COOLING

- Removal/Installation of the Pump
- Removal/Installation of the Cooler
- Removal/Installation of the Expansion tank
- Removal/Installation of the Overflow bottle

76-00 GENERAL

- Motor control quadrant Inspection/check

77-40 INTEGRATED ENGINE INSTRUMENT SYSTEMS

- Software update procedure for Electric Propulsion System Instrument (EPS1570)

Training is generally divided in three parts which cover pilot rating, maintenance personnel and organisations ratings and approvals and service centres (reserved and TBD).

5 Privileges

Upon completion of the training with successful results, approved MO/CAO as described in exemption, may issue organisation authorisation for corresponding staff, which authorizes for activities as described in their Part-66 licenses.

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