International regulation of vehicle emissions control rules and its influence on academic engine development experimental study and vehicle manufacturing

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International regulation of vehicle emissions control rules and its influence on academic engine development experimental study and vehicle manufacturing

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Abstract. In this century, global on-road passenger vehicles raised rapidly with concerns regarding of air pollutions, greenhouse, climate change, economical and human life safety. However, what are the new vehicles emission standards implementation regulation involved? How can new emission regulation impact vehicle performance and environment pollution reductions? What is (Worldwide Harmonized Light Vehicle Test Procedure - WLTP)? How can (WLTP) regulation promote improvement to vehicle quality in reduction of emission to lower level possible and add more performance to the vehicles for open market? What is the real-world on-road (Real world Drive Emission- RDE) test new emission regulation and its demand? Why vehicle manufactures should present both emission level of laboratorial engine emission level and vehicle (RDE) emission level in EU? Presenting an accurate vehicle pollutant determination due to new EU regulation procedure of (WLTP) will help the consumer identifying the regulation cost fee and tax in registration the vehicle. Methodology based on comparative EU regulation assessment and (WLTP) regulation vehicle emission control technologies assessment. The paper focus on viewing, the potential of pollution regulation (WLTP) for vehicle emissions reductions. Provide an outline of the status of the EU vehicle pollution emission regulations information and identify priorities options and recommendations to the introduction of the (WLTP). Offering information gridline data for researchers in future study for the strict pollution regulation adopted by European countries and its impact on future academic study of vehicle emission experimental process in non-applicable countries, contribute the procedure process of (RDE) emission implementation test within (WLTP) to be familiar by researchers for future intended joining the regulation.

1. Introduction.

A dramatically increase of vehicle productions and critical rise of environmental pollutions, global warming, climate, greenhouse and transportation growth make countries around the world as a result to unite to find effective solutions [1][2][3]. The global pollution statues nowadays is not easy to control over classic regulations and rules. Thus, they agree that situation really need for concern and very strict sever urgent actions in law and regulations to reduce passenger vehicles pollutions [4].

In 2014 the European regulation (EU) pollution CO_2 emissions No# 333/2014, was planned for 2020/2021 (Figure 3) [5], the specific emission target conducted over calendar till 2017 to become 100% authorized depending on emission weight (CO_2 g/km) proportional to the vehicle weight parameter to define the total emission fee tax to pay annually Figure 1 and 2. The environment test of (WLTP) test procedure since September 2017, CO_2 emissions test including the ambient temperature correction to be at 14°C. However, regulations made to control the industrial manufactures productions, control pollutions and control human society rules for better life [6]. Aiming for reducing the environmental impact of vehicles use with intending to represent dynamic experienced conditions with real life vehicles use [7]. (WLTP) regulation emission and (RDE) test is a solution for emission exhaust control, it was adopted after long observation and recognized that (RDE) test of vehicle emission test result is not same as vehicle manufacturing certified, it was substantially higher than the certified engine emission level. This regulation take effect in Europe in September 2017 [8][9]. The (WLTP) introduced after conducting road emission test through remote sensing measurement to indicate diesel vehicle emissions on the roads, the study show 25% exceeded in (NO_x) amount over certified value [10][11]. Another reason to adopt (WLTP) is due to approval procedure test type used for emission certified it is simulate the real-world statues condition accuracy [12][13][14]. China in 2016 released the final rules of (china 6 emission)[15], added more regulation to (RDE) test to become more accuracy of emission exhaust by adding road load test and weight determination beside chassis dynamometer test in the laboratory. However, this rules and regulation are better for human life protection and clean environments, but still there is countries especially automobile manufacturing country don't want to obligate with the new technique and regulation due to economic benefits [16]. The (WLTP) drive test will help the researchers to identify the real exhaust emission output from the selected study vehicle, and not just engine dynamiter or chassis dynamiter emission test represent the real pollution emission [17].

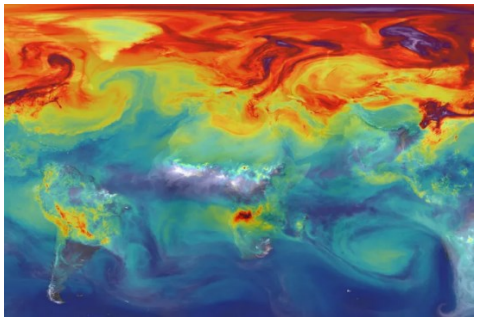

Figure 1. simulation of carbon dioxide in the atmosphere- source: NASA / GSFC

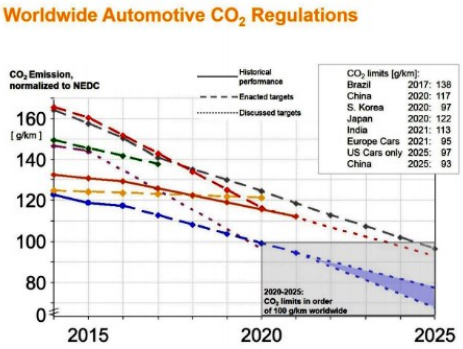

Figure 2. Global Historic of CO_2 Emissions for different regions - source: ICCT 2015

Table 1. Test emitters rating bands discriminate between high and low- by EQUA Air Quality Index

Rating	Lower bound (g/km, exclusive)	Upper bound (g/km, exclusive)	External reference point
A	0.00	0.08	Meets Euro 6 limit for diesels, and meets Euro 4 limit for gasoline
B	0.08	0.12	Meets 1.5 Conformity Factor under Euro 6 Real Driving Emissions regulation
C	0.12	0.18	Meets Euro 5 limit for diesels (and similar to 2.1 Conformity Factor under Euro 6 Real Driving Emissions regulation)
D	0.18	0.25	Meets Euro 4 limit for diesels
E	0.25	0.50	Meets Euro 3 limit for diesels
F	0.50	0.75	No comparable Euro standard: roughly equal to 6-8 times Euro 6 limit
G	0.75	1.00	Roughly equal to 8-12 times Euro 6 limit
H	1.00	Non	None Roughly equal to 12+ times Euro 6 limit

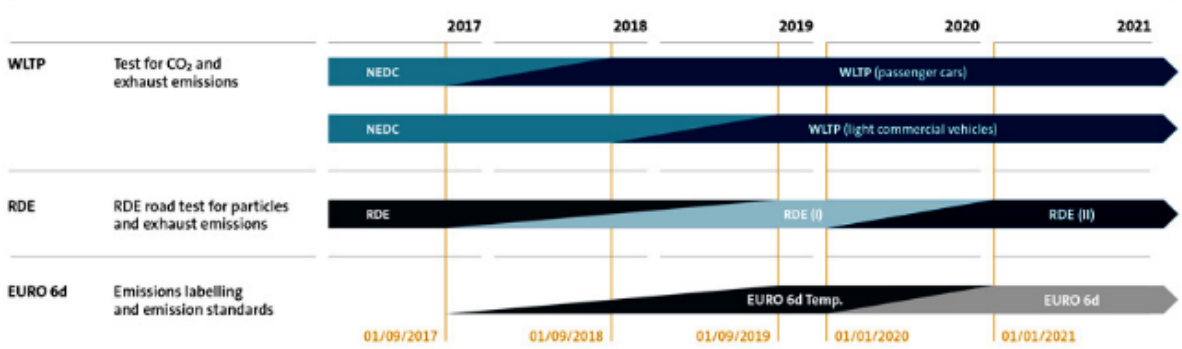

Figure 3. Fulfil the EURO 6, WLTP, RDE over date implementation –source by :Volkswagen aktiengsellschaft -https://www.volkswagenag.com/en/group/fleet-customer/WLTP.html

2. Worldwide Emission Standards and Regulations

(WLTP) is the new protocol regulation as well as the requirement process to measure exhaust emissions in the real world with the real driving emissions (RDE) Test. EU is the first political and economic introduce the (WLTP) as a legally binding procedure to achieve uniform test protocol throughout the world, gave the opportunity of compares the vehicles across continents and ability of harmonies manufacturing product offer. The (WLTP) taking in consideration optional equipment of the vehicle for everything that increases the vehicles fuel consumption and its emissions, the type approval will become a lot more complex. In fact, every vehicle gets its own CO_2 rating based on its equipment, body type, aerodynamic properties and mass.

2.1 The State of Global Air-Pollution Regulation

The old regulation of the first multilateral instrument that addressed air pollution was the Long-Range Transboundary air pollution Convention (LRTAP) in 1979. Establishing a framework for subsidiary agreements in addressing specific pollutants and set strict reduction limits [18], since protocols upgraded added to the regulation Sulphur dioxide (SO_2) emissions and both nitrogen oxide (NO_x) emissions and volatile organic compound (VOC). The European Union concern its focus on greenhouse gas (GHG) emission reductions achievement, planning for future commitment period of the Kyoto protocol for the period 2013 to 2020, targeting to 2020 achieving at least 20% minimum of (GHG) reduction compared

with 1990 base regulation. The EU continues tighten strictly the CO_2 emission limits for passenger vehicles, especially Diesel vehicles emit in real driving conditions more NOx than under type approval conditions, this lead to the new real driving emission type approval test. Most vehicle types will be mainly affected is the diesel vehicles more than gasoline vehicles as the previews is (NO_X) high emission producer. The regulation development is a result of EU concern of important developments towards these areas:
(GHG) reduction. Pollutant emission reduction. Revision of type approval framework.

The regulation subjects is to work on the following:

- The regulation foresees a phase-in of the 95 gCO_2/km based on the (NEDC) test procedure during the years 2020 and 2021 allowing discarding the 5% most emitting vehicles during the first year.
- The (WLTP) is a result of recognizing that the NEDC test-procedure does not provide CO_2 emission data characteristic for real driving that why regulation 2017/1151 replacing the EU regulation 692 in September 2017.
- The CO_2 emissions measured using the (WLTP) have to be converted to a (NEDC) basis to be compared to the CO_2 emission values and defined the limits of the NEDC (130 gCO_2/km until 2019 and 95 gCO_2/km starting 2020).
- Utilize parameter of vehicle footprint as alternative to the current mass based weighting method, first proposal for post 2021 CO_2 targets is of 2017.
- The new real driving emissions (RDE) test procedure is based on Portable Emission Measurement Systems (PEMS) and driving on public roads. (PEMS) will be applied for NOx (CO only for monitoring) and for PN. HC emissions are not included in the RDE test procedure.
- Type of approval framework is trilogies process that third party testing and market surveillance and improved control of national type approval authorities.

In November 2016, United Nations Framework Convention on Climate Change (UNFCCC) of 194 country meet to adopt new climate change agreement, which take effect in 2016 [19]. Adopt new regulation of environment pollution efforts to limit controls. Emission legislations for light duty vehicles divided into two different categories:

- *Pollutant emissions* **(**criteria emission) which are harmful to human health and local air quality. Those emissions are:
  - Carbon monoxide (CO), highly toxic, measured in mg/km
  - Unburned hydrocarbons (HC), depends on the detailed chemical composition, toxic
  - Nitrogen oxides NO and NO_2 (commonly treated as NOx) harmful to human health and photochemical effects in the atmosphere measured in mg/km
  - Particulates (soot and ash) measured as PM in mg/km and PN measured in number/km

All regulations limit the maximum emissions in mg/km for each vehicle sold. Each vehicle has to be certified.

- *Greenhouse gas emissions***,** mainly CO_2, CH_4 and N_2O. Greenhouse gases affect the world climate, for this reason, all major world regions limit the CO_2 emissions as average for the new vehicle fleet sold in a given year. The regulations in the world regions are different, but the target converges for the main regions to around 100 gCO_2/km in the period 2020-2025

2.2 The regulation impacts

To understand the impacts of the new pollution regulation on vehicle market or education filed and industrial filed, we need to understand the change in regulations. The change done on three process, the emission testing process, emission tax fee and emission limitations. Test process changed from (NEDC) to (WLTP) that many manufacturers are yet to conduct pollution test over (NEDC), the (WLTP) will address a realistic emission of the vehicle, which is higher than (NEDC) test value. Tax fee process of emission raised conflicting on marketing behavior price and vehicle manufactures concerns. Limitation control of emissions impact on market vehicle availability. The emissions of carbon dioxide are directly

related to vehicle consume, so the test will present fuel consumption were going up, that means that your CO_2 figure is going up. That means that both price of your car and the amount of annual tax you may pay both going to rise. Both vehicle registration Tax (VRT) and motor tax calculated depend on the level of CO_2 emissions. This means that new vehicles will need to comply with legislative limits for exhaust emissions in both the test laboratory and in the real world to be qualified entering the EU markets. The regulation will influence the vehicle quality and market price to meet the requested emission limitation impact the product price to become higher, influencing the market consumer's demand. As the emission related to fuel type and fuel quality, there will be conflicting in price for good quality fuels. Demand for plug-in electric vehicle will rise too. Electric automation manufacturing and technology will control the future market.

2.2.1 Political influence

Political influence refer to country income from vehicle manufacturing process beneficial, oil company and invoice tax and commotions from facility's. The regulation effect on local vehicle market as the price go higher the consumer goes towards other manufactures brands with les cost. Creating a clean environment less noise and less traffic pollution requires shifting to advanced electric transportations in public use. Comfortable and secured transportation service encourage people use of public transportation and reduce pollutions.

2.2.2 Industrial technology influence

The regulation of zero pollution will lead to birth of green vehicle production in global. General vehicle manufacturing companies will face the regulation with concerns even they can join the green vehicle production but the political power and petroleum control prevent form converting. Green vehicle manufacturing will control the market in future as demand rise with time (Figure 4) shows vehicle market behavior in EU during 2018 after (WLTP) registration influenced the diesel tax cost due to high emission (Figure 5), and people become more knowledge about the harmful of pollutions and should pay very high tax fee.

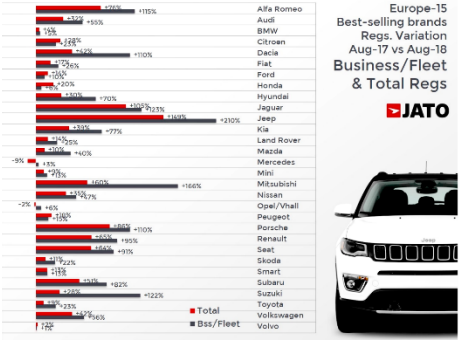

Figure 4. EU 2018 vehicle market behavior, rise in gasoline vehicle registration- source: JATO-*www.jato.com/th*e-false-positive-effect-of-wltp.

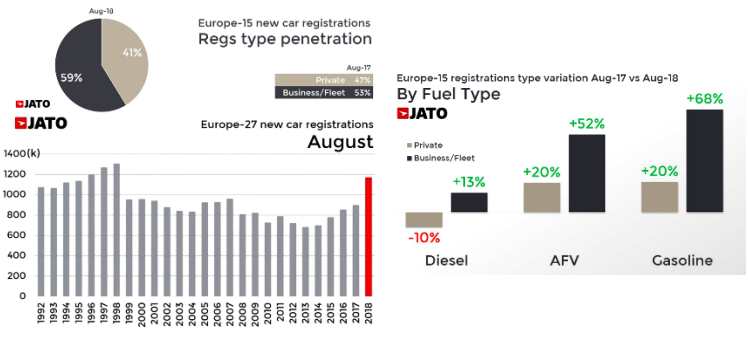

Figure 5. Registration compare in vehicle variation 2017-2018 by fuel type.

2.2.3 Social influence

Social environment influenced by the regulation for its benefaction for life safety, creating green and clean environment to live. Emission pollution play turn in food chain by spoiling it or exposed for contamination due harmful waste or gases, traffic jam noise and city life disturbing noise pollution effected on society behavior . People start to understand the critical statues of global air pollution and global warming that make some society do cherty work for cleaning and helping each other's. the amount of passenger vehicle becomes very widely in use, which lead to delay of transportation time due to traffic jam, that why people start to use public transportation as it is much more time accrued and cheaper operation. Daily accident's and life lose teach people the meaning of safety, quality, time management and health care, understanding the need for more sever rules and regulation for much better

life safety for next generation in future. They understand how a public transportation can reduce pollution, noise and space, that why the high economical countries focus it's developing on public transportations for better speed, better quality and comfortable. The (Figure 6) shows the effect of variable transportation type used for same amount number of 60 person, the figure shows how vehicle ownership influence the environment and economical use of fuel and space.

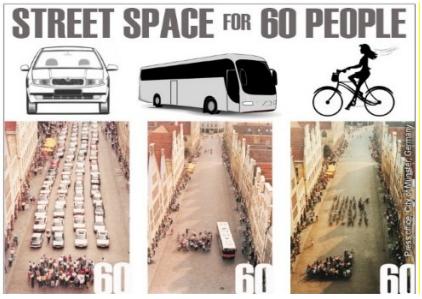

Figure 6. The 60 vehicle owner if they change transportation type –source: Press-Office city of Muenster, Germany/via

Figure 7. India, New Delhi traffic jam – photo by : Anil Sood / Twitter

3. Vehicle performance test

The term engine performance is refer to engine parameter performance as mechanical parameters involve, fuel consumption, thermal performance and emissions. The vehicle consist of many parts involved such as engine performance involved, gear box, chassis, axles, body, brake system, light system, electrical and computer system and wheels. All these are performance parameter in vehicle test. That why, the new pollution regulation require all parameters to be tested in lab and real-world on-road test to confirm real data results, to insure full human life safety and vehicle performance. The new regulation emissions standard for EU confirm of all new vehicles enter EU market should meet this standard (Euro 6) of pollution test (WLTP), also requires for full checks of (in-service conformity) of vehicles in use on-road, confirmation to ensure that the vehicles are not diverge from the EU standards before released in the street for consumers.

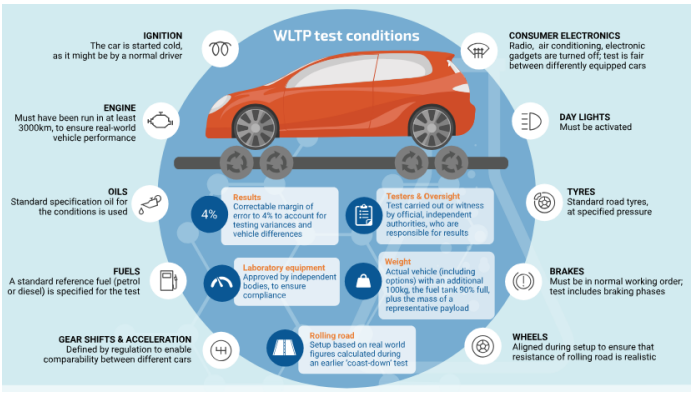

Figure 8. Vehicle performance lab test- source: http://www.caremissionstestingfacts.eu/nedc-how-do-lab-tests-work/.

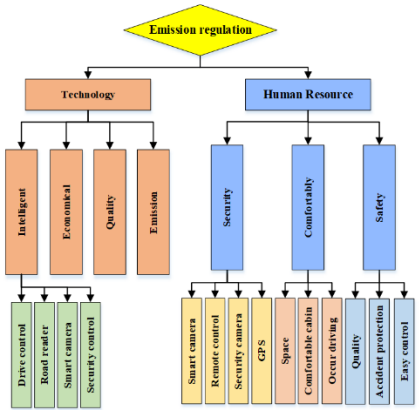

Figure 9. regulation influence on vehicle development technology.

3.1 (WLTP) Worldwide Harmonized Light Vehicle Test Procedure

The new regulation of Worldwide Harmonized Light Vehicle Test Procedure (WLTP) [20] request for extra vehicle test beside the previous test (NEDC)-New European Driving Cycle that established since

1980, as the revolution of vehicle technology developed and the regulation need for update [21]. The new tests are laboratory test measurement of emissions for both CO_2 and pollutants. Vehicle conditions set-up, all should be set. Testing and handling of test results for vehicles are defined by EU law [22]. (WLTP) presents more realistic vehicle speed profile based on an international database of really driven drive sequences that will allows for a standardized and repeatable testing procedure process, which helps the consumers to compare emissions between different vehicle models [23]. Vehicle mass, vehicle air resistance, vehicle conditioning and environmental conditions more precisely defined in test. (WLTP) defines 3 main classes of vehicles with one cycle for each and 2 sub-classes for the class 3. The cycle to be driven depends on the ratio of the test vehicle's rated power to "mass in running order" minus 75 kg for driver's weight, W/kg, and its maximum velocity, Vmax.

$$P_{mr} = \text{Power [W]} / (\text{Mass in running order - 75 kg}) \quad (1)$$

The Mass in running order is total mass of the vehicle full tank fuel with other extra accessory as well as tools. The three classes cycle test are:

Class 1 test: Pmr < 22 W/KG : Class 2 test: Pmr > 22 W/KG : Class 3 test: Pmr > 34 W/KG
The cycle test done through deferent speed profile: low speed, medium speed and extra high speed. For class 3 vehicles there are two subclasses for vehicles with a maximum speed <120 km/h and those with higher maximum speed.

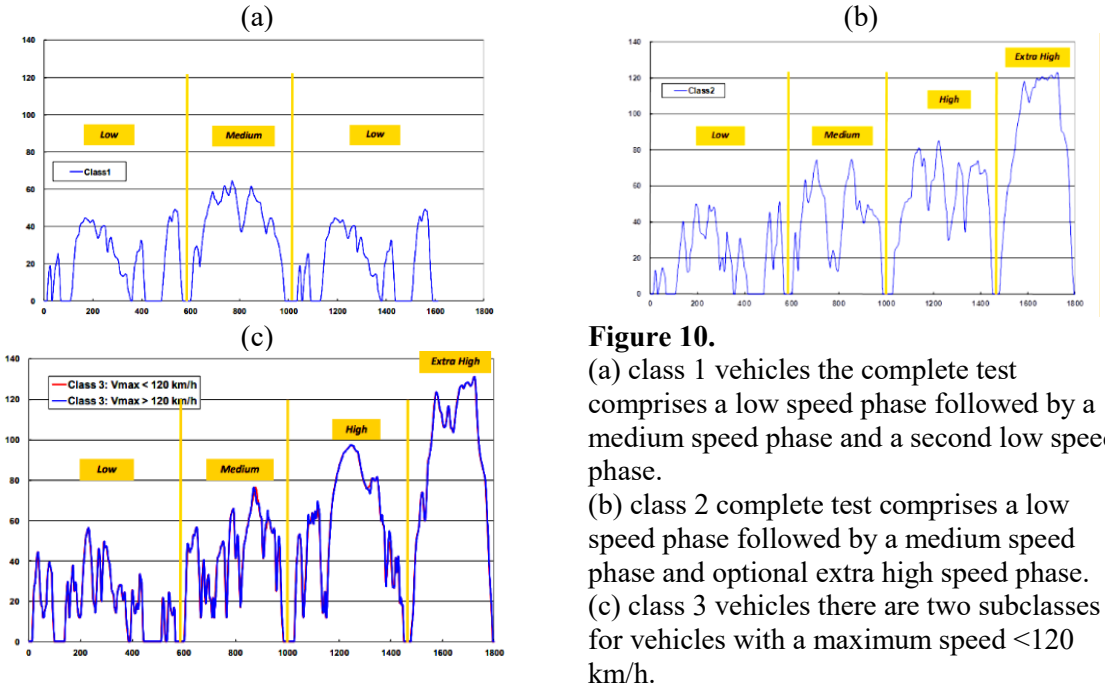

Figure 10.
(a) class 1 vehicles the complete test comprises a low speed phase followed by a medium speed phase and a second low speed phase.
(b) class 2 complete test comprises a low speed phase followed by a medium speed phase and optional extra high speed phase.
(c) class 3 vehicles there are two subclasses for vehicles with a maximum speed <120 km/h.

3.2 Real-world on-road Emission test
The EU regulation for emission of vehicle (WLTP) for any new vehicle reach the EU market should first undergo through the realistic world test process to measure the (CO_2) and fuel economy and other variables as show in (Figure 12). If the vehicle meets these requirements, approved for sale in Europe market. EQUA sets the standard for independent real-world emissions data, provides vehicle performance in real-world driving accurate fuel consumption and air quality data Index [24]. Selected

test environment where depend on country of test. Europe country most common weather is cold, that why selected control temperature is 23ºC. For the on-road test, additional regional specific tests correction added by the EU, as the low temperature test 14°C. This selection will force the vehicle manufactures to take consideration of engine thermal cooling system design. The engine cooling system for Europe area cannot be suitable for middle east area as the most common weather is hot summer and temperatures reach high level of 50ºC- 55ºC. such country if they used the (WLTP) regulation, they will select higher boundary conditions weather temperatures.

Figure 11. Portable emissions testing systems used by independent EQUA Air Quality Index, powered by Emissions Analytics, April 2016 (source: https://equaindex.com/)

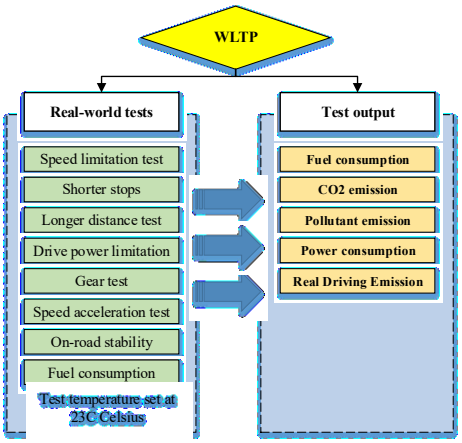

Figure 12. (WLTP) regulation test process output flow chart

Table 2. Euro standards and emissions limits (2016-2017).

Rating	Lower bound (g/km, exclusive)	Upper bound (g/km, exclusive)	External reference point
A	0.00	0.08	Meets Euro 6 limit for diesels, and meets Euro 4 limit for gasoline
B	0.08	0.12	Meets 1.5 Conformity Factor under Euro 6 (RDE) regulation
C	0.12	0.18	Meets Euro 5 limit for diesels (and similar to 2.1 Conformity Factor under Euro 6 RDE regulation)
D	0.18	0.25	Meets Euro 4 limit for diesels
E	0.25	0.50	Meets Euro 3 limit for diesels
F	0.50	0.75	No comparable Euro standard: roughly equal to 6-8 times Euro 6 limit
G	0.75	1.00	Roughly equal to 8-12 times Euro 6 limit
H	1.00	Non	None Roughly equal to 12+ times Euro 6 limit

4. Discussion

The new emission regulation influenced the vehicle test procedures in academic study through change in test process by adding extra test process for performance and pollution analysis test. Previously, the common test conducted was Engine dynamiter performance with emission analysis test, then developed in few study in to vehicle chasses dynamiter test. Now with the new regulation, academic researchers should be familiar with complete test procedure and follow the updates of new regulation requirement. This work presents the process of the (WLTP) test case to be failure for researchers in future study. This paper will present a narrative review of the frame key process required to know by the academic researchers in time and future works as it is become valuable compulsory conducted technological process in vehicle emission pollution test method.

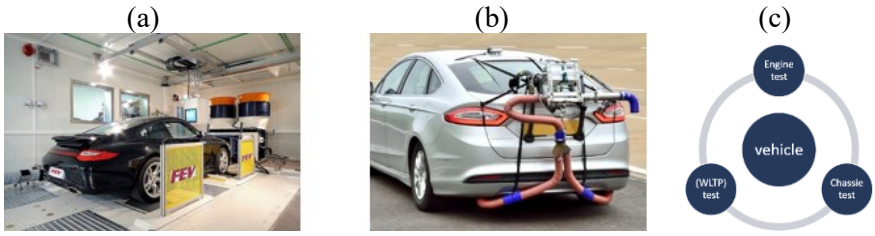

Figure 13. vehicle process test (a) vehicle chasses test (b) real-world on-road test.

4.1 Existent technology process

The study process flow chart in Figure 15 shows the steps of the existent experimental test process flow up chart used in vehicle pollution test analysis, through the (WLTP) regulation.

4.1.1 Pretest preparation

- *Sample selection*

  Selecting the study vehicle, which selected for the experimental test. Define all vehicle specification and data obtained from manufacture details or vehicle analyzing. Find the vehicle weight mass with full fuel tank and all vehicle accessory include. Define other samples as Fuel property used for test.

- *Test design (Project design)*

  Draw the test process schematic diagram plan of connection and sensors, DAQ system and any connection and device needed. Define conduct tested needed steeps, test names and number of test tray. Define which parameters need tested first and what equipment is required for the test.

- *Test equipment and tolls*

  Complete project design will help you to select the correct equipment's and tools for test implementation, Connection, installation, reset, and calibration equipment for test starting.

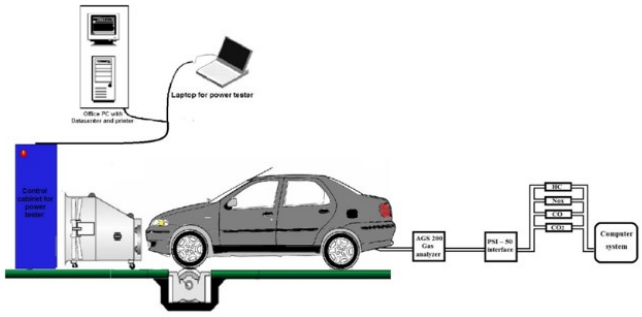

Figure 14. Chasses test bench.

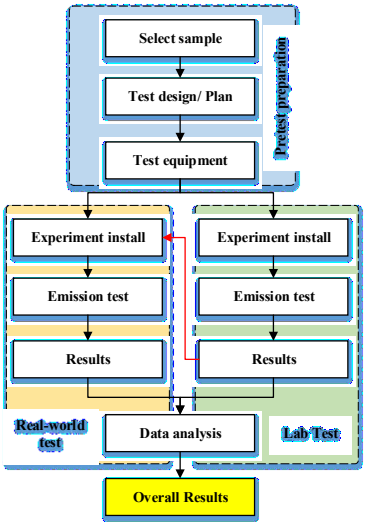

Figure 15. test process flow chart.

4.1.2 Laboratorial test

In laboratory test a chasses dynamometer used to determine the vehicle engine emissions and power performance with engine emission exhaust.

• *Experimental installation*

In the laboratory, the installation of sample vehicle on the selected equipment prepared for start test. Check all connections, labels, sensors all in right position, check for wiring is correct, fuel level, battery checkup, area is clean and most important part is safety equipment and first aid box around and never forget fire extinguish as you are working with flammable danger fuel.

• *Emission test*

The emission test implemented in three steps, cold start or no-load emission test, internal load or attached load test as air-conditioning load and any other engine add-on equipment then road-load test emission. The three tests will define the engine emissions in different conditions.

a- *No-load test emission*

Test vehicle engine with no move or load, free engine work. This will identify the engine exhaust emission only without any load.

b- *Engine add-on emission test*

Test vehicle engine with no move too, turn on air-conditioning system. This will identify the amount of air-conditioning load consuming and its emission influence. If there is any other consumer add-ons device then it should start another test for second add-ons device operation to identify its power consuming and emission influence. Then total load add-ons test on engine start to identify final power consuming from engine and its emissions. This test will identify the engine exhaust emission with add-ons power consumer. The add-ons power used to calculate net power performance of engine on road test ass the add-ons power will be negative as they are power consumer, that why it should be tested independently and define each one amount.

c- *Road-load test*

To test the road-emission, there is a need to define the load range apply on vehicle and speed selections. Accrue result can be find by selecting variable load with each speed selection. There will be too many reading and tests but the result graph will help u to identify each speed and load how much emission is exhaust. Selecting variable speed to simulate the road speed variation.

Figure 16. Ono Sokki various vehicle performance tests (www.onosokki.co.jp).

Figure 17. chasses test graphical interface data acquisition by labView software.

• *Test Results*

The results of each test separately identify emission of vehicle on each status. The results obtained digitally from Data Acquisition device used. The file result save as Excel file for use in any analyzing application software or used for graph inputs. Do not waste your error data reading, its helping you in identify the error reason and why you have error data. This will help in your writing to support future test to be aware of what not do, and help the reader to understand what you done.

4.1.3 Real-world driving emission test (RDE)

The new regulation request real-world emission test. Which implement the emission test on road driving. A portable emission system will integrated on vehicle exhaust for canalizing the exhaust emissions. At same time find the real-world road-load test of vehicle real performance on road with real fuel

consumption [25]. This study mostly will be suitable for each geographical environment, as each country climate condition is variable. To determine the road test result, you need for identify road route, altitude used GPS navigation record system, speed variation, and fuel-consuming system can use the ECU or DAQ system.

• *Experimental installation*

Install the portable emission analyzer system, GPS and wind speed meter on vehicle. Check for connection and equipment test and fuel level, wheel status of air pressure and vehicle weight after add the extra equipment. Needed in vehicle power calculation if needed. Rest all reading device and start the vehicle for the test.

a- GPS navigation system

The GPS, is used to record the journey road route and distance, so as the speed record for each point. Variation speed recorded with variation time implemented. This will help to identify regular speed range and real fuel consumption and engine power required from engine RPM and wind speed resistant, which work as negative drag force.

b- Wind or air speed meter

The air or wind speed meter used to define the drag force, which work as resistance force against the vehicle face front area on impact at drive status. The amount of wind force vary with vehicle speed.

c- Portable Emissions Measurement System (PEMS)

The new (RDE) test procedure is based on Portable Emission Measurement Systems (PEMS) and driving on public roads. (PEMS) will be applied for vehicle NOx (CO only for monitoring) and for PN. HC emissions are not included in the RDE test procedure. The cold start phase is included in the test

Figure 18. (PEMS) installation on vehicles.

• *Emission test*

The emission test can implemented in two steps for accuracy emission reading. First drive with no engine add-ons load emission test, no air-conditioning load. Second drive test conduct with add-ons device used. The two tests will define the vehicle emissions in different condition. This will help to know the engine real power performance on-road drive.

• *Test Results*

Same as the laboratory test results process. Variable data were obtained, each data identify each status.

• *Data analysis*

Experimental results of laboratory and real-world road test data, is used in an analyzing application software that graph the relation and results, which help the researcher to identify and understand all parameters behaviors and others parameters needs to be find or calculate. Draw the emission results, there will be many emissions results, due to variable testes don. These results will compare with manufacture emission data to find the gap and reason why the deferent levels of variation emission.

4.1.4 Overall process output

The final output is the result of all experimental tests for both chassis laboratory test and real-world on-road drive test is finalized with the requirements that need by researcher such as; engine power, fuel consumption, drift power, emissions both for engine and vehicle test other parameters depend on test requirement. All data presented in tables and graphs to show the study results. Finely compare the

vehicle test results with the (WLTP) regulation limits authorized, find if the vehicle under approved of (WLTP) or under range, this will introduce the fact that your vehicle can be accepted or rejected in countries under (WLTP) regulation.

4.2 Data validation

To insure all steps are correct and your data is correct and approve your tested results, validation of data is required. Generally, can use the manufacturing data as baseline for validation as the vehicle and engine approved clean test or new component test where all parts is new manufactured, the output results of selected vehicle will compered to find the operation life effect due to vehicle use. If the gap in data change is critical and close to baseline data, then it is refer to boundary conditions change such as air property or type of fuel used. This variation could use as error percentage.

5. Conclusions

The investigation of new vehicle emission test regulations, shows significant influence on vehicle and engine manufacturing future concern for better development and designs to reach zero pollutions and minimum (CO_2, CO, NO_x, HC and PM) emissions. The regulation will influence positively and beneficially on human life and social activity, as the law of climate is to safe human life from pollutions and protect the environment from global warming, ozone and climate change for better healthy life. Even its conducted and adopted by few countries, soon other country governments will understand the issue of pollution risk and adopt the new regulations. (Figure 19) introduce the (RDE) test individual of NO_X emission conducted in EU end of 2017, amendment to the Euro 6 standard diesel passenger vehicles using portable emissions measurement system (PEMS) for recording emissions under two organizations or governments used smart emissions measurement systems (SEMS) equipment. The results shows only 10% of vehicles pas the regulation only. Since 2018 any new brand vehicle imported to EU should pass the regulation test to reach the market [26].

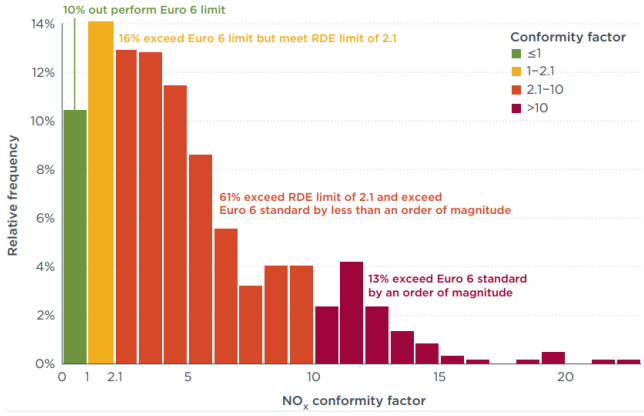

Figure 19. Euro 6 diesel passenger vehicle (RDE) test histogram individual NO_X measurements.

(RDE) procedure is a new on-road emissions test, Academic study influenced with new regulation too, the type of experimental and tests become widely and more parameters introduced in test process method day by day. This will effect economically on project grants and test variation, as the equipment is cost high. Best future suggestion to avoid high cost study, is to cooperation between educational societies to build a shared test center or research center, which will reduce the cost to minimum and make vehicle test regulation available to all researchers for use. Impact of road gradients, (PEMS) trips over different routes implemented in order to investigate the impact of route characteristics on NO_x emissions. With consideration of altitude gain and mean altitude numbers with average values of all conducted trips on each route. Governments defend as political concerned party in case of joining the regulating; a fully technical knowledge about the process already known by researchers for, how to conduct and consultation required for developing the regulating to be suitable for the knowing government country.

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