Type Acceptance Report

TAR 16/21B/31

M&D FLUGZEUGBAU MD-TJ42

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Executive Summary

New Zealand Type Acceptance has been granted to the M&D Flugzeugbau MD-TJ42 turbine engine based on validation of EASA Type Certificate number E.099. There are no special requirements for import.

Applicability is limited to the Models and/or serial numbers detailed in Appendix 1, which are now eligible for installation on a NZ-registered aircraft. Additional variants or serial numbers approved under the foreign type certificate can become type accepted after supply of the applicable documentation, in accordance with the provisions of NZCAR §21.43(b).

NOTE: The information in this report is correct as at the date of issue. The report is only updated when an application is received to revise the Type Acceptance Certificate. For details on the current type certificate holder and any specific technical data, refer to the latest State-of-Design Type Certificate Data Sheet.

1. Introduction

This report details the basis on which Type Acceptance Certificate No.16/21B/31 was granted in the Standard Category in accordance with NZCAR Part 21 Subpart B.

Specifically the report aims to:

(a) Specify the foreign type certificate and associated airworthiness design standard used for type acceptance of the model(s) in New Zealand; and

(b) Identify any special conditions for import applicable to any model(s) covered by the Type Acceptance Certificate.

2. State-of-Design Type Certificate Details

Manufacturer:	M&D Flugzeugbau GmbH & Co. KG
Type Certificate:	EASA.E.099
Issued by:	European Aviation Safety Authority
Models:	MD-TJ42

3. Type Acceptance Certificate

The initial application for New Zealand type acceptance of the MD-TJ42 was from the manufacturer, dated 28 June 2016. The MD-TJ42 is a small turbojet engine with a maximum thrust of 350 Newton (78.6 lbf) certified for installation on self-sustaining sailplanes only, i.e. it is not intended for take-off operation.

Type Acceptance Certificate Number 16/21B/31 was granted on 13 July 2016 to the Model MD-TJ42 based on validation of EASA Type Certificate EASA.E.099. There are no special requirements for import of the engine.

The MD-TJ42 is a single-shaft turbojet featuring a single stage centrifugal compressor, an annular combustion chamber, and a single stage axial turbine and exhaust nozzle, controlled by a single-channel Digital Electronic Control System. The engine Type Design covers an aircraft mounted ECU and Fuel Board consisting of electrical pump, filter and valve. The first type certificated application was on the Jonker Sailplanes JS-1 Series.

4. Type Data

The type data requirements of NZCAR Part 21B Para §21.43 have been satisfied by supply of the following documents:

(1) State-of-Design Type certificate:

EASA Type Certificate Number EASA.E.099

EASA Type Certificate Data Sheet no. E.099 at Issue 01 dated 18 November 2015 – Model MD-TJ42 approved 18 November 2015

(2) Airworthiness design requirements:

(i) Airworthiness Design Standards:

The certification basis of the MD-TJ is CS-22, Subpart H at Amendment 2 dated 5 March 2009 (see CRI-A1), except for CS-22 paragraphs; §22.1801, §22.1825, §22.1833, §22.1835, §22.1839, §22.1843, §22.1845, §22.1849 and §22.1851, which were replaced by individual special conditions. Nineteen special conditions were applied (see CRI-T1), which have been reviewed and accepted by CAA. This is an acceptable airworthiness standard as CS-22 Subpart H is the basic design standard for powered glider engines called up under Part 21 Appendix C and Advisory Circular 21-1. There are no non-compliances and no special conditions have been prescribed by the Director under §21.23.

(ii) Special Conditions:

SC01 Applicability – Because of the use of these engines in sailplanes, there are several assumptions to simplify the requirements for certification. These assumptions are:

- the engines will be used for self-sustaining sailplanes only, not intended for take off;
- no bleed air, no reverse functions;
- no flight in icing or hail conditions;
- no aerobatic operation;
- the turbine engine is not used to drive accessories that are essential for any other means than the turbine itself;
- the strike and ingestion of foreign matter can be treated as extremely remote, because the engine is started and shutdown in f1ight. Ground operation will only take place for maintenance purposes.

SC02 Functioning – The engine must be free of dangerous surge and instability throughout its operating range within the intake pressure and temperature conditions declared by the constructor.

SC03 Accessory Attachment – Each accessory drive and mounting attachment must be designed and constructed so the engine will operate properly with them attached; and will allow their examination, adjustment or removal. Only essential accessory drives for the engine shall be used.

SC04 Engine Control System – It must be substantiated by test, analysis or a combination thereof that the ECS performs the intended functions in an acceptable manner, maintaining parameters within limits in all conditions, and is capable of functioning properly in case of exposure to EMI. The demonstration levels have to be included in the installation instructions.

SC05 Vibration – The engine must be designed and constructed to function throughout its declared flight envelope of rotational speeds and power/thrust without inducing excessive stress in the engine due to vibration or imparting excessive vibration forces on the aircraft structure.

SC06 Fuel and Induction System – a) The fuel system of the engine must be designed and constructed to supply appropriate fuel throughout the operating range of the engine; b) The engine intake shall be designed and constructed to minimise ice accretion; c) The type and degree of fuel filtering necessary must be specified; d) The engine design has to prevent fuel accumulation.

SC07 Lubrication System – (a) The design of the oil system must ensure proper functioning under all intended flight attitudes, installation, atmospheric and operating conditions, including oil temperature and expansion factors; (b) If required, means for cooling the lubricant shall be provided; (e) The oil system including the oil tank expansion space must be adequately vented.

SC08 Vibration Test – (a) The engine must undergo a survey to show the characteristics of those components that are subject to mechanically or aerodynamically induced vibratory excitations are acceptable throughout the declared flight envelope. This must be based on an appropriate combination of experience, analysis and component test and must include blades, vanes, rotor discs, spacers and rotor shafts. (b) The surveys must cover the ranges of power or thrust and both the physical and corrected rotational speeds for each rotor system, for all operations as specified.

SC09 Calibration Test – To identify thrust or power changes during the endurance test, thrust or power calibration curves of the test engine must be established either beforehand or during the test.

SC10 Endurance Test – (a) The engine must be subjected to an endurance test that includes 50 hours of specified running cycles covering sequence, duration and operating conditions. (b) During or after the endurance test the fuel and if applicable oil and gas consumption must be determined.

SC11 Operation Test – This shall include demonstration of various engine characteristics, including idling, transitional stages, design load, overspeeding, and any other operational issues.

SC12 Cyclic Endurance Test – Depending on results of the Vibration Test, further endurance testing may be required at other defined rotational speed(s) to show freedom from fatigue failure.

SC13 Rotor Containment – To prevent the (hazardous) release of high energy debris, either containment must be provided as described in SCl4(c) or a rotor approved life established per SCl9.

SC14 Containment – (a) Compliance with SC13 of each high-energy rotor, critical and non-critical, must be substantiated by test, analysis or combination thereof as specified. (b) Containment must be demonstrated at the specified speed and temperature conditions. (c) Hub containment must be substantiated (using a representative mounting system) for all types of compressors and turbines, from fragments resulting from a failure with the maximum kinetic energy. (d) It must be shown that: (1) The engine did not experience a sustained external fire; (2) It did not release high-energy fragments radially through the casings; (3) It did not axially release any substantially whole rotors with high residual energy; (4) If debris were ejected from the inlet or exhaust the maximum size, weight, speed and trajectory must be estimated and provided in the installation instructions.

SC15 Continued Rotation – If the engine core continues to rotate after shutdown for any reason while in flight and cannot be stopped it must be shown that continued rotation during the maximum expected period must not result in effects that would be unacceptable under SC17.

SC16 Amendment for Turbine Engines to CS22.1823(c) – For turbine engines the compliance demonstration to CS22.1823(b) has to address seizure and blade-off loads.

SC17 Safety Analysis – The engine and control system must be analysed to assess those failures that could result in hazardous effects, such as non-containment of high energy debris, uncontrolled fire, inadvertent separation due to failure of the engine mount, or complete inability to shut the engine down. It must be shown that Hazardous Engine Effects are predicted to occur at a rate not in excess of that defined as Extremely Remote *(probability less than 1 E-05 per engine flight hour).*

SC18 CS22.1808 Selection of Engine Power and/or Thrust Ratings – *(adjustment to the headline for consistency with terminology in this CRI).*

SC19 Approved Life – To establish an approved life for a rotor, the following tests must be highly conservative: *Approved Life.* (A highly conservative way will be achieved by using pre-prepared rotors [compressor and turbine] with an initial crack at the most critical position from a stress point of view.) *Cycling.* (a) The start-stop cycle to be applied should be defined and corrected for inherent scatter. (b) To establish a conservative and acceptable cycle life, the engine test can be performed with a real engine on a bench, using an appropriate reduction factor (RF). (c) Cycling Test to be fully defined. *Rotor Integrity*. (a) For each rotor it must be established by test and analysis that with the most adverse combination of material properties and dimensional tolerances it will not burst when operated for 5 minutes at the most critical condition. (b) Specified speeds must be evaluated, in conjunction with their associated temperatures and temperature gradients, throughout the operating envelope. Growth of the rotor must not cause the engine to: i. Catch fire; ii. Release high energy debris; iii. Generate loads greater than design ultimate loads. iv. Lose the capability of being shut down. After the operating period the rotor must not exhibit conditions such as cracking or distortion which preclude safe operation during any likely continued operation following such an over-speed event in service. The applicant must develop: i. An engineering plan. ii. A manufacturing plan. iii. A Service Management Plan.

(iii) Equivalent Level of Safety Findings:
Nil

(iv) Airworthiness Limitations:
See OMM Section 5.1 – Airworthiness Limitations

(3) Engine Emission Standards:

(i) Environmental Standard:
The MD-TJ42 has been certificated for fuel venting under CS-34.1 and for smoke number under CS-34.2.

(ii) Compliance Listing:
MD02-CPL-78-001 and MD02-CPL-78-002

(4) Certification Compliance Listing:

Doc. No.: MD02-CPS00-001 – MD-TJ42 Compliance Summary

(5) Flight Manual: N/A

(6) Operating Data for Engine:

(i) Maintenance Manual:
MD02-OMM-70-001 – Operation and Maintenance Manual

MD02-EIM-70-001 – Engine Installation Manual

MD02-EOM-70-001 – Engine Overhaul Manual

(ii) Current service Information:
Service Bulletin SB-MD02-001 – Conversion of Pre-Type-Certificate (Pre-TC) engines to the certified standard – All MD-TJ engines up to and including S/N MD02-0048 can be converted to the type certified configuration by replacement of specified parts and the use of the latest software version in the ECU. Conversion can only be carried out by the manufacturer.

Service Bulletins and Service Letters are available on the M&D website:

http://md-flugzeugbau.de/en/customer-support/

(iii) Illustrated Parts Catalogue:
Not produced.

(7) Agreement from manufacturer to supply updates of data in (5), and (6):

CAA 2171 from M&D Flugzeugbau Accountable Manager dated 28.06.2016

Attachments

The following documents form attachments to this report:

Copy of EASA Type Certificate Data Sheet Number E.099

Sign off

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David Gill	Checked – Greg Baum
Team Leader Airworthiness	Airworthiness Engineer

Appendix 1

List of Type Accepted Variants:

Model:	*Applicant:*	*CAA Work Request:*	*Date Granted:*
MD-TJ42	M&D Flugzeugbau GmbH	16/21B/31	13 July 2016