Performance Requirements and Test Methods for Door Locks and Door Retention Components of Vehicles

1 Scope

This Standard specifies the performance requirements and test methods for door locks and door retention components of vehicles.

This Standard applies to the locks and retention components of all the side doors for the entry and exit of people for M_1-type and N_1-type vehicles.

2 Terms and definitions

The following terms and definitions are applicable to this Standard.

2.1 Doors

All the hinged doors and sliding doors at the sides of the M_1-type and N_1-type vehicles that can be opened and closed for the entry and exit of people, excluding folding doors, scrolling doors, and easily mountable/dismountable simple doors.

2.2 Door lock

The mechanism locking the door of the vehicle, including latch, striker, internal and external operation mechanisms and internal and external latching mechanisms.

2.3 Door retention components

Components that permanently connect the doors to the body of the vehicle, including the hinges of the hinged door, the guide rails or other support components of the sliding door.

2.4 Door hinges

The assembly of components connected to the door and body of the vehicle, linked to each other and capable of rotating around the same axis.

2.5 Latch

The component fixed in the door of the vehicle, and engaged with the striker on the doorpost to keep the door locked.

2.6 Striker

The component fixed on the doorpost and engaged with the latch to keep the door of the vehicle locked.

2.7 Full latching

The engagement position of the latch and striker when the door of the vehicle is completely closed.

2.8 Secondary latching

The engagement positions of the latch and striker when the door of the vehicle is not completely closed.

3 Technical requirements

3.1 General requirements

3.1.1 The locks and retention components of all the side doors for the entry and exit of people in M_1-type and N_1-type vehicles shall be designed, manufactured and installed in compliance with

this Standard.

3.1.2 Every set of door locks shall have a full latching. The locks for hinged doors shall also have a secondary latching.

3.1.3 A sliding door without secondary latching, if not at full latching, it shall be able to automatically move to a partly open position that can be easily identified by passengers in the vehicle.

3.1.4 Door locks shall be designed to prevent the door of the vehicle from being opened accidentally.

3.1.5 The door hinge system of the hinged door at the side of the vehicle must be installed at the front edge of the door in the driving direction of the vehicle. For a double-door mechanism, this requirement applies to the door that opens first, while the other door can be latched.

3.2 Performance requirements for door locks

3.2.1 Longitudinal load

The assembly of the latch and striker of the door lock shall be capable of sustaining 4440 N longitudinal loads at secondary latching and 11110 N longitudinal load at full latching, without becoming disengaged in either case.

3.2.2 Lateral load

The assembly of the latch and striker of the door lock shall be capable of sustaining 4440 N lateral at secondary latching and 8890 N lateral load at full latching, without becoming disengaged in either case.

3.2.3 Resistance to inertia

While the latching mechanism is in the unlocked status, the door lock (including the operation unit) shall remain at full latching at the acceleration of 294.2 m/s^2(30g) longitudinally or laterally without becoming disengaged.

3.3 Performance requirements for door hinges

The assembly of a set of door hinges shall be capable of sustaining the door of the vehicle plus 11110 N longitudinal loads and 8890 N lateral loads without becoming disengaged.

3.4 Performance requirements for sliding doors

For sliding doors, when a 8890 N lateral outward force is applied on the opposite sides of the door (17780 N in total), the guiding rails and sliding door assembly or other supporting components shall not become disengaged. The test can be conducted on the vehicle or on a test bench together with the door assembly.

4 Test methods

4.1 General requirements

4.1.1 The clamping fixture for the test shall be rigid enough to prevent the door locks or door hinges from sustaining extra local pressure during the test.

4.1.2 The test piece and the clamping fixture shall be firmly connected to guarantee valid test results.

4.1.3 The test piece shall be connected to the clamping fixture in the same or equivalent way as in normal production or on the vehicle.

4.1.4 The test system shall guarantee the accuracy of loads provided during the entire test: 11110 N ± 112 N and 8890 N ± 89 N.

4.1.5 Loads applied during the entire test shall be recorded continuously, excluding the 890 N weight on the door lock when loads are applied longitudinally.

4.1.6 The tension tester shall apply tension loads not faster than 5 mm/min until the required test load is reached.

4.1.7 A new set of test pieces shall be used for every test.

4.2 Door lock test procedure

4.2.1 Longitudinal load at secondary latching

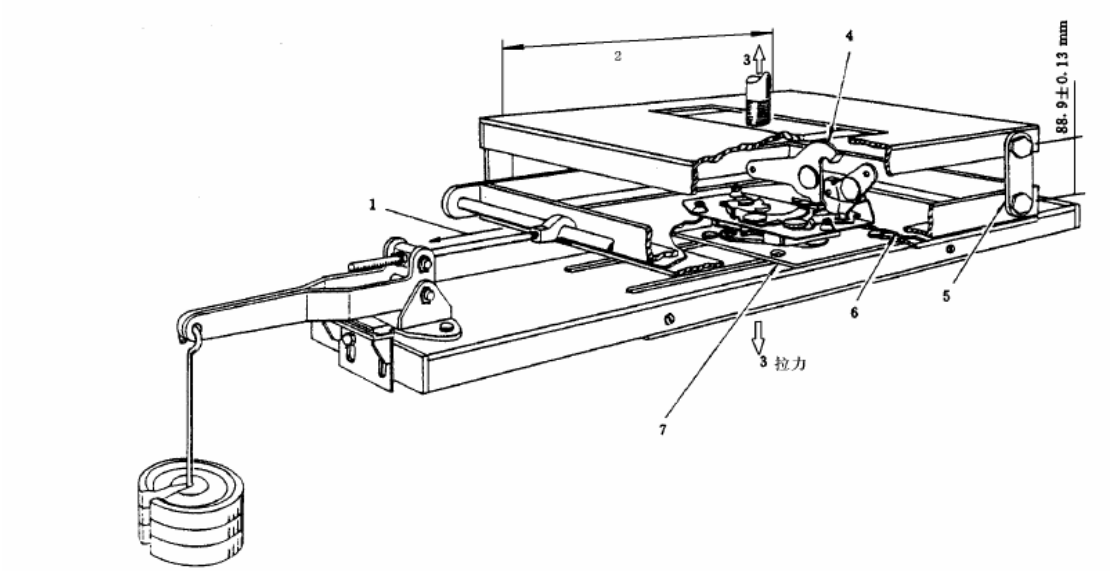
4.2.1.1 Fix the latch and striker on the static longitudinal load clamping fixture, and then fix the clamping fixture on the tension tester as required below: (see Figure 1).

4.2.1.1.1 Let the tension pass the centre of the engagement interface between the latch and striker.

4.2.1.1.2 Make the tension act on the latch and striker in the longitudinal direction of the vehicle.

4.2.1.2 Keep the latch and striker at secondary latching.

4.2.1.3 Apply 890 N load on the latch and striker in the lateral direction of the vehicle, i.e. the direction in which the door is opened.



1-890 N load; 2-distance between axial leads: 203.2 ± 0.13 mm; 3-tension; 4-The test equipment shall match the models of the door lock and striker to be tested; 5-balance connector; 6-interchangeable door lock mounting panel (recommended thickness 3.05 ± 0.25 mm); 7- interchangeable striker mounting panel (recommended thickness 3.05 ± 0.25 mm)

Figure 1 Door Lock–Static Longitudinal Load Clamping Fixture

4.2.2 Longitudinal load at full latching

4.2.2.1 Fix the latch and striker on the static longitudinal load clamping fixture, and then fix the clamping fixture on the tension tester as required below: (see Figure 1).

4.2.2.1.1 Let the tension pass the centre of the engage interface between the latch and striker.

4.2.2.1.2 Make the tension act on the latch and striker in the longitudinal direction of the vehicle.

4.2.2.2 Keep the latch and striker at full latching.

4.2.2.3 Apply 890 N load on the latch and striker in the lateral direction of the vehicle, i.e. the direction in which the door is opened.

4.2.3 Lateral load at secondary latching

4.2.3.1 Fix the latch and striker on the static lateral load clamping fixture, and then fix the clamping fixture on the tension tester as required below: (see Figure 2).

4.2.3.1.1 Let the tension pass the centre of the engage interface between the latch and striker.

4.2.3.1.2 Make the tension act on the latch and striker as horizontally as possible in the direction that the door is opened.

