The research of the inspection and maintenance program and its implementation

Chongzhi Zhong1,2, Shu Shen1,2,* , Jingyuan Li1,2 , and Zhengjun Yang1,2

1 China Automotive Technology and Research Center Co., Ltd, Tianjin, China
2 CATARC Automotive Test Center (Tianjin) Co., Ltd, Tianjin, China

Keywords: In-use vehicle, Inspection and maintenance program, OBD system inspection.

Abstract. Based on the research and comparison of the main contents and measurement methods for the inspection and Maintenance Program in the United States, the European Union, and China, and the analysis of the OBD inspection in China, it is found that the in-use vehicle measurement method in our country has covered the mainstream measurement methods, however, the overall system design still lacks corresponding standards and technical support for maintenance and closed-loop supervision, the cause of the OBD inspection failure is concentrated the malfunction of the oxygen sensor and three-way catalytic converter.

1 Introduction

In 2019, the total emission of four pollutants from motor vehicles nationwide was initially calculated to be 16.038 million tons, of which carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NOx), and particulate matter (PM) emissions were 7.716 million tons, 1.892 million tons, 6.356 million tons, and 74,000 tons [1], automobiles are the main contributor to total pollutant emissions. To adapt to this change, the focus of automobile emission control has been gradually switched from novice vehicles to in-use vehicles. The key to meeting the emission standards of in-use vehicles is whether the function of the emission control system is sound. If the fault condition can be repaired at the critical point of exceeding the standard, it can avoid the high pollution of the vehicle driving with illness [2], and this mainly depends on the on-board diagnostic(OBD) system. The normal operation of the OBD system of the in-use vehicles can ensure that it is as clean as possible during the lifetime.

The Inspection and Maintenance(I/M) Program refers to that, by regular and irregular emission inspections, supervision and random testing of in-use vehicles, and compulsory maintenance of vehicles that do not meet the standards, so that the vehicles are in good operation condition, thereby reducing pollution. The United States and other countries have

* Corresponding author: shenshu@catarc.ac.cn
taken the implementation of the I/M program as an important means to control the pollution emissions of in-use vehicles, formed and implemented a systematic legal and regulatory system, and achieved remarkable results. In 2001, OBD inspections were included in the I/M program in the U.S, and all states are required to begin to incorporate OBD inspection into the I/M program before 2002\cite{3}. The introduction of OBD into the I/M program has brought the emission management of in-use vehicles into a brand new stage\cite{4}.

In 2018, the Ministry of Ecology and Environment of the People’s Republic of China issued "Limits and measurement methods for emissions from gasoline vehicles under two-speed idle conditions and short driving mode conditions "(GB18285-2018) \cite{5} and "Limits and measurement methods for emissions from diesel vehicles under free acceleration and lugdown cycle"(GB3847-2018) \cite{6}, tighten the in-use vehicle emission standards and increase the OBD inspection, but the difference between Chinese I/M program and the domestic mainstream I/M program And the advantages and disadvantages, as well as the adaptability of OBD inspection still need to be researched.

Based on the investigation and comparison of domestic and foreign I/M program and their implementation, finds reference to our I/M program, and by analyzing and summarizing the failure of OBD inspection, proposing a supervision plan provides support for the implementation of the I/M program.

2 Research on foreign I/M program

Foreign I/M programs are mainly divided into two categories. One is represented by the United States and Canada. Through legislation, standard formulation, scientific quality control, the quality assurance system, and the management mechanism, their I/M program is mainly aimed at the detection and control of emission pollutants emitted by in-use vehicles. By regularly conducting mandatory emissions testing, if vehicles with excessive emissions or vehicles with tampered emission control systems are found, they are ordered to be repaired within a time limit \cite{7}.

The other is represented by the European Union and Japan. In addition to emission testing, the scope of their I/M program also includes safety performance inspections of in-use vehicles. Through regular inspections and maintenance, the power, economy, and safety of vehicles are improved.

2.1 The I/M program and its implementation in the U.S

2.1.1 The I/M program and its implementation in the U.S

In the 1940s and 1950s, the industry and transportation in the U.S developed rapidly. With the widespread use of motor vehicles and the surge in use intensity, air pollution was serious. To improve air quality, the Air Pollutant Control Act was issued in 1955\cite{3}. In 1970, the federal government officially promulgated the "Clean Air Act", and in the same year granted the Environmental Protection Agency (EPA) law enforcement power. In 1997, the amendment act required the establishment of the I/M program in areas where the air was not up to the standard, and in 1990 it required mandatory implementation in specific areas. In 1992, the "Requirements for Vehicle Inspection and Maintenance Program" was issued as the framework of the I/M program, which stipulated the technical and management requirements for emission pollutant limits, testing methods, quality control, and the recall of defective automobile products. In 2001, the OBD inspection was included in the technical report of the I/M program. At the same time, each state formulates its I/M
implementation plans based on requirements and air quality and implements them after approval by EPA.

2.1.2 The main content of the I/M program in the U.S

The EPA takes the lead in carrying out top-level design, supervision and management, and effect evaluation; the Bureau of Automotive Repair (BAR) or the Air Resources Bureau takes the lead in formulating the state implementation plan; the Department of Motor Vehicles (DMV) will cooperate with the EPA to implement the road inspections and check the vehicle registration process. Take the I/M program in California as an example, it mainly includes the following eight aspects:

1. Implement a differentiated I/M system based on the air quality of each state.
2. Carry out classified management for each inspection/maintenance station, and regularly monitor and evaluate the stations. California divides the sites into inspection stations, maintenance stations, inspection and maintenance stations, STAR certification stations (testing stations or inspection and maintenance stations where equipment and personnel meet higher requirements), and arbitration stations (state vehicle emission inspection agencies authorized by the government to provide arbitration, issuing maintenance fee exemption certificates and other services), different sites must meet different licensing conditions and delimit different business scopes.
3. Qualification requirements for inspectors and maintenance personnel.
4. Establish an information management platform for data sharing. The state inspection/maintenance database is connected to the federal central data system. Each state uploads vehicle inspection, maintenance, and equipment quality control data by unified regulations, and regularly submit evaluation reports to the EPA.
5. Establish a strict road inspection, random inspection, and punishment program.
6. Establish a project operation guarantee mechanism. California has established a special fund to subsidize the maintenance costs of stations established by the government and low- and medium-income owners.
7. Require the manufacturers to disclose technical information on maintenance of environmentally friendly devices and provide quality assurance. The federal government requires automobile manufacturers to disclose technical information about environmental protection accessories and provide a corresponding warranty and promotes the use of certified non-original environmental control components to reduce maintenance burden.
8. Test procedures and emission limit requirements.

2.1.3 The inspection methods of the I/M program

The inspection methods of the I/M program are roughly divided into five categories, namely:

1. No-load working condition method: two-speed idle test (TSI), free acceleration test;
2. Acceleration Simulation Mode Test (ASM);
3. IM240 and Vehicle Mass Analysis System (VMAS);
4. Remote sensing Detector (RSD);
5. On-Board Diagnostic System Focused Inspection.

The environmental protection regulations required that since 1996, vehicles should be equipped with OBD systems in stages. And on August 6, 1996, in section 207(b) of the CAA Act, the OBD inspection was formally established as a statutory simple inspection item. On April 5, 2001, the final amendment to the requirements of the OBD inspection
required that from January 1, 2002, the OBD inspection should be added to the I/M program of each state, and considering using the OBD inspection partially or completely replace the exhaust emission test according to its situation[4]. Take the I/M program in California as an example, California has replaced the tailpipe emission test with the OBD inspection, the specific requirements are shown in Table 1 below.

<table>
<thead>
<tr>
<th>Type</th>
<th>Period</th>
<th>Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enhanced</td>
<td>Every 2 years or When Owner Changes</td>
<td>OBD inspection for 2000+ model years vehicles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OBD inspection and ASM for 1996-1999 model years vehicles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ASM for 1976-1996 model years vehicles</td>
</tr>
<tr>
<td>Basic</td>
<td>Every 2 years or When Owner Changes</td>
<td>OBD inspection for 2000+ model years vehicles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>OBD inspection and TSI for 1996-1999 model years vehicles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TSI for 1976-1996 model years vehicles</td>
</tr>
</tbody>
</table>

The I/M program in the U.S was originally applied to gasoline cars and light trucks and later expanded to heavy trucks and motorcycles[8]. California incorporated the OBD inspection of diesel vehicles into the I/M program in 2010, requiring that model years after 1998 be subject to the OBD inspection.

2.2 The I/M program and its implementation in the EU

2.2.1 The history of the I/M program in the EU

In 1977, the European Economic Community formulated and issued the Technical Directive 7/143/EEC-the consistency of the laws of the member states on the road operation suitability test of motor vehicles and their trailers [9]. In 1992, the European Economic Community put forward the requirements for pollutant emission testing of in-use vehicles, covering all the requirements for the safety and emission of in-use vehicles in Directive 92/55/EEC[8].

The European Union promulgated Council Directive 96/96/EC in December 1996, which stipulated the periodic inspection limits for gasoline and diesel vehicles. At the same time, to adapt to the increase in vehicle emission levels, the EU revised the Directive 77/143/EEC in 2001 and 2003[8], tightening the emission limits, and the OBD system is required to be inspected after Euro III.

2.2.2 The main content of the I/M program in the EU

In addition to the emission testing, the I/M program also puts forward requirements for the safety of vehicles. The main contents of the I/M program are as follows:

①In addition to complying with the EU directives, the member states can formulate their laws and regulations based on air quality conditions and management requirements.

②Certification of the inspection stations, the maintenance stations, equipment and inspector, and so on. The Ministry of Transport of the member states is responsible for the annual inspection technology, the certification of the inspection station, and the maintenance station.
③ Test items include emissions, braking, lights, suspension vibration, etc., including both emission inspection and safety inspection.

④ The road inspection procedure in the EU has been established for commercial vehicles.

⑤ Test procedures and emission limit requirements.

Vehicles that do not meet the emission standards must go to a government-approved maintenance station for repairs and re-inspect them within one month in the EU.

2.2.3 The inspection methods of the I/M program

The testing items include emissions, braking, lights, suspension vibration, etc. The emission testing methods are roughly divided into two categories, namely:

① No-load working condition method: two-speed idle test (TSI), free acceleration test;

② On-Board Diagnostic System Focused Inspection.

The OBD inspection was introduced in 2001. Directive 98/69/EC stipulates that "For motor vehicles equipped with OBD systems, the member states can take appropriate methods to read the OBD information to determine whether the vehicle's emission control system is normal, and at the same time check whether the OBD system function is correct. For models equipped with the OBD system, the OBD system inspection method can be used to replace the two-speed idle test." But it is not a mandatory item and can be selected and can replace the idle test. Taking the in-use diesel vehicles as an example, the inspection methods used in the EU are shown in Table 2.

<table>
<thead>
<tr>
<th>State</th>
<th>Methods</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>OBD inspection</td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>free acceleration test</td>
<td>Limit nameplate value</td>
</tr>
<tr>
<td>Italy</td>
<td>OBD inspection</td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>free acceleration test</td>
<td>Limit nameplate value</td>
</tr>
<tr>
<td>Spain</td>
<td>free acceleration test</td>
<td>Limit nameplate value</td>
</tr>
<tr>
<td>Rumania</td>
<td>OBD inspection</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Inspection method for the in-use diesel vehicles in the EU.

3 The I/M program and its implementation in China

3.1 The history of the I/M program in China

In 1983, the standards "Emission standard for pollutants at idle speed from road vehicle with petrol engine" (GB3842-83), "Emission standard for smoke at free acceleration from road vehicle with diesel engine"(GB3843-83) and "Emission standard for smoke at full load from diesel engine of vehicle"(GB3844-83) were issued. In 1993, the Ministry of Ecology and Environment of the People’s Republic of China issued the "Emission standard for smoke at free acceleration from vehicle with diesel engine" (GB14761.6-93), "Emission standard for smoke at full load from diesel engine of vehicle" (GB14761.7-93) and "Emission standard for pollutants at idle speed from vehicle with petrol engine" (GB14761.5-93). To adapt to the development of automobile technology and pollutant detection technology, in 2005, the "Limits and measurement methods for exhaust smoke..."
from C.I.E.(Compression Ignition Engine) and vehicle equipped with C.I.E." (GB3847-2005) and "Limits and measurement methods for exhaust pollutants from vehicle equipped with ignition engine under two-speed idle conditions and simple driving mode conditions" (GB18285-2005) were issued.

With the development of vehicle emission control technology, considering that the above-mentioned standard limits are too wide to reflect the application and development of OBD technology, the new vehicle off-line detection methods need to be revised, and the diesel vehicles lack the detection requirements for NOx. Therefore, in 2018, the Ministry of Ecology and Environment of the People’s Republic of China issued the "Limits and measurement methods for emissions from gasoline vehicles under two-speed idle conditions and short driving mode conditions" (GB18285-2018) [5] and "Limits and measurement methods for emissions from diesel vehicles under free acceleration and lugdown cycle" (GB3847-2018)[6], which added the vehicle appearance inspection, the OBD inspection and stricter pollutant emission limits.

In December 2018, the China Automobile Maintenance and Repair Trade Association issued the "Technical conditions for the establishment of vehicle emission maintenance stations"(T/CAMRA 010-2018), which stipulated the requirements for the classification, personnel, and equipment conditions of maintenance stations, but the effect is not obvious.

In April 2020, the Ministry of Ecology and Environment of the People’s Republic of China issued the "Notice on establishing and implementing the inspection and maintenance program" to promote the strengthening of I/M supervision and management and closed-loop supervision.

3.2 The main content of the I/M program in China

From the history of the I/M program above, it can be seen that the I/M program in China has formed a relatively complete system for the detection of in-use vehicles, but due to the imperfection of the upper-level law, and still, a lack of feasible standards, technology, and legal support, the maintenance of in-use vehicles and the closed-loop supervision are still weak. The main content of the existing I/M program:

① Differentiated standards, pollutant emission limit values a and b, which can be selected according to the air quality control situation in various cities.
② The inspection content and methods of supervision and sampling, and remote sensing detection methods.
③ The Appearance inspection, OBD inspection, test procedures, and emission limit requirements under the new car off-line inspection, in-use vehicle inspection, registration inspection, and supervision and random testing, etc.
④ Technical requirements for testing equipment[5][6].

3.3 The inspection methods of the I/M program

The inspection methods of in-use vehicles in China are the same as those in the U.S, which is roughly divided into 6 categories as follows, the difference lies in diesel vehicles, China has adopted the lugdown cycle:

① No-load working condition method: idle speed method, two-speed idle test(TSI), free acceleration test;
② Acceleration Simulation Mode Test (ASM);
③ Vehicle Mass Analysis System (VMAS) ;
④ LUGDOWN cycle;
⑤ Remote sensing Detector (RSD);
3.4 The analysis of the OBD inspection results

3.4.1 The procedure of the OBD inspection

Concerning the OBD inspection content of in-use vehicles in the U.S, the standard "Technical specification for on-board diagnostic(OBD) system of compression ignition and gas fuelled positive ignition engines of vehicles" (HJ 437-2008)[10] and "Technical specification for on-board diagnostic system of light vehicles" (HJ500-2009)[11], the standard GB3847-2018 and GB18285-2018 stipulate the main content of the OBD inspection include: malfunction indicator lamp (MIL), MIL status, communication test, and the readiness code. The steps are as follows:

1) Enter the vehicle information and lock the vehicle being inspected.
2) Locate the data link connector (DLC) of the vehicle, and plug the general diagnostic instrument into the connector.
3) Turn the vehicle's ignition switch to the "ON", but do not start the engine, the indicator lamps on the instrument panel perform self-checking, and observe the status of MIL, the MIL should illuminate. If the MIL doesn't illuminate, judge failure.
4) Start the engine, turn on the general diagnostic instrument, and automatically establish communication with the vehicle, the MIL should extinguish. If the MIL illuminates continuously, judge failure; If the communication can't be established with the OBD system, and the general diagnostic instrument is functional, and this model has a successful case of communication in the database, judge failure.
5) Use the fast inspection function of the general diagnostic instrument, without manual operation, read the diagnostic trouble codes (DTCs), MIL status, readiness code, fault mileage, and other information, the diagnostic instrument will automatically output the inspection results, and output the inspection results to the computer. If the MIL status read by the general diagnostic instrument is not the same as the status observed on the instrument panel, judge failure; if the minimum required readiness coeds aren't set to “Ready”, judge rejection, the owners should be required to re-inspect after fully driving.
6) Turn off the ignition switch and disconnect the general diagnostic instrument[5][6].

3.4.2 The analysis of the OBD inspection

3.4.2.1 The analysis of OBD communication success rate

A total of 1011 in-use vehicles were tested in this round in China, including 79 diesel vehicles and 931 gasoline vehicles. The OBD inspection was tested with two types of general diagnostic instruments. Using general diagnostic instrument 1, 62 diesel vehicles successfully communicated, 17 vehicles failed, the communication success rate was 78.48%; 829 vehicles gasoline vehicles successfully communicated, and 102 vehicles failed, with a communication success rate of 89.04%. Using general diagnostic instrument 2, 62 diesel vehicles successfully communicated and 17 vehicles failed, with a communication success rate of 78.48%; gasoline vehicles successfully communicated with 843 vehicles and 88 vehicles failed, with a communication success rate of 90.55%. As shown in Figure 1 below. It can be seen that the communication success rate of gasoline vehicles is higher than that of diesel vehicles, which may cause by the development of OBD technology of diesel vehicles lags behind that of gasoline vehicles.

The main reasons for communication problem are found: 1) the difference in the general diagnostic instrument, the inapplicability of communication protocol, and instability of the
program will cause communication failure; 2) there are problems with the OBD system of
the vehicle, such as the OBD interface pin position error, the damaged OBD interface or the
software not upgraded.

![Fig. 1. The analysis of OBD communication success rate.](image)

It’s found that a total of 88 gasoline vehicles from 19 brands were failed in establishing
communication. The number of vehicles that failed to communicate with different brands is
shown in Figure 2 below. It can be seen that a relatively large proportion of vehicles failed
to communicate with individual brands.

![Fig. 2. Statistics of communication failure vehicles of different brand.](image)

3.4.2.2 The analysis of the reasons for the OBD inspection failed

As shown in Figure 3 below, there are a total of 11 diesel vehicles that failed the OBD
inspection. The reason for the failure is that the MIL status read by the general diagnostic
instrument is inconsistent with the status visually observed by the dashboard, and existing
DTCs or freeze frame data. A total of 54 gasoline vehicles failed the OBD inspection, of
which 53 were inconsistent with the MIL status read by the general diagnostic instrument
and the status visually observed by the dashboard, the remaining 1 vehicle failed, due to the
number of the readiness code exceeds allowed.

It’s found that the overall failure rate of diesel vehicles is higher than that of gasoline
vehicles, mainly due to the use environment of diesel vehicles is worse, and the failure rate
is generally higher than that of gasoline vehicles. By strengthening the supervision and
timely maintenance of diesel vehicles, it is possible to ensure that diesel vehicles meet the
emission standards and reduce pollutant emissions. For the failure caused by the readiness
code, the OEM can set the working condition curve that can complete the ready state, and
the owner can complete the ready state at the 4S shop.
Fig. 3. The analysis of the reasons for the OBD inspection failed.

3.4.2.3 Typical failure analysis

After analyzing 1011 vehicles, there are 97 vehicles with DTCs or freeze frame data, as shown in Figure 4 below. Among them, the most frequent DTC in order is the P0141 (oxygen sensor heater circuit) and P0420 (catalyst system efficiency below threshold), P0171 (system too lean), P0172 (system too rich), and P0507 (idle air control system RPM higher than expected). The cause of the failure has concentrated on the failure of the oxygen sensor and three-way catalytic converter.

Fig. 4. Typical failure analysis.

3.4.3 Recommendations of the OBD inspection

According to the OBD inspection results calculated by the EPA, the time of the OBD inspection is shorter than the tailpipe testing and easier to repair. It is found that: 1) The communication success rate of the OBD diagnostic instrument is 99% or higher, which can meet the implementation of the inspection items; 2) The most common OBD faults include oxygen sensor, misfire, EGR, and evaporation fault codes; 3) The rate of unqualified with not-ready codes is low.\cite{12,13,14,15,16}

The principle of the OBD inspection is to ensure that high-emission vehicles can be screened out and the owners are notified to repair them in time to reduce pollutant emissions. Compare the results of OBD inspections in the U.S, the main regulatory recommendations are as follows:

1) Strengthen the OBD inspection and management of new vehicles to ensure that the OBD system is normal when the vehicle leaves the factory.

2) Tighten the certification and requirements for the general diagnostic instruments on the market, Increase the communication success rate.
(3) Strengthen the publicity and education of the OBD inspection. It is recommended to popularize the OBD knowledge requirements of the owners and urge the owners to repair and maintain them in time when the MIL is illuminated to ensure the clean use of vehicles.

4 Comparison of the implementation of the I/M program

4.1 Comparison of the main content of the I/M program

The main content and comparison of the I/M program at home and abroad are shown in Table 4 below. The same thing in all countries is that they all stipulate emission testing methods and procedures, road inspection systems, certification requirements for stations, inspector, a maintenance worker, and testing equipment.

The main difference is that the in-use vehicle testing systems in the EU include safety inspections and emission testing, and there are no requirements for the information supervision platform for the time being.

The I/M program in China is currently completely separated from inspection and maintenance, and different departments are responsible. Therefore, certification specifications for data sharing platforms, maintenance technical requirements, and replacement parts are still missing.

<table>
<thead>
<tr>
<th>Table 4. Comparison of the main content of the I/M program.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main items</strong></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
</tbody>
</table>

4.2 Comparison of the inspection methods

The comparison of the inspection methods at home and abroad are shown in Table 3 below. It can be seen that the inspection methods in China have completely covered the current mainstream detection methods.

The emission detection method in China is similar to that of the U.S. The pollutant emission detection is mainly based on the working condition method and supplemented by the no-load working condition method. The main difference is that some areas in the U.S have replaced pollutant emission testing with the OBD inspection. And in the EU, the pollutant emission test is mainly based on the no-load working condition method.

<table>
<thead>
<tr>
<th>Table 3. Comparison of inspection methods for in-use vehicles.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The U.S</strong></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>
5 Conclusion

Based on the research and comparison of the main contents and inspection methods of the I/M program in the United States, the European Union, and China, and the analysis of the OBD inspection in China, it is found that the in-use vehicle measurement method in our country has covered the mainstream measurement methods and is relatively complete. However, the overall system design still lacks corresponding standards and technical support for maintenance and closed-loop supervision. The main contents that need to be improved are as follows:

(1) Improve the I/M program, formulate technical requirements for maintenance station, certification specifications for maintenance staff, certification specifications for non-original environmental control components, etc.

(2) Establish an I/M information management platform to realize the exchange of inspection and maintenance data, the I/M system organic closed-loop supervision, to ensure the thorough maintenance of unqualified vehicles, as well as the coordination and division of labor among various departments, and close cooperation.

(3) Strengthen the regular supervision of the station, form a mechanism for regular evaluation and reporting of the I/M program, and evaluate the implementation effect of the I/M program.

(4) It is recommended to strengthen the inspection of the OBD system of new cars offline, the certification requirements for general diagnostics instrument.

References

5. GB18285-2018. Limits and measurement methods for emissions from gasoline vehicles under two-speed idle conditions and short driving mode conditions [S].
6. GB3847-2018. Limits and measurement methods for emissions from diesel vehicles under free acceleration and lugdown cycle[S].
8. Hongliang Lin. Study on Scheme and Technology of Inspection and Maintenance Program about In-use Vehicle in Xi’an City[D]. Chang’an University,2007

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>IM240/VMAS</td>
<td>√</td>
</tr>
<tr>
<td>4</td>
<td>LUGDOWN</td>
<td>×</td>
</tr>
<tr>
<td>5</td>
<td>OBD</td>
<td>√</td>
</tr>
<tr>
<td>6</td>
<td>RSD</td>
<td>√</td>
</tr>
</tbody>
</table>

3 Road inspection system

4 I/M data sharing platform

2 Differentiated I/M program

5 Test methods and procedures

6 Vehicle safety inspection requirements

7 Certification of stations, inspectors, maintenance staff, and testing equipment, etc.

8 Main items

<table>
<thead>
<tr>
<th>Country</th>
<th>The U.S</th>
<th>EU</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>√</td>
<td>√</td>
<td>×</td>
</tr>
<tr>
<td>2.</td>
<td>×</td>
<td>×</td>
<td>√</td>
</tr>
<tr>
<td>3.</td>
<td>×</td>
<td>×</td>
<td>√</td>
</tr>
<tr>
<td>4.</td>
<td>√</td>
<td>√</td>
<td>×</td>
</tr>
<tr>
<td>5.</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>6.</td>
<td>RSD</td>
<td>√</td>
<td>×</td>
</tr>
<tr>
<td>7.</td>
<td>IM240/VMAS</td>
<td>√</td>
<td>×</td>
</tr>
<tr>
<td>8.</td>
<td>LUGDOWN</td>
<td>×</td>
<td>×</td>
</tr>
<tr>
<td>9.</td>
<td>OBD</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>10.</td>
<td>RSD</td>
<td>√</td>
<td>×</td>
</tr>
</tbody>
</table>
11. HJ 500-2009..Technical specification for on-board diagnostic system of light vehicles[S].