SUPERVISOR'S OPINION OF FINAL THESIS

I. IDENTIFICATION DATA

Thesis name:	**Variance in nanoparticle emissions over WLTP Brake wear testing procedure**
Author's name:	**Praneet Ayyagari**
Type of thesis :	Master
Faculty/Institute:	Faculty of Mechanical Engineering (FME)
Department:	Department of Automotive, Combustion Engine and Railway Engineering
Thesis supervisor:	Prof. Michal Vojtíšek, Ph.D.
Supervisor's department:	Department of Automotive, Combustion Engine and Railway Engineering

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment **Challenging**

Evaluation of thesis difficulty of assignment.

The focus of the thesis was on evaluation of brake wear particles over a recently developed WLTP brake wear test cycle. Analysis of experimental data obtained during a rather extensive series of tests conducted at the Technical University of Ostrava was the main part of the thesis. The topic is interdisciplinary and subject of ongoing research, with many knowledge gaps and no comprehensive textbook, which makes the assignment challenging. The experimental data shows that state of the art brakes can produce relatively low amounts of particles, challenging the detection limits of the instruments and the overall measurement setup.

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.

Mr. Ayyagari has chosen this topic voluntarily with knowledge that it will be a difficult one. He has fulfilled the assignment at a level corresponding to, and in my opinion even slightly exceeding, level expected of master's students and entry-level engineers. He has analyzed data from three different instruments and four different combinations of brake pads and rotors, totaling over a hundred hours of instrument run time, at a second-by-second resolution. While the topic has not been exhausted and there are ample opportunities for new questions to be raised, additional analysis would go far beyond the master's level.

Activity and independence when creating final thesis **A - Excellent**

Assess that student had positive approach, time limits were met, conception was regularly consulted and was well prepared for consultations. Assess student's ability to work independently.

Mr. Ayyagari has shown interest and positive attitude at all times throughout the thesis work. He has taken considerable initiative, has consulted his work on a regular basis, always coming prepared for progress meetings, and has worked independently on the preparation of the thesis and of the underlying work. There was a considerable learning curve and frequent consultations were needed to comprehend specialty topics of aerosols and their measurement and to work with very large data sets. Once familiar with the data, Mr. Ayyagari has worked on his own, with excellent results.

Technical level **B – Very good**

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 addresses a highly specialized topic of brake wear particle production. Mr. Ayyagari has learned several new topics and gained a considerable experience with aerosol measurement, data analysis, critical evaluation and technical writing while working on the thesis.

The data offer a potential for additional exploitation, however, I do not see this as a major flaw, due to the topic done being rather complicated and the work representing the state of the art in technology and science (see earlier comments), and also, due to the experiments being delayed to February and March due to the coronavirus related restrictions, and additional time was needed to resolve issues with instrumentation.

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Formal and language level, scope of thesis	**B - Very good**
Assess correctness of usage of formal notation. Assess typographical and language arrangement of thesis.	
The work is written in good technical English, well structured, comprehensible, grammatically and linguistically correct. The arguments are logical, supported by facts and/or data. The writing is clear, concise, and remarkably accurate and comprehensible. The thesis is rather extensive, 101 pages including appendices with instrument specifications, with 61 figures and 17 tables. The formatting and the visual appearance is very good, with minor issues that would have probably be resolved with additional time available. In Fig. 1, 2, 3 and 6, the font size is too small and/or fuzzy, but these are illustrative figures adopted from literature. There are very minor formal issues, such as inconsistent use of indexes (both PM10 and PM_{10} are acceptable, but the notation should be consistent), variations of English (both tyre and tire are grammatically correct), and overly high precision of data (i.e., Table 15, Fig. 47 x-axis).	

Selection of sources, citation correctness	**B – Very good**
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.	
A total of 36 sources are cited in the thesis, well representing the current knowledge on the topic. These are primarily high-quality peer-reviewed technical and scientific papers, with several references to governmental air quality and technical reports, conference proceedings, and technical specifications of the instruments. The sources are cited correctly. Except for a vague citation of ref. 1 (WHO introductory document), the cited work can be clearly and readily identified. There are some inconsistencies in the formatting (i.e., author names) representing a minor formal flaw.	

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.
The thesis work was part of a real research project representing the state of the art, and brings new and valuable results that can be useful to the research community and that will probably be, after additional analysis and refinement, incorporated into a scientific publication.

III. OVERALL EVALUATION, QUESTIONS FOR DEFENSE, CLASSIFICATION SUGGESTION

Summarize thesis aspects that swayed your final evaluation.

Mr. Ayyagari has picked up a specialty interdisciplinary assignment focused on experimental investigation of nanoparticles originating from state of the art light vehicle disc brakes subjected to the newly developed WLTP brake wear testing procedure. The presented thesis is well written in professional technical English, and corresponds to the reasonable expectations of master's level, with good, but not exhaustive, analysis of data. Shortcomings are relatively minor and often of a formal nature. Mr. Ayyagari has demonstrated a positive attitude and has grown professionally over the course of the thesis work.

I evaluate the submitted thesis with classification grade **B - very good.**

Date: **August 22, 2022** Signature: