中汽中心

基于多支柱法的自动驾驶测试验证研究
Research on Test of Automated Driving System (ADS) Based on Multi pillar Method

CATARC

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中汽中心

整体内容介绍
Overall content introduction

中汽中心在中国国内推动自动驾驶标准制定以及测试验证工作的研究。目前研究的自动驾驶相关标准包括以下内容：
The CATARC is promoting research on the development of automated driving standards and testing verification in China. In China, the current ADS related standards include the following:

标准①
Standard ①
GB/T《智能网联汽车 自动驾驶系统通用技术要求》
GB/T《Intelligent and connected vehicle—**General technical requirements** for automated driving system》

标准②
Standard ②
GB/T《智能网联汽车 自动驾驶功能仿真试验方法及要求》
GB/T《Intelligent and connected vehicles——**Virtual testing methods** and requirements for automated driving functions》

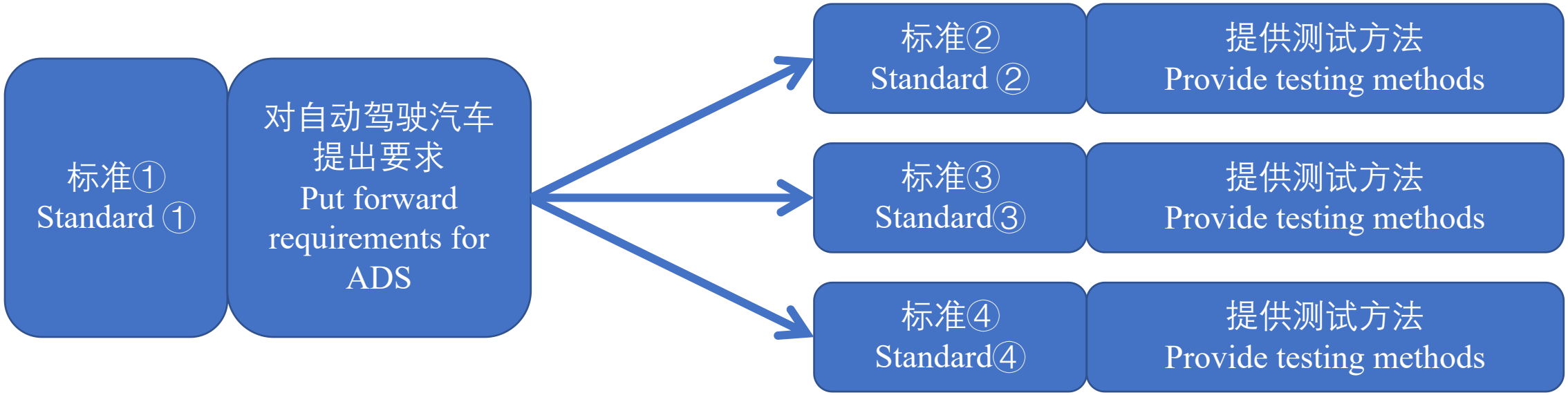
标准③
Standard ③
GB/T 41798-2022《智能网联汽车 自动驾驶功能场地试验方法及要求》
GB/T 41798-2022《Intelligent and connected vehicles——**Track testing methods** and requirements for automated driving functions》

标准④
Standard ④
GB/T《智能网联汽车 自动驾驶功能道路试验方法及要求》
GB/T《Intelligent and connected vehicle——**Real world testing methods** and requirements for automated driving functions》

整体内容介绍
Overall content introduction

根据标准①中对自动驾驶汽车提出的技术要求，使用标准②③④中提出的测试方法对自动驾驶汽车功能进行测试验证。从而实现利用多支柱方法对自动驾驶汽车进行测试验证评估。

According to the technical requirements for ADS in Standard ①, test and verify the functions of autonomous vehicle using the test methods in Standard ② ③ ④. Therefore, the Multi Pillar method can be used to test, verify and evaluate the autonomous vehicle.



多支柱标准状态
Multi pillar standards status

①GB/T《智能网联汽车 自动驾驶系统通用技术要求》
GB/T《Intelligent and connected vehicle—General technical requirements for automated driving system》
状态：正在研究过程中，已经形成标准稿件，还没有发布。
Status: In the process of research, a standard manuscript has been formed and has not been published yet.

②GB/T《智能网联汽车 自动驾驶功能仿真试验方法及要求》
GB/T《Intelligent and connected vehicles——Virtual testing methods and requirements for automated driving functions》
状态：正在研究过程中，已经形成标准稿件，还没有发布。
Status: In the process of research, a standard manuscript has been formed and has not been published yet.

③GB/T 41798-2022《智能网联汽车 自动驾驶功能场地试验方法及要求》
GB/T 41798-2022《Intelligent and connected vehicles——Track testing methods and requirements for automated driving functions》
状态：2022年12月，已经作为国家推荐性标准完成发布。
Status: In December 2022, it has been **published** as a national recommended standard of China.

④GB/T《智能网联汽车 自动驾驶功能道路试验方法及要求》
GB/T《Intelligent and connected vehicle——Real world testing methods and requirements for automated driving functions》
状态：正在研究过程中，已经形成标准稿件，还没有发布。
Status: In the process of research, a standard manuscript has been formed and has not been published yet.

中国自动驾驶汽车功能调研
Research on the Functions of autonomous vehicle in China

1. 我们调研了17家车企和自动驾驶供应商，其中13家企业的产品具备高速或城市快速路通行功能。少数产品具备城市同行功能。

We surveyed 17 OEMs and ADS solution suppliers, most companies have ADS products for highway scenario, A few companies have ADS products for urban scenario.

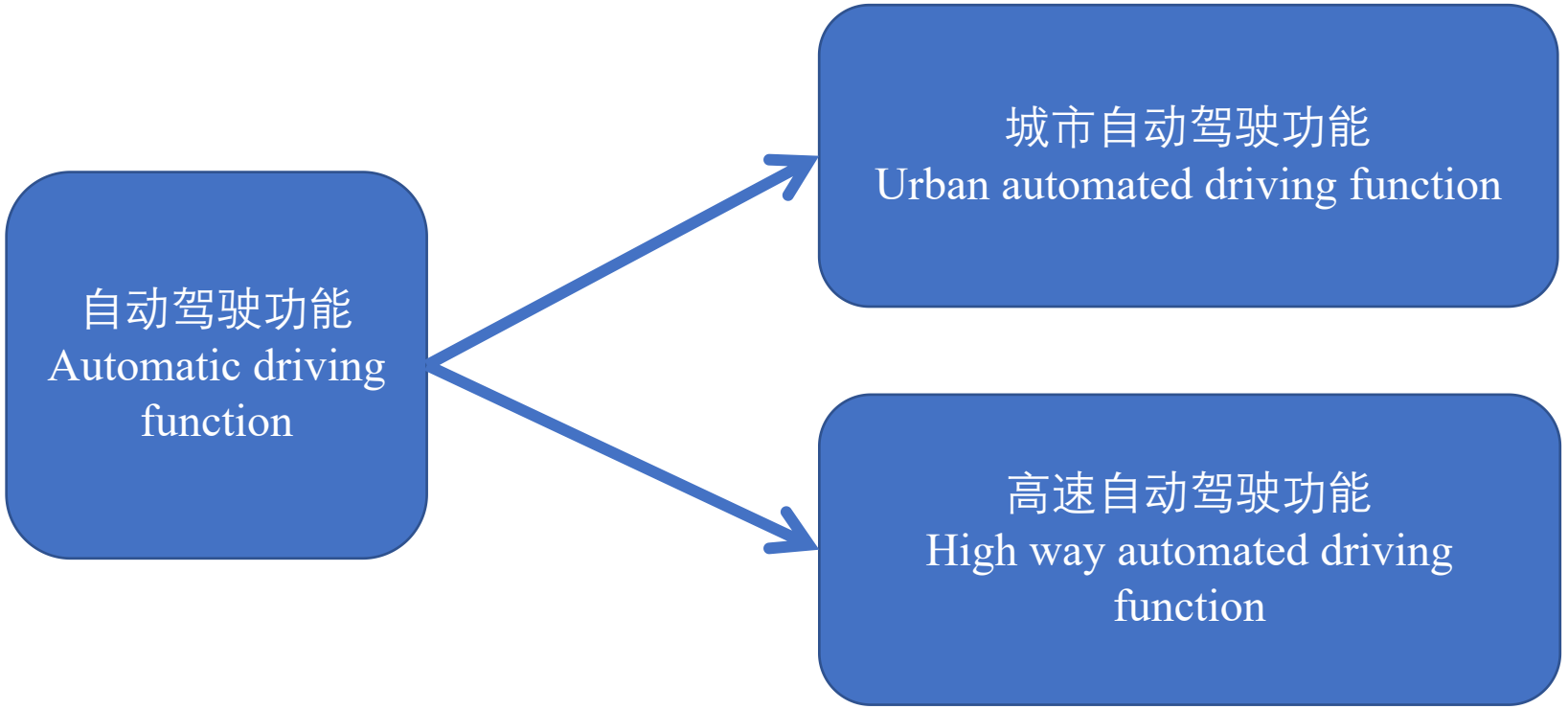
2. 本次调研内容中的自动驾驶厂家产品主要分为三类：

“适用于高速、类高速及一般城市道路的自动驾驶功能”
“适用于全速范围的高速、类高速道路的自动驾驶产品”
“适用于交通拥堵环境的高速、类高速道路的自动驾驶产品”。

In this survey, products are mainly divided into three categories:

- "ADS product suitable for highway traffic jam scenario"
- "ADS product suitable for highway scenario"
- "ADS product suitable for highway and urban scenario"

自动驾驶功能分类
Classification of autonomous driving functions



我们形成了两个研究小组，分别对城市自动驾驶功能和高速自动驾驶功能测试验证开展研究。
We have formed two research groups to conduct research on the testing and verification of urban and highway automated driving function, respectively.

技术要求与测试方法的对应关系
The corresponding relation between technical requirements standard and test methods standards

标准①提出技术要求
Standard ① proposes technical requirements

标准②提供仿真测试方法
Standard ② provides Vitual testing methods

标准③提供场地测试方法
Standard ③provides Track testing methods

标准④提供场地测试方法
Standard ④ provides Real world testing methods

序号 Serial Number	GB/T《智能网联汽车自动驾驶系统通用技术要求》要求条款Requirements of GB/T《Intelligent and connected vehicle—General technical requirements for automated driving system》	GB/T《智能网联汽车自动驾驶功能仿真试验方法及要求》试验项目Test Item of GB/T《Intelligent and connected vehicles——Virtual testing methods and requirements for automated driving functions》	GB/T 41798-2022《智能网联汽车自动驾驶功能封闭场地试验方法及要求》试验项目Test Item of GB/T 41798-2022《Intelligent and connected vehicles——Track testing methods and requirements for automated driving functions》	GB/T《智能网联汽车自动驾驶功能道路试验方法及要求》试验项目Test Item of GB/T《Intelligent and connected vehicle——Real world testing methods and requirements for automated driving functions》
1	4.1	/	/	/
2	4.2	本标准测试方法及测试场景能够用于验证标准①中对应条款的技术要求。This standard testing method and testing scenario can be used to verify the technical requirements of the corresponding clause in standard ①.	本标准测试方法及测试场景能够用于验证标准①中对应条款的技术要求。This standard testing method and testing scenario can be used to verify the technical requirements of the corresponding clause in standard ①.	本标准测试方法及测试场景能够用于验证标准①中对应条款的技术要求。This standard testing method and testing scenario can be used to verify the technical requirements of the corresponding clause in standard ①.
3	4.3			
4	4.4	——	——	——
… …	… …	… …	… …	… …

标准①中的技术要求条款编号
Technical requirement clause number in standard ①

三个测试方法标准中，可以用来验证标准①中技术要求条款的内容
Among the three testing method standards, it can be used to verify the content of the technical requirements clause in standard ①

不需要进行测试验证的条款
Provisions that do not require testing and verification → /

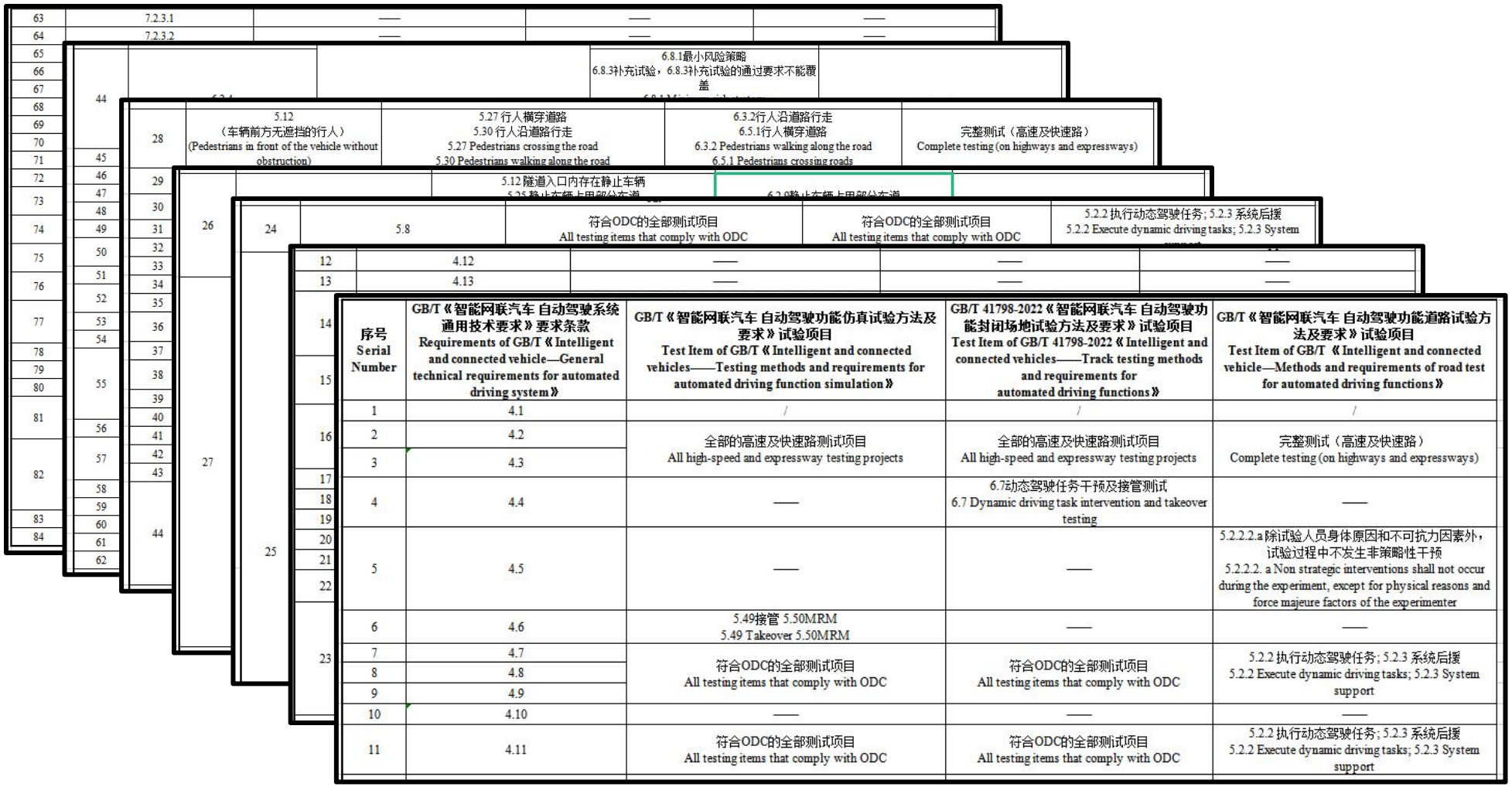
标准中没有相应的验证方法
There is no corresponding validation method in the standard → —

城市自动驾驶功能对应的测试方法
Test method corresponding to urban automated driving function

城市自动驾驶功能测试方法研究成果物
Research results of urban automated driving function test method

序号 Serial Number	GB/T《智能网联汽车自动驾驶系统通用技术要求》要求条款 Requirements of GB/T《Intelligent and connected vehicle—General technical requirements for automated driving system》	GB/T《智能网联汽车自动驾驶功能仿真试验方法及要求》试验项目 Test Item of GB/T《Intelligent and connected vehicles——Testing methods and requirements for automated driving function simulation》	GB/T 41798-2022《智能网联汽车自动驾驶功能封闭场地试验方法及要求》试验项目 Test Item of GB/T 41798-2022《Intelligent and connected vehicles——Track testing methods and requirements for automated driving functions》	GB/T《智能网联汽车自动驾驶功能道路试验方法及要求》试验项目 Test Item of GB/T《Intelligent and connected vehicle—Methods and requirements of road test for automated driving functions》
1	4.1	/	/	/
2	4.2	所有城区道路试验项目 All urban road test projects	所有城区道路试验项目 All urban road test projects	完整测试（城区） Complete testing (urban area)
3	4.3			
4	4.4	——	6.7动态驾驶任务干预及接管测试 6.7 Dynamic driving task intervention and takeover testing	5.2.1 功能激活 5.2.3动态驾驶任务后援 5.2.1 Function activation 5.2.3 Dynamic driving task support
5	4.5	——	——	5.2.2.2.a 除试验人员身体原因和不可抗力因素外，试验过程中不发生非策略性干预 5.2.2.2. a Non strategic interventions shall not occur during the experiment, except for physical reasons and force majeure factors of the experimenter
6	4.6	补充故障注入场景 Supplementary fault injection scenario	——	——
7	4.7	符合ODC的所有城区道路试验项目 All urban road test projects that comply with ODC	符合ODC的所有城区道路试验项目 All urban road test projects that comply with ODC	5.2.2 执行动态驾驶任务； 5.2.3系统后援 5.2.2 Execute dynamic driving tasks; 5.2.3 System support
8	4.8			
9	4.9			
10	4.10	——	——	——
11	4.11	符合ODC的所有城区道路试验项目 All urban road test projects that comply with ODC	符合ODC的所有城区道路试验项目 All urban road test projects that comply with ODC	5.2.2 执行动态驾驶任务; 5.2.3系统后援 5.2.2 Execute dynamic driving tasks; 5.2.3 System support

高速自动驾驶功能对应的测试方法
Test method corresponding to highway automated driving function



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1	4.1	/	/	/
2	4.2	全部的高速及快速路测试项目 All high-speed and expressway testing projects	全部的高速及快速路测试项目 All high-speed and expressway testing projects	完整测试（高速及快速路） Complete testing (on highways and expressways)
3	4.3			
4	4.4	——	6.7动态驾驶任务干预及接管测试 6.7 Dynamic driving task intervention and takeover testing	——
5	4.5	——	——	5.2.2.2.a除试验人员身体原因和不可抗力因素外，试验过程中不发生非策略性干预 5.2.2.2. a Non strategic interventions shall not occur during the experiment, except for physical reasons and force majeure factors of the experimenter
6	4.6	5.49接管 5.50MRM 5.49 Takeover 5.50MRM	——	——
7	4.7	符合ODC的全部测试项目 All testing items that comply with ODC	符合ODC的全部测试项目 All testing items that comply with ODC	5.2.2 执行动态驾驶任务；5.2.3 系统后援 5.2.2 Execute dynamic driving tasks; 5.2.3 System support
8	4.8			
9	4.9			
10	4.10	——	——	——
11	4.11	符合ODC的全部测试项目 All testing items that comply with ODC	符合ODC的全部测试项目 All testing items that comply with ODC	5.2.2 执行动态驾驶任务；5.2.3 系统后援 5.2.2 Execute dynamic driving tasks; 5.2.3 System support

高速自动驾驶功能对应的测试方法研究过程与前面的城市自动驾驶研究基本相似。
The research process of testing methods corresponding to highway automated driving functions is basically similar to the previous research on urban

未来工作计划
Future work plan

- 通过标准②③④的测试方法，能够对标准①提出的一部分技术要求内容进行测试验证。但是测试场景仍然不能满足标准①中提出的所有要求。可以从表格中看出，是存在一些“/”和“—”的。
  Testing scenarios in our multi pillar tandards cannot meet all the technical requirements proposed in standard ①.It can be seen from the table that there are still some symbols like this"/" and "—".

- 后续将根据标准GB/T《智能网联汽车 自动驾驶系统通用技术要求》提出的技术要求。建立一个最小的自动驾驶功能测试验证场景库。这个自动驾驶场景库里面的测试用例，将使用封闭场地、公开道路和仿真的测试方法进行测试。
  A minimum automated driving function test verification scenario catalog will be established.

- 当最小场景库建立以后，将会开展测试用例与测试方法相互匹配的研究工作。
  Researching the matching of test cases and testing methods.