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SUPERVISOR'S OPINION OF FINAL THESIS

I. IDENTIFICATION DATA

Thesis name:	**Validation of roadside vehicle emission sensing by tailpipe tests**
Author's name:	**Koushik Vijayakumar**
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, M.S., 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 assignment called for evaluating the performance of a remote sensing instrument by measuring vehicle with known emissions characteristics. The interdisciplinary nature of the assignment, including some atmospheric chemistry, aerosol science and signal processing, makes it challenging. Such assignment would be normally given to an instrumentation scientist and not very likely to an automotive engineer. The student had to work with scientific literature, something not typically done in an engineering programme, and had to learn many new principles and terms. A considerable amount of data processing was needed. The student was made aware of the challenging nature of the assignment and accepted it.

Satisfaction of assignment **Fulfilled with minor objections**

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. Vijayakumar has used data from experiments conducted by an interdisciplinary group and his main goal was to process the data and interpret the results. The assignment has generally been followed and fulfilled. The interpretation of the data is rather vague, stating a good agreement between emission factors measured by remote sensing and particle number concentrations in the vehicle tailpipe during a short test at idle, but without arriving to this conclusions by presenting exact numbers (i.e., out of 47 tested vehicles, xx were identified by both methods as low emitters, xx as high emitters, …) and without a critical reasoning as to what a "good" correlation is. Such interpretations are, however, difficult even for an experienced engineer. Still, more can be learned from the data made available than what is presented in the thesis.

Activity and independence when creating final thesis **C – Good**

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. Vijayakumar has exhibited positive approach throughout the process. When given an assignment that he was able to comprehend, he was able to work on it independently. His initiative was fair - not much independent work beyond the specific assignment was done. A considerable degree of guidance and supervision was needed. The student has learned considerably, and has demonstrated willingness to learn. The grade reflect both the starting position (fair) and the motivation and professional and personal growth (very good).

Technical level **D – Satisfactory**

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

The overall technical level of the thesis as the final product ranges from good to very good. However, I am suggesting a satisfactory grade due to a substantial amount of feedback, including checking calculations and text for errors, etc. The feedback also included specific guidance to include or address many partial topics. There was a last-minute correction to remedy errors in data in two tables originating from an incorrect use of formulas in Excel.

SUPERVISOR'S OPINION OF FINAL THESIS

Formal and language level, scope of thesis	**C – Good**
Assess correctness of usage of formal notation. Assess typographical and language arrangement of thesis.	
The thesis is well structured, the writing is reasonably comprehensible. It is written in reasonably good technical English, with some minor formal errors. The visual appearance is good, aside from occasional blank lines and similar, the formatting is appropriate, figures are mostly appropriate and well legible. The length of the thesis, 83 pages plus appendix with detailed data, is appropriate, without parts that are clearly missing, redundant or irrelevant.	

Selection of sources, citation correctness	**C – 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 20 sources are cited in the thesis, including peer-reviewed journal papers. The selection and peruse of the sources, and references made in the text, are all generally very good. The citations are incomplete and thus formally deficient, but the cited work is identified with a clarity sufficient to find it (i.e., the volume, issue and pages of a journal article are missing, but the article can be positively identified and easily retrieved using a DOI link).	

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.

There are two arguments to the student's credit that I would like to present. First, he has taken on the challenge even after both of us agreeing that given his moderate or relatively weaker starting point and rather difficult subject to address, the thesis on this topic will be difficult for him. Second, he has learned and grown considerably, making more progress than someone starting at a higher level.

It is my opinion that engineering programs would benefit from more coverage of technical writing and working with engineering data and scientific literature.

I would like to note that results similar to ones shown in the thesis were presented at an international conference by other members of the experimental group. These results were obtained in parallel with the student's work as they were needed much earlier, but to maintain the learning experience, communicated to the student only after he has done his work.

III. OVERALL EVALUATION, QUESTIONS FOR DEFENSE, CLASSIFICATION SUGGESTION

Summarize thesis aspects that swayed your final evaluation.

Mr. Vijayakumar has picked up a specialty interdisciplinary assignment focused on evaluating point sampling measurement of particle number emissions of passing vehicles. The experiments were, due to their complex nature, designed and supervised by an experienced team. The student has actively participated in the experimental campaigns and his task was to process, analyze and interpret the data. In the end, the task was successfully accomplished, and a quite reasonable writing handed in. I see the considerable guidance throughout the project as a weakness. A combination of average starting point and a challenging assignment has created a challenge that has been, in my opinion, despite a specific warning, underestimated by the student, but he has followed through on his commitment. I see the positive attitude, commitment, and major professional growth throughout the thesis as added strengths.

I evaluate the submitted thesis with classification grade **C - Good.**

Date: **August 25, 2023** Signature: