SUPERVISOR'S OPINION OF FINAL THESIS

I. IDENTIFIKAČNÍ ÚDAJE

Název práce:	**Design and Cold-air Tests of a Single-stage Axial Micro Turboexpander for an ORC Power System**
Jméno autora:	**Jan Špale**
Typ práce:	diplomová
Fakulta/ústav:	Fakulta strojní (FS)
Katedra/ústav:	Ústav energetiky 12115
Vedoucí práce:	Ing. Václav Novotný
Pracoviště vedoucího práce:	Ústav energetiky 12115, UCEEB

II. HODNOCENÍ JEDNOTLIVÝCH KRITÉRIÍ

Assignment **challenging**

Evaluation of thesis difficulty of assignment.

The extent is rather broad, requiring a good knowledge of turbomachinery principles as well as time and precision demanding conducting of experiments and analysing their results.

Satisfaction of assignment **fulfilled**

Assess that handed thesis meets assignment. Present points of assignment that fell short or were extended. Try to assess importance, impact or cause of each shortcoming.

All tasks of assignment are fulfilled in decent quality. Only mechanical design in point 4) could be arguably going beyond just 3D flow path design, however it would result in excessive extent of the work.

Activity and independence of the student **A - excellent.**

Assess activity of the student, fulfilling agreed deadlines, continuous consultations and his preparation for the consultations. Assess ability of independent genuine work.

Student has shown a good level of independence and responsibility in his own tasks as well as teamwork, where he was actively involved in ongoing research projects.

Technical level **A - excellent.**

Assess level of thesis specialty, use of knowledge gained by study and by expert literature, use of sources and data gained by experience.

The thesis is a complex summary of various research activities in field of micro-scale turbomachinery with a future goal of developing an efficient yet cost effective turboexpander for an ORC microcogeneration unit. It shows a very deep understanding of the topic by the student and his personal interest in it. All of the distinct parts, introduction into turbomachinery physics and calculation, literature review, fluid dynamic design of ORC expander as well as conducting experiment and analysis of data are of a very high level. Some of the sections of the thesis have been published in the team where the student is working, while he has made in them a significant contribution. Other parts are planned to be published. Thesis still contains some mistakes and inaccuracies, though marginal, e.g.:

- Sometimes, e.g. p. 28, misleading distinction between stage loading coefficient vs. blade (mechanical) loading
- FDM typical should be > 150 um, not other way
- In the 3D flow path design, manufacturability is repeatedly stressed. This is contradicting the previous focus on additive manufacturing. Perhaps intention of manufacturing intentions of this expander generation by traditional aside of additive manufacturing should be rather mentioned once at chapter beginning.
- p. 47 "rotor is designed as shrouded", later it is designed as unshrouded
- p. 52 axial gap does not reflect 35% of axial chord length
- Fig. 5.8. probably shifted some time stamps, Fig. 5.9. misleading horizontal yellow lines, "Power" in y-axis
- p. 70 "frames" should be better explained to non-involved reader
- Fig. 5.14 and 5.15. seems to be missing one dataset (DMLS)
- Especially in printed form, the legibility of many graphs with experimental turned out to be still very poor (clearer distinction by more grey colour or symbols could help).

- SLS is reported as significantly more rough than SLA, while measured values for both, accounting for measurement error, can be the same or in opposite order.

Regardless, the high overall level of work in many aspects earns still classification A – excellent.

Formal and language level, scope of thesis **B - very good.**

Assess correctness of usage of formal notation. Assess typographical and language arrangement of thesis.

In overall the formal level of the work is very good. The English level is very good, as well as mostly technical clarity and readability. However some formal mistakes are present, such as having [82] and [131] both as references (conference paper and resulting, only extended journal paper), sometimes wrong capitalization, subscripts or accent in equations, acronyms and subscripts list not in alphabetical order or missing units in tolerance.

More serious issues are missing data rows or on the other hand extra unexplained lines and parameters in axis description for data are not present in graphs. Poor readability of some graphs especially in printed version.

Selection of sources, citation correctness **A - excellent.**

Present your opinion to student's activity when obtaining and using study materials for thesis creation. Characterize selection of sources. Assess that student used all relevant sources. Verify that all used elements are correctly distinguished from own results and thoughts. Assess that citation ethics has not been breached and that all bibliographic citations are complete and in accordance with citation convention and standards.

Perfect selection and use of scientific literature is excellent and formally well cited. Very well received is including a distinction of the student's work and work of the entire research team where student is involved at the beginning of the thesis.

Additional commentary and evaluation

Present your opinion to achieved primary goals of thesis, e.g. level of theoretical results, level and functionality of technical or software conception, publication performance, experimental dexterity etc.

Some of the sections of the thesis have been published in the team where the student is working, while he has made in them a significant contribution. Other parts are planned to be published in scientific journals or conferences.

III. OVERALL EVALUATION, QUESTIONS FOR DEFENSE, CLASSIFICATION SUGGESTION

Summarize thesis aspects that swayed your final evaluation

The thesis manages to contain in a standard length a complex and correct summary of various information and research activities leading towards design of a micro-scale turbomachinery for an ORC microcogeneration unit. All of the distinct parts, introduction into turbomachinery physics and calculation, literature review, fluid dynamic design of ORC expander as well as conducting experiment and analysis of data are of a very high level and show a very deep understanding of the topic by the student. Some of the sections of the thesis have been published in the team where the student is working, while he has made in them a significant contribution. Mistakes and errors are in reflection of the entire thesis only marginal.

I evaluate handed thesis with classification grade **A - excellent.**

Date: **5.1.2021** Signature: