

I. IDENTIFICATION DATA

Thesis name:	Detection of excess NO_x emissions of Heavy vehicles during ordinary operation
Author's name:	Alden Fred Arul Raj
Type of thesis :	MASTER THESIS
Faculty/Institute:	Faculty of Mechanical Engineering
Department:	Department of Automotive, Combustion Engine and Railway Engineering
Thesis reviewer:	Ing. Martin Pechout, Ph.D.
Reviewer's department:	Department of Vehicles and Ground Transport, CZU Prague

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	A
<i>Evaluation of thesis difficulty of assignment.</i>	
This thesis represents participation on a comprehensive experimental study with extensive data to be processed and evaluated.	

Satisfaction of assignment	C
<i>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.</i>	
The thesis fulfils nearly all assignment points. Unfortunately, there is on little about statistical analysis, measurement uncertainty and discussion on normal and excessive NO _x emitters such as evaluation of share excessive emitters based on heavy duty vehicles emission standard.	

Method of conception	B
<i>Assess that student has chosen correct approach or solution methods.</i>	
Student was prepared the data for analysis (drift suppression, individual plumes response selection, etc.) and used multiple evaluation methods. On other hand, comparison of the evaluation methods was done on few examples only and some little work on the statistic of the results would result in more helpful results.	

Technical level	C
<i>Assess level of thesis specialty, use of knowledge gained by study and by expert literature, use of sources and data gained by experience.</i>	
Student had to gain and use specific knowledge of the topic by study and expert literature. Their usage was on reasonable level in most cases. There is some lack of statistical data based on obtained NO/CO ₂ ratios or NO emission factors. On other hand, some given sentences are ambiguous, incomplete or inaccurate:	
<ul style="list-style-type: none"> - Euro Normal Standards – not commonly used description - “During lean operation, NO is stored in storage material like barium carbonate, barium nitrate is formed and when the engine is operated in slight rich mixture for an instance (richer than ordinary operation)” – it is not clear that some shift to rich mixture or just less lean is needed - “Air in the atmosphere has 78.6% of Nitrogen and 21% of Oxygen” with no information if the shares are by mass or by volume - “Trap (LNT) which performs effectively by alternative lean and rich mixtures” 	

Formal and language level, scope of thesis	D
<i>Assess correctness of usage of formal notation. Assess typographical and language arrangement of thesis.</i>	
Unfortunately, the language is far from precise in many cases (singular and plural nouns usage): “Traffic areas and congested street with vehicle are the major source of NO _x ”, “in most of the European Country”, “the environmental and operating condition is not the same”, “Hydrocarbon fuel powering vehicles”	
Capitals are used for common names (page 11: “Burnt gases”; “Oxygen”, “Carbon” throughout the thesis).	

Some sentences word order is somewhat confusing or some word seems to be missing:

- "Fuel has mass fraction of Carbon. 86% of the mass fraction of carbon in fuel is assumed to be oxidised which is equal to 698 g/kWh", p. 53
- "Though particles are dangerous pollutant than NOx from internal combustion engines", p. 8

Some statements are repeated in unrelated chapters when discussed before and are not following common sequence (general description, motivation of concern, possible solutions or IMRAD scheme):

- Chapter about NOx abatement before the Health effects chapter
- "The major harmful emissions from the Engine Exhausts are Oxides of Nitrogen (NOx), Particulate Matter (PM), Carbon monoxide (CO) and Hydrocarbons (HC)" is repeated
- Chapters 6.2 and 6.3 are describing the route location where the experiments took place and its altitude profile, but is located below the analyzed results

Some information is repeated such as:

- "The maximum allowed annual limit of NO emissions in most European cities is 40µg/m³" on page 23 is mentioned before.
- "The major harmful emissions from the Engine Exhausts are Oxides of Nitrogen (NOx), Particulate Matter (PM), Carbon monoxide (CO) and Hydrocarbons (HC)." on page 22 in a chapter describing high emitters detection

The scope of the thesis is adequate and somewhat enlarged by using extensive tables with results.

Selection of sources, citation correctness

B

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.

Student selected proper sources of study and background description literature. On other hand, some sources and its results are mentioned, but not cited, e.g.:

"But certain detailed studies and research have said that the rate of formation of NOx is mostly at the kinetic phase of combustion where the mixing of Air and fuel takes place predominantly and the occurrence of initial rapid combustion results in enormous amount of temperature", page 10

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.

In some cases (especially table 6.1) the graphical expression would be more readable with a potential to see some trends. Sometimes, incorrect labeling is used (Nox, NOX for nitrogen oxides, "KM" for kilometer, "time (seconds)" for time expressed in hours:minutes:seconds format

III. OVERALL EVALUATION, QUESTIONS FOR DEFENSE, CLASSIFICATION SUGGESTION

Summarize thesis aspects that swayed your final evaluation. Please present apt questions which student should answer during defense.

Questions:

- On the page 14 in chapter about N-SCR is mentioned reduction mechanism $\text{NO}_2 + \text{CO} \rightarrow \text{N}_2 + \text{CO}_2$. Why Non-Selective Catalytic Reduction using this mechanism is not used in diesel engines aftertreatment?
- Could you comment on share of high emitters share for each emission standard heavy duty vehicles?

I evaluate handed thesis with classification grade **C**.

Date: **29.1.2020**

Signature: