Feature Article

Trend of Automotive Emission Regulations and Required Measurement Systems in China
中国における自動車排ガス規制と計測設備要求

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It is quite important to understand the latest trend of automotive industry in China, whose economy is growing up so fast in 21st century, from both environmental and business point of view. In China, environmental concern comes to be heightened along with automotive industry growth, and vehicle emission standards have been rapidly established for reducing pollutants. In this movement, emission measurement systems for R&D and/or certification purposes, which contribute to reduce pollutants in engine emissions, are highly demanded. This paper describes the latest trend of automotive industry in China and Chinese emission regulations for light-duty vehicles, heavy-duty vehicles, motorcycles and non-road engines. HORIBA's solution and products are also introduced as required measurement systems for Chinese emission regulations and as appropriate measurement and control systems for R&D of next generation vehicles such as hybrid electric vehicles.

21世紀に入り劇的な経済成長を遂げている中国の自動車産業の最新動向をつかむことは，環境面から，あるいはビジネス面からきわめて重要である。中国では，自動車産業の発展に伴って環境に対する関心も高まり，排ガス低減を目指した法整備が急速に進められた。その中で，排ガス低減を支える研究開発用，認証用排ガス計測設備へのニーズが非常に高まっている。本稿では，中国の自動車産業の最新動向と，乗用車・重量車・二輪車・汎用エンジンの排ガス規制動向に触れる。さらに，中国市場で求められる排ガス認証設備や，ハイブリッド車などの次世代自動車開発を支援する計測・制御ツールとして，HORIBAのソリューション・製品ラインナップを紹介する。

Introduction

After the beginning of this century, the automotive industry in China grew up rapidly with various types of vehicles being produced. This remarkable growth widely influenced many aspects of Chinese industries, such as parts production, service repair, improved infrastructure of roads and gas stations and the build-up of financing services for vehicle sales promotion. As a result, the automotive industry is creating a huge opportunity for employment in China and contributes to the development of the economy and Chinese society. As number of vehicle production grew over 10 million units in 2009, China has established its position in the world as one of the major countries in vehicle production. While the growth in the automobile industry has been successful, other issues have emerged in Chinese industries, such as an imbalance in industrial structure, insufficient technology distribution, slow development capability and a delay in financial enforcement for consumption, promotion and infrastructure improvement. Reduction of air pollutants and Carbon Dioxide (CO2) from vehicles in China is recognized as one of the major issues to be solved. In this article, we summarize the Chinese activities used to promote automotive industry growth and introduce vehicle emission regulations. We outline the requirements for vehicle and engine measurement systems required for emission testing.

Trend of Automotive Industry in China.

Institution of governed promotion project

In March 2009, the Chinese government officially announced a three-year plan to restructure the automotive industry and promote its growth. The plan aims at continuous, constant growth of the automotive industry and describes specific actions for expanding domestic demand through stable automotive consumption while restructuring the industry restructuring and reinforcing the domestic skill necessary for development and improvement throughout all levels of industry.

Outline of the Three-year Plan

This chapter describes clear overview of the three-year plan the Chinese government has for the automotive industry.

Fundamental Strategies

There are four fundamental strategies in the plan that is discussed below.

- Achieve stable economic growth by expanding and boosting domestic consumption of automobiles under with positive financial management policies and maintain the balance between demand and supply.
- Consolidate and enhance technologies by restructure automotive manufacturing as an action to improve automotive performance.
- Raising the level of Research and Development capability and promote the improvement of existing products while also developing new energy efficient vehicles in China.
- Boost both manufacturing and service practices in a coordinated manner by reinforcing financial performance and providing after sales service for consumers in the automotive industry.

Target and Policy

Table 1 shows concrete targets and policies based on the fundamental strategies.

Environmental Protection

The main environmental target the Chinese government seeks to improve is the Direct Injection (DI) 1.5 liter or smaller, gasoline engine. The plan supports Research and Development towards the compliance with the Chinese Stage IV emission standards. These standards are explained later.

Table 1 Target and policy of the three-year plan to adjust and promote the automotive industry

Item	Target	Action
Stable growth of automotive production and sales	- Production and sales in 2009: 1 million or more - An average growth rate from 2009 to 2011: 10% a year	- Increase the budget amount of subsidy when consumers scrap older vehicles. - Arrangement and elimination of irrational regulation on purchasing vehicle, existing in each department of government and locality. - Laying down governance code for revising and arranging loan institution on vehicle purchasing. - Modeling of used-car market by rousing replacing vehicle. - Reforming system of traffic, parking space and parking fee, for traffic jam reduction in urban area.
Improve automotive market structure	- Market share of 1.5 L or below passenger cars: 40% or more - Among above, below 1.0 L models: 15% or more - Market share of heavy-duty trucks: 25% or more	- Reduce the purchase tax on 1.6 L or below passenger cars from 10% to 5%, from January 20 to December 31 in 2009, as a measure to create and boost domestic demand - Provide a certain amount of subsidy, from March to December, to farmers when they purchase motorcycles or 1.3 L or below minivans or scrap tricycles or low-speed trucks to replace them with light-duty trucks.
Promote restructuring of automotive industry	- Automotive manufactures that annually produce and sell 2 million or more vehicles: two or three - Automotive manufactures that annually produce and sell 1 million or more vehicles: four or five - Manufactures in terms of output hold more than 90% share of the market: top ten manufactures	- Reforming support based on action plan for solving problems, such as handling excess personnel, assignment of assets, debt disposal, and distribution of gain and loss. - Foster of R&D and production of new vehicles or main parts through cooperation between automotive manufactures.
Expand the market share of Chinese models; Energy saving, eco-friendliness, safety	- Market share of Chinese models of the passenger car market in China: 40% or more - Export ratio of the production/sales volume of own-brand vehicles: 10% or more - Level of energy saving, eco-friendliness, safety in low-emission cars: world-class level	- Additional 10 billion investment by government, for three years after 2009.
Increase the scale of production and sales of alternative energy vehicles including EV, HEV and FCV	- Annual production capacity of 500,000.	- Finance budget and subsidy issue by government. - Foster adoption of new energy vehicle for public transportation, by local government.

Framework and Trend of Emission Regulations in China

Vehicle and engine emission regulations in China were first published in 1983 and have been rapidly reinforced and enhanced since initially instituted. Especially, after 1998, Chinese emission regulations have followed those in Europe. Euro 1 to 6 for Passenger vehicles and light-duty trucks during these years, and for heavy-duty engines, Euro I to VIs. The Euro 1 equivalent regulation was applied in 2000 for light-duty vehicles the Euro 2 equivalent in 2004 and the Euro 3 equivalent in 2007. "Chinese stage VI", which is equivalent to Euro 4, will be enforced in 2010. Enforcement timing of these regulations is about 5 years later than Europe. The Chinese government however, is expected to accelerate the regulatory process in order to catch up to Europe in near future.

Regulatory emission standards are organized as Chinese national standards published by the China State Bureau of Technical Supervision. The national standards are classified into GB, GB/T and GB/Z according to legal enforcement regulations. Table 2 Shows an example of Chinese GB standards related to emission regulations for mobile sources.

Table 2 GB standards related to emission regulation

No.	Contents (Items)	Remark
GB20998-2007	Motorcycle & Moped, Evaporative Emissions	
GB20891-2007	Non-road engine, Exhaust gas	Stage I, II
BG20890-2007	Heavy duty truck, Emission Durability	
GB19758-2005	Motorcycle & Moped, Smoke	
GB19756-2005	3 wheeled & Low speed vehicle, Exhaust gas	Stage I, II
GB18352.3-2005	Light duty vehicle, Exhaust gas	Stage III, IV
GB18322-2002	3 wheeled & Low speed vehicle, Smoke	
GB18285-2005	Light duty & Heavy duty gasoline vehicle, Idling test	
GB18176-2007	Moped, Exhaust gas	Stage III
GB17691-2005	Heavy duty diesel, vehicle, Exhaust gas	Stage III, IV, V
GB14763-2005	Heavy duty gasoline vehicle, Evaporative Emissions	
GB14762-2008	Heavy duty gasoline vehicle, Exhaust gas	Stage III, IV
GB14622-2007	Motorcycle, Exhaust gas	Stage III
GB14621-2002	Motorcycle & Moped, Idling test	
GB11340-2005	Heavy duty gasoline vehicle, Crank case emission	
GB 3847-2005	Light duty diesel & Heavy duty diesel vehicle, Smoke	

Chinese automotive manufacturers in the past have resisted the enforcement of emission regulations for their vehicles. Ultimately, this resulted in vehicles failing to meet global emission regulations when Chinese manufactures tried to export their vehicles to other countries. Spurred by a sense of crisis over this situation, the Chinese automotive manufacturers have become highly motivated to adapt to the latest emission standards. Aggressive movement of the Chinese EPA to introduce new standards accelerates their actions toward emission regulations moreover as well as special funds for automotive industry has been allocated by the government.

Strong Emission Regulations in China[2, 3]

Passenger Vehicles, Light-duty Trucks

Emission Standards

As mentioned above, emission regulations in China basically follow those in Europe. As nationwide regulations, Chinese Stage III (Euro 3 equivalent) in 2007, Stage IV (Euro 4 equivalent) from July 2010, were applied. In specified major urban areas, enforcement of emission regulations was more accelerated. Typically, in Beijing where the 2008 Olympic Games were held, Stage III regulations were applied for gasoline, LPG/CNG and diesel vehicles in 2005, and Stage IV for gasoline and LPG/CNG vehicles in 2008. In Guangzhou, Stage III was applied for all vehicles in 2006. And in Shanghai, Stage III regulations were applied in 2006 and Stage IV in 2009 for all vehicles.

Table 3 to 6 show limits for Stage III and Stage IV for tail-pipe emissions. The vehicle category for Chinese regulations is the same as European regulations, e.g. M1 (passenger vehicles) and N1 (light-duty trucks).

Table 3 Stage III limits for tail-pipe emissions from passenger vehicles

Vehicle category	CO mass		HC mass		HC+NOx mass		NOx mass		PM mass
Unit	g/km		g/km		g/km		g/km		g/km
Fuel category	G	D	G	D	G	D	G	D	D
M	2.3	0.64	0.20	-	-	0.56	0.15	0.50	0.05

G=gasoline, D=diesel

Table 4 Stage IV limits for tail-pipe emissions from passenger vehicles

Vehicle category	CO mass		HC mass		HC+NOx mass		NOx mass		PM mass
Unit	g/km		g/km		g/km		g/km		g/km
Fuel category	G	D	G	D	G	D	G	D	D
M	1.0	0.50	0.10	-	-	0.30	0.08	0.25	0.025

G=gasoline, D=diesel

Table 5 Stage III limits for tail-pipe emissions from light-duty trucks

Vehicle category		Vehicle mass (RM)	CO mass		HC mass		HC+NOx mass		NOx mass		PM mass
Unit		kg	g/km		g/km		g/km		g/km		g/km
Fuel category			G	D	G	D	G	D	G	D	D
N1	I	RM<1305	2.3	0.64	0.20	-	-	0.56	0.15	0.50	0.05
N1	II	1305<RM<1760	4.17	0.80	0.25	-	-	0.72	0.18	0.65	0.07
N1	III	1760<RM	5.22	0.95	0.29	-	-	0.86	0.21	0.78	0.10

G=gasoline, D=diesel

Table 6 Stage IV limits for tail-pipe emissions from light-duty trucks

Vehicle category		Vehicle mass (RM)	CO mass		HC mass		HC+NOx mass		NOx mass		PM mass
Unit		kg	g/km		g/km		g/km		g/km		g/km
Fuel category			G	D	G	D	G	D	G	D	D
N1	I	RM<1305	1.0	0.50	0.10	-	-	0.30	0.08	0.25	0.025
N1	II	1305<RM<1760	1.81	0.63	0.13	-	-	0.39	0.10	0.33	0.04
N1	III	1760<RM	2.27	0.74	0.16	-	-	0.46	0.11	0.39	0.06

G=gasoline, D=diesel
RM=net vehicle mass

Fuel Consumption Standards

In 2004, the fuel consumption standard for passenger vehicles was published as GB19578-2004, and the Phase I regulation was applied in 2005. Phase II regulations were applied in 2008. Chinese fuel consumption limits in "L/100 km" units are calculated from the measured concentration of Hydrocarbon (HC), Carbon Monoxide (CO), and Carbon Dioxide (CO2) when driving the New European Driving Cycle (NEDC). Table 7 shows the fuel consumption limits for manual transmission passenger vehicles, and Table 8 shows limits for automatic transmission vehicles, mini-vans (MPV), and sport-utility vehicles (SUV). These limits are applied to passenger vehicles whose net-mass is 3500 kg or less. The regulation for light-duty trucks has been separately started based on GB20997-2007.

Heavy-duty Trucks

Emission Standards

Even though the percentage of heavy-duty trucks compared to all vehicles in China is approximately 5%, about 80% of Nitrogen Oxides (NOx) and particulate matter (PM) from vehicles are due to heavy-duty trucks. Therefore, reduction of emission from heavy-duty trucks, especially NOx and PM, is very important. Table 9 shows the schedule for enforcing emission regulations for heavy-duty trucks. Emission limits in Chinese Stage I to V are equivalent to those in Euro I to V respectively. Enforcement of the regulation in Beijing, where air pollution for the Olympic Games was a significant concern, were advanced more quickly compared to remaining China. Similar emission regulation limits were imposed upon light-duty vehicles in anticipation of the Olympic Games.

Table 7 Fuel consumption limits for passenger vehicles (manual transmission type) CM=net mass

Class(CM)	After July 1st 2005	After January 1st 2008
Unit	l/100 km	l/km
CM=<750	7.2	6.2
750<CM=<865	7.2	6.5
865<CM=<980	7.7	7.0
980<CM=<1090	8.3	7.5
1090<CM=<1205	8.9	8.1
1205<CM=<1320	9.5	8.6
1320<CM=<1430	10.1	9.2
1430<CM=<1540	10.7	9.7
1540<CM=<1660	11.3	10.2
1660<CM=<1770	11.9	10.7
1770<CM=<1880	12.4	11.1
1880<CM=<2000	12.8	11.5
2000<CM=<2110	13.2	11.9
2110<CM=<2280	13.7	12.3
2280<CM=<2510	14.6	13.1
2510<CM	15.5	13.9

Table 8 Fuel consumption limits for passenger vehicles (automatic transmission type, MPV and SUV) CM=net mass

Class(CM)	After July 1st 2005	After January 1st 2008
Unit	l/100 km	l/km
CM=<750	7.6	6.6
750<CM=<865	7.6	6.9
865<CM=<980	8.2	7.4
980<CM=<1090	8.8	8.0
1090<CM=<1205	9.4	8.6
1205<CM=<1320	10.1	9.1
1320<CM=<1430	10.7	9.8
1430<CM=<1540	11.3	10.3
1540<CM=<1660	12.0	10.8
1660<CM=<1770	12.6	11.3
1770<CM=<1880	13.1	11.8
1880<CM=<2000	13.6	12.2
2000<CM=<2110	14.0	12.6
2110<CM=<2280	14.5	13.0
2280<CM=<2510	15.5	13.9
2510<CM	16.4	14.7

Note (1): applied on vehicle types which will be newly approved after enforcement of Phase I or Phase II; applied on all newly produced vehicle 1 year later.

Table 9 Emission limits for heavy-duty trucks

Regulation	Applied date	Note
Euro I	September 2000	
Euro II	September 2003 (September 2004)	
Euro III	January 2008	Beijing: December 2005
Euro IV	January 2010	Beijing: January 2008
Euro V	January 2012 (planned)	

Emission tests at Stage I/II were conducted using the 13-Mode Cycle described in the UN/ECE regulation No.49 established by the United Nations as a unified standard or the Chinese 9-Mode Cycle, which is a Chinese, developed test cycle. Stages III to V emission regulations require the application of the European Steady Cycle (ESC[*1]), European Transient Cycle (ETC[*2]) and European Load Response (ELR[*3]) modes for engine emission tests.

*1: "European Steady-state Cycle". 13-Mode Steady-State cycle for heavy-duty trucks. Applied in 2000 by EU directive.

*2: "European Transient Cycle". 1800 seconds transient driving cycle for heavy-duty trucks. Applied in 2000 by EU directive.

*3: "European Load Response". Optical absorption coefficient evaluation test cycle for heavy-duty trucks, using opacimeter. Applied in 2000 by EU directive.

Durability Tests

Current requirements for emission durability performance on heavy-duty trucks are shorter than corresponding European standards.

- Category M2 and gasoline vehicles: 80,000 km or 5 years
- Category M3 (7.5 t or less), category N2, category N3 (16 t or less): 100,000 km or 5 years
- Category M3 (over 7.5 t), category N3 (over 16 t): 250,000 km or 6 years

Motorcycles

Emission Standards

Throughout China, Stage III (Euro III equivalent) emission regulations were applied in 2008 for motorcycles. Table 10 shows the Stage III emission limits for motorcycles. Additionally, in Beijing, the local emission standards for CO of 3.5 g/km and HC+NOx limits of 2 g/km were applied to 2-stroke and 4-stroke motorcycles.

Table 10 Emission standards for motorcycles.

Vehicle category		CO mass	HC mass	NOx mass
Unit		g/km	g/km	g/km
2 wheels	<150 cc (UDC)	2.0	0.8	0.15
	150 cc (UDC+EUDC)=<	2.0	0.3	0.15
3 wheels	All displacement (UDC)	4.0	1.0	0.25

Mopeds*4 are regulated separately according to the GB standard.

*4: a type of low-powered motorcycle typically equipped with bicycle-like pedals.

Durability Tests

Emission durability performance requirements for motorcycles throughout China are 12000 km if the engine is displacement is less than 150 cc. If the engine displacement is greater than 150 cc and has a maximum speed of 130 km/h, the durability requirement is 18000 km. If the motorcycle displacement is greater than 150 cc and has a maximum speed greater than 130 km/h, the durability requirement is 30000 km. The driving cycle is 11 modes, and the target speed is changed according to engine size, i.e. 45 to 70 km/h for mode #1 to #9 and 70, 90, 100 km/h for mode #10 to #11.

In Beijing, the requirements for emission durability performance of motorcycles are 15000 km for 2-stroke or 4-stroke motorcycles. The duty cycle in the UN/ECE Regulation No.40 is used for vehicle emission testing.

Non-road Engines

Emission Standards

Emission standards for non-road engine were published in 2007 as GB20891-2007. Emission limits on Chinese Stage I and II are equivalent to those on European Stage I and II non-road engine regulations. Small diesel engines, which are out of scope in European regulations, are also regulated in China. Emission limits for the small engines are following those in US under the Tier 1/2 standards. Table 11 shows emission limits corresponding to engine ranges.

Table 11 Emission limits for non-road engines (g/kWh)

Rated power	CO mass	HC mass	NOx mass	HC+NOx mas	PM mass
Unit	g/kWh	g/kWh	g/kWh	g/kWh	g/kWh
Stage I: October 2007					
130=<P=<560	5.0	1.3	9.2	-	0.54
75=<P<130	5.0	1.3	9.2	-	0.7
37=<P<75	6.5	1.3	9.2	-	0.85
18=<P<37	8.4	2.1	10.8	-	1.0
8=<P<18	8.4	-	-	12.9	-
0<P<8	12.3	-	-	18.4	-
Stage II: October 2009					
130=<P=<560	3.5	1.0	6.0	-	0.2
75=<P<130	5.0	1.0	6.0	-	0.3
37=<P<75	5.0	1.3	7.0	-	0.4
18=<P<37	5.5	1.5	8.0	-	0.8
8=<P<18	6.6	-	-	9.5	0.8
0<P<8	8.0	-	-	10.5	1.0

Emission testing of non-road engines follows the ISO8178 C1 steady-state cycle. Other duty cycles are applied, according to the application work of the engine.

Requirement for Emission Measurement Systems

Equipment for Emission Certification

Emission certification in China as discussed above has been based on European regulations for both emission limits and test procedures. At present measurement systems that meet corresponding European standards (Euro 1 to 4 or Euro I to IV) are sufficient for only the domestic Chinese market. It is very apparent that stricter regulations like Euro 5/6 will be introduced in the future by China. Therefore the measurement systems must also meet the expected future regulations. For example, the requirements for PM measurement equipment for heavy-duty trucks have partially changed as the regulation level moved from Euro I to VI. Thus, it is necessary to adequately consider equipment specifications for various requirements, such as sample filter diameter, temperature range of sampling point, and the necessity of particulate number measurement when installing a new emission measurement test system.

Regulations in other areas, such as LEV II regulations from the California Air Resources Board (CARB) in US, are being focused upon also. Low-level emission measurement systems required for the CARB LEV II regulations, have been installed at the China EPA Facility in Beijing and the China Automotive Technology and Research Center (CATARC) government-affiliated research facility. Also, as export to US is becoming important to the non-road engine industry, it is considered increasingly critical to install emission measurement systems that meet requirements of 40 CFR Part 1065, which is official test procedure for non-road engines established by the United States Environmental Protection Agency (EPA) .

It is characteristic of the Chinese situation to attempt to take regulations from a wide range of requirements and implement them in short time. From this point of view, for a measurement system to be adopted in China, it is ideal to design system based upon the requirements for Europe and to develop the strong points of the system based upon the requirements for US and Japan in advance.

Equipment for Research and Development

The Sulfur content in fuel in China is higher than that in Japan, Europe or US, therefore, sulfur dioxide (SO2) pollution is becoming a focus point for control. In addition, as regulations become stricter, development of after-treatment devices for NOx and PM emission from diesel engines becomes more important. In the future, demand for emission measurement systems that can support Research and Development for NOx and PM emission control will increase. There are manufactures that are focusing on hybrid electric vehicle (HEV), plug-in hybrid electric vehicle (PHEV) and fuel cell electric vehicle development. Chinese manufacturer BYD as an example demands instruments to measure exhaust emissions and fuel consumption from all these type of vehicles. Thus the demand for equipment to support these requirements will also increase.

Proposed Measurement Systems by HORIBA

Exhaust emission test equipment for certification, requires measurement of other items, such as ambient temperature, ambient humidity, air flow and fuel flow, besides the concentration of gas components CO2, CO, HC, NOx, Particulate mass and smoke opacity related to the amount of soot present in the exhaust. Additionally, for consistent emission testing, various related equipment, such as engine cooling water or intake air conditioner, is necessary to maintain the test environment. Based on experience in Japan, Europe and US, HORIBA is supplying total systems that provide the measurement and control devices to meet the needs of the Chinese market.

Equipments for Emission Certification of Light-duty Vehicle

Light-duty vehicles, such as passenger vehicles, are tested on chassis dynamometers for emission certification. Figure 1 shows an image of typical chassis test cell for diesel vehicles in Europe and US. Test cells in China are also configured in a similar way. HORIBA can configure test cells for gasoline vehicles or for both gasoline and diesel vehicles as well as those for diesel vehicles as shown in Figure 1.

An emission certification cell and, measurement system consists of at least a chassis dynamometer (ECDM-48 series) an emission sampling and analyzing system (MEXA-7000 series, CVS-7000 series), and also PM sampling equipment (full dilution tunnel system) if necessary. In addition to these devices, a driving cycle indicator, so called “drivers aid” (CRSD-7000), is used to show the test driver the speed and time relationship. Automated vehicle driving cycles can be performed with a robot vehicle (ADS-7000) driver system. In order to control all this equipment a vehicle emission test system (VETS series) is often used, to control the test process,

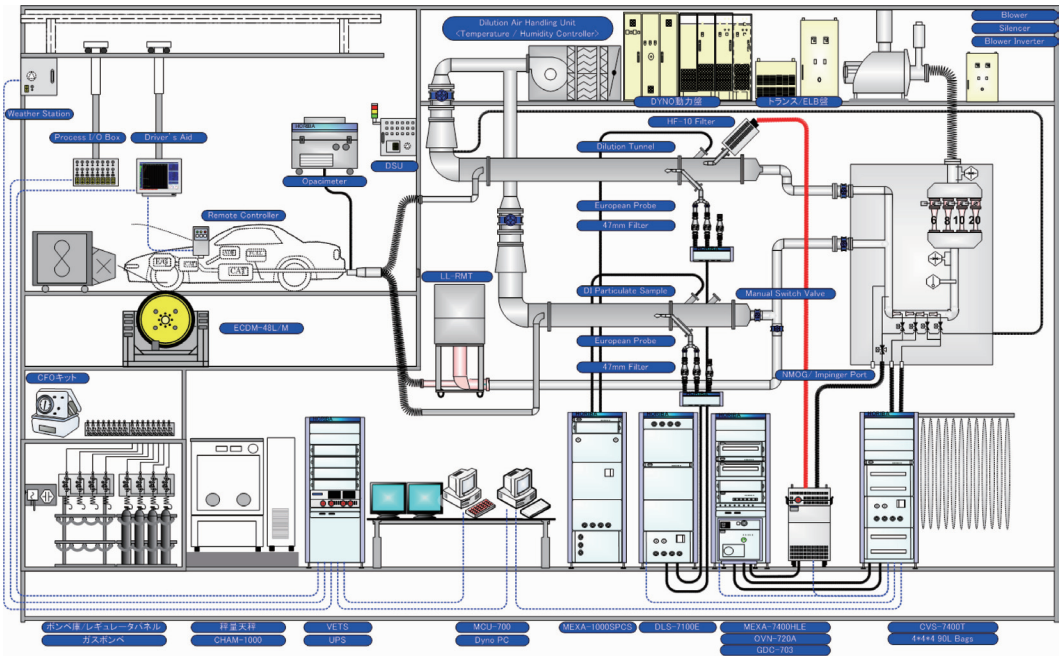

Figure 1 An example of typical chassis test cell for diesel passenger vehicles in Europe and America

calculate emission mass and output formatted report results.

In future test systems, an exhaust particle counting system (MEXA-2000SPCS series) is required to be used on Euro 5 and later tests. The MEXA-2000SPCS series is an instrument for counting solid particles in the engine exhaust. The SPCS uses a CPC (Condensation Particle Counter) as detector, and is used to in a wide range of tests in the form of certification, Research and Development and performance evaluation.

Equipment for Emission Certification of Heavy-duty Engines

Heavy-duty engines and non-road engines are generally tested with engine dynamometers. HORIBA also supplies many pieces of equipment for engine test cells including engine dynamometers, gas sampling and analyzing equipment, and PM measurement devices. An automation system controls all these devices and other instruments that are in the engine test cell. Figure 2 shows an example of a test cell for heavy-duty engines. The measurement system consists of gas sampling and analyzing equipment along with a full-flow exhaust dilution sampling system for PM measurement. Other systems including gas and PM measurement equipment for direct, raw exhaust sampling methods are also available and may be used according to a corresponding regulation and the customers testing needs.

HORIBA's STARS engine test automation system has an application package called HDEET (Heavy-duty Engine Emission Test), which provides a solution by automatically controlling the measurement processes of an emission certification test. Since HDEET executes an automated procedure from pre-test preparation to creation of final reports in emission certification tests for heavy-duty engines and non-road engines, it contributes to improved test results and ultimately saving the customer labor. Using the STARS test system, the customer can to switch to different emission test procedure between European, US and Japanese easily, so that it is applicable in future to emission tests for engines to be exported. HDEET can also execute users original test procedures.

HORIBA's DYNAS3 engine dynamometers provide low inertia, high torque and high response performance, resulting in highly accurate transient test execution.

Application for Next Generation Vehicles

The Chinese government promotes growth of next generation vehicles as a policy, under the basic strategy promoting electric vehicles (EV) for passenger vehicles and diesel vehicles for commercial use from the point of

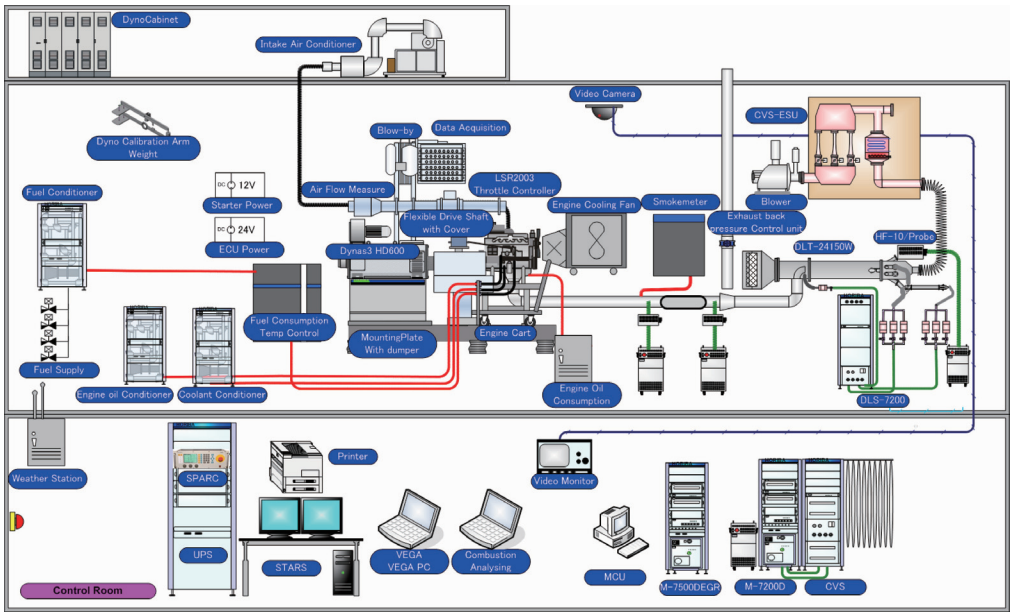

Figure 2 An example of typical engine test cell for heavy-duty engines

view of emission reduction. "Program 863"[*5] and "10 City 1000 project"[*6] were launched by the Chinese government to promote development of HEV, PHEV and FCEV vehicles. HORIBA has been supplying an Electric Motor Test Stand (EMTS) and battery simulator (Virtual Battery), test systems for specific components of these new generation vehicles. Virtual Battery has a function of simulating voltage output from a real battery and also simulates the influence of the charge condition of the battery. Virtual Battery is a very valuable tool for EV development, as it permits over-load testing which is dangerous if using a real battery. The Virtual Battery also reduces the test time as preparation time for charge and discharge of real batteries is eliminated. Furthermore, when Virtual Battery is combined with EMTS a constant DC power level can be supplied as the system consists of a dynamometer and controller eliminating the need of additional power suppliers.

*5: Clean car project promoted from 1990s.

*6: 10 City 1000 project: Framework of launching model operation projects with new energy vehicles for 1000 units scale in more than 10 cities per year, for three years till 2011. At first, it started in Chongqing city (November 27, 2008). As same as Chongqing and Wuhan city, four cities and area, Dalian, Shanghai, Shenzhen city and ChangZhuTan area (Changsha, Zhuzhou, Xiangtan city), are selected as "First stage cities". Beijing, Tianjin and Hangzhou city are selected as "Nominated cities".

Conclusion

This article summarizes vehicle emission regulations in China and systems that HORIBA provides. Even now, the environment surrounding emission regulations in China is changing significantly. When we consider recent global environmental issues, it is quite important from the environmental point of view to contribute to the reduction of vehicle exhaust emissions and contribute to the development of the next generation of vehicles in China which is increasing daily as the economy grows in China. As Chinese manufacturers advance into Europe and US as a large-scale exporter, needs partners who can support them globally. From this aspect, HORIBA believes in the importance of our mission to supply the best optimized solutions, as a leading company of vehicle emission certification systems.

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