4.2.3.2 Keep the latch and striker at secondary latching.

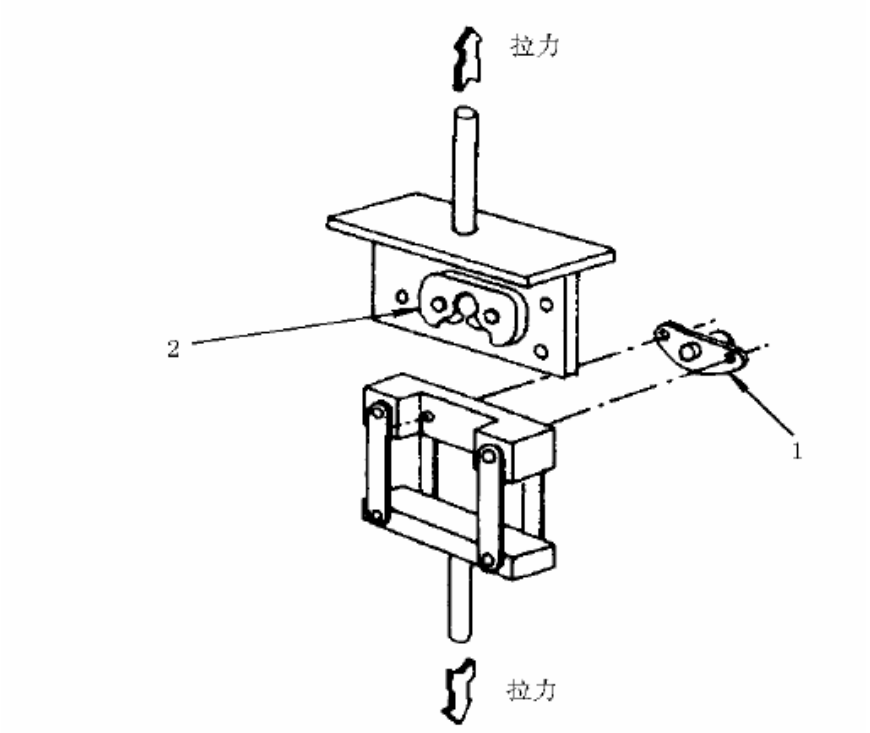
4.2.4 Lateral load at full latching

4.2.4.1 Fix the latch and striker on the static lateral load clamping fixture, and then fix the clamping fixture on the tension tester as required below: (see Figure 2).

4.2.4.1.1 Let the tension pass the centre of the engage interface between the latch and the striker.

4.2.4.1.2 Make the tension act on the latch and striker laterally in the direction the door is opened.

4.2.4.2 Keep the latch and striker at full latching.



1-Striker assembly; 2-Latch assembly

Figure 2 Door Lock Assembly–Static Lateral Load Test Equipment

4.2.5 Methods for measuring the inertia forces of door locks

4.2.5.1 Impact test

4.2.5.1.1 The inertia forces of the door locks may be measured via dynamic tests or calculated by analysis. In a dynamic test, fix the vehicle for testing or simulation structure on the test bench and keep the door lock system at full latching. Apply on the bench an acceleration of 294.2 m/s^2 ~ 353.0 m/s^2 (30g ~ 36g) for at least 30 ms respectively along the longitudinal front direction of the vehicle and along the direction vertical to the above direction in which the door is opened.

4.2.5.1.2 If a latching mechanism (the device keeping the latch and striker at full latching) is installed, keep the mechanism idle during the test.

4.2.5.1.3 The accelerations recorded by the measuring system shall not be too distorted at the frequency range of 100Hz. The permitted distortions are: $60\ ^{+0.5}_{-1}$ HzdB, $100\ ^{+0.5}_{-4}$ HzdB

4.2.5.2 Calculation methods

In calculation, the friction resistance, and the deadweight component force and inertia component force of the door lock members keeping the door lock latched may be ignored. The elastic force shall be the average of the minimum value when the door lock is at full latching and the maximum value when it is opened. In calculation, the latching mechanism of the door lock shall be considered as not functioning. See Appendix A for a sample calculation.

4.3 Door hinge assembly test procedure

4.3.1 Longitudinal load

Fix the door hinge assembly on the clamping fixture when the door is at full latching. (See Figure 3)

4.3.1.1 Integral hinge: The clamping fixture shall be large enough to hold the entire integral hinge as required below:

4.3.1.1.1 The tension action line should perpendicularly bisect the length of the hinge pin joint.

4.3.1.1.2 In applying load, the tension should act almost longitudinally along the vehicle on the hinge assembly.

4.3.1.2 Compound hinge: Fix the hinge assembly on the clamping fixture as required below:

4.3.1.2.1 All hinge pins should be in a straight line to keep the specified longitudinal load on the plane passing the hinge rotating axis and perpendicular to the hinge rotating axis.

4.3.1.2.2 The outer ends of two adjacent hinges should be 406 mm apart. If not, the inner ends of them should be at least 100 mm.

4.3.1.2.3 The tension action line should perpendicularly bisect the connection line between the centres of two outmost hinge pin joints.

4.3.1.2.4 In applying load, the tension should act almost longitudinally along the vehicle on the hinge assembly.

4.3.1.3 A set of door hinge assemblies should be fixed to the clamping fixture as specified above.

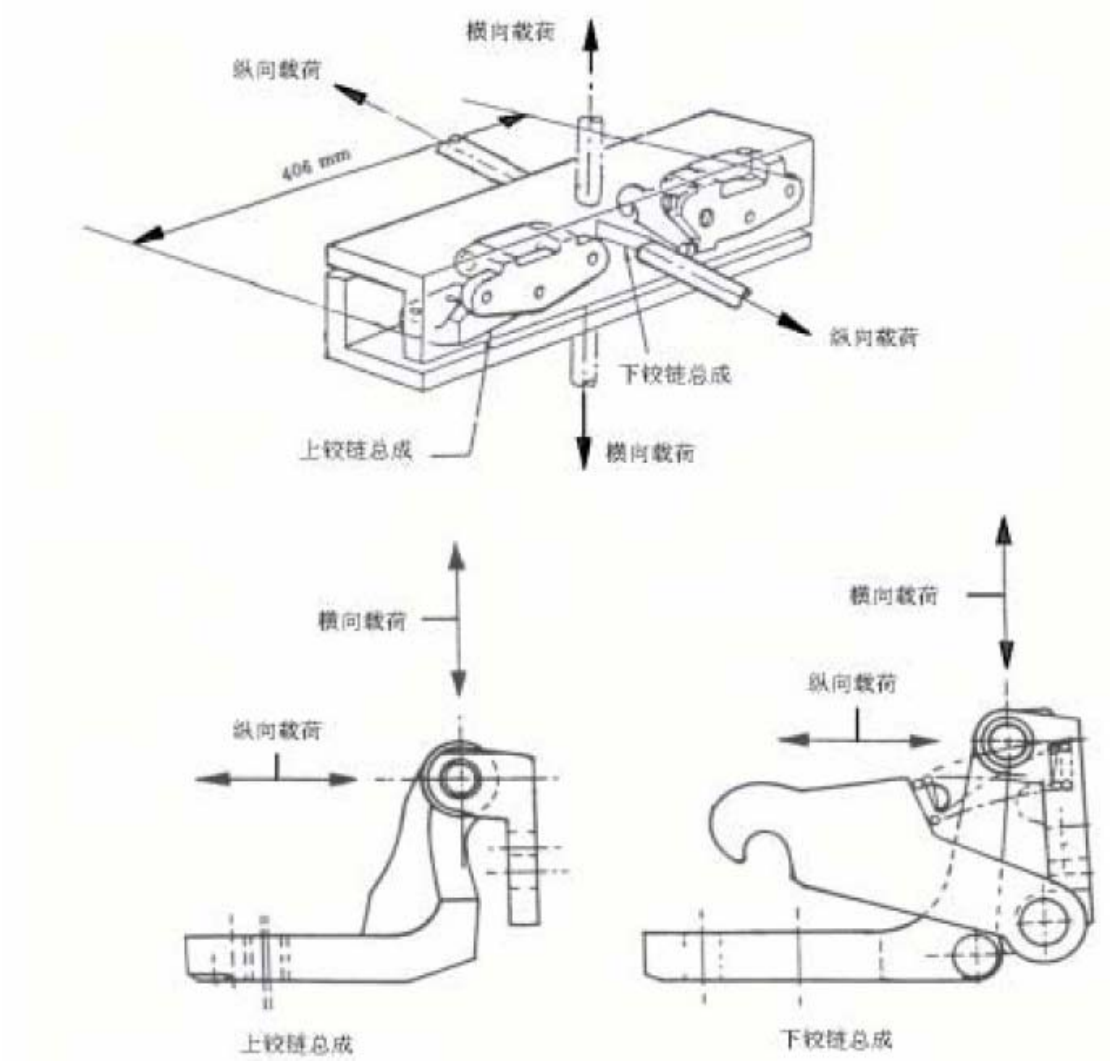


Figure 3 Test Door Hinge System–Static Load Test Device

4.3.2 Lateral load

4.3.2.1 Fix the door hinge assembly on the clamping fixture when the door is closed. (See Figure 3)

4.3.2.2 Integral hinge: The clamping fixture shall be large enough to hold the entire integral hinge as required below:

4.3.2.2.1 The tension action line should perpendicularly bisect the length of the hinge pin joint.

4.3.2.2.2 The stress direction of the hinge assembly shall be near the lateral direction of the vehicle.

4.3.2.3 Compound hinge: Fix the hinge assembly on the clamping fixture as required below.

4.3.2.3.1 All hinge pins should be in a straight line to keep the specified lateral load on the plane passing the hinge rotating axis and perpendicular to the plane and hinge pin axis defined for longitudinal load.

4.3.2.3.2 The outer ends of two adjacent hinges should be 406 mm apart. If not, the inner ends of them should be at least 100 mm.

4.3.2.3.3 The tension action line should perpendicularly bisect the connection line between the centres of the two outmost hinge pin joints.

4.3.2.3.4 In applying load, the tension should act almost laterally to the vehicle on the hinge assembly.

4.3.2.4 A set of door hinge assemblies should be fixed to the clamping fixture as specified above.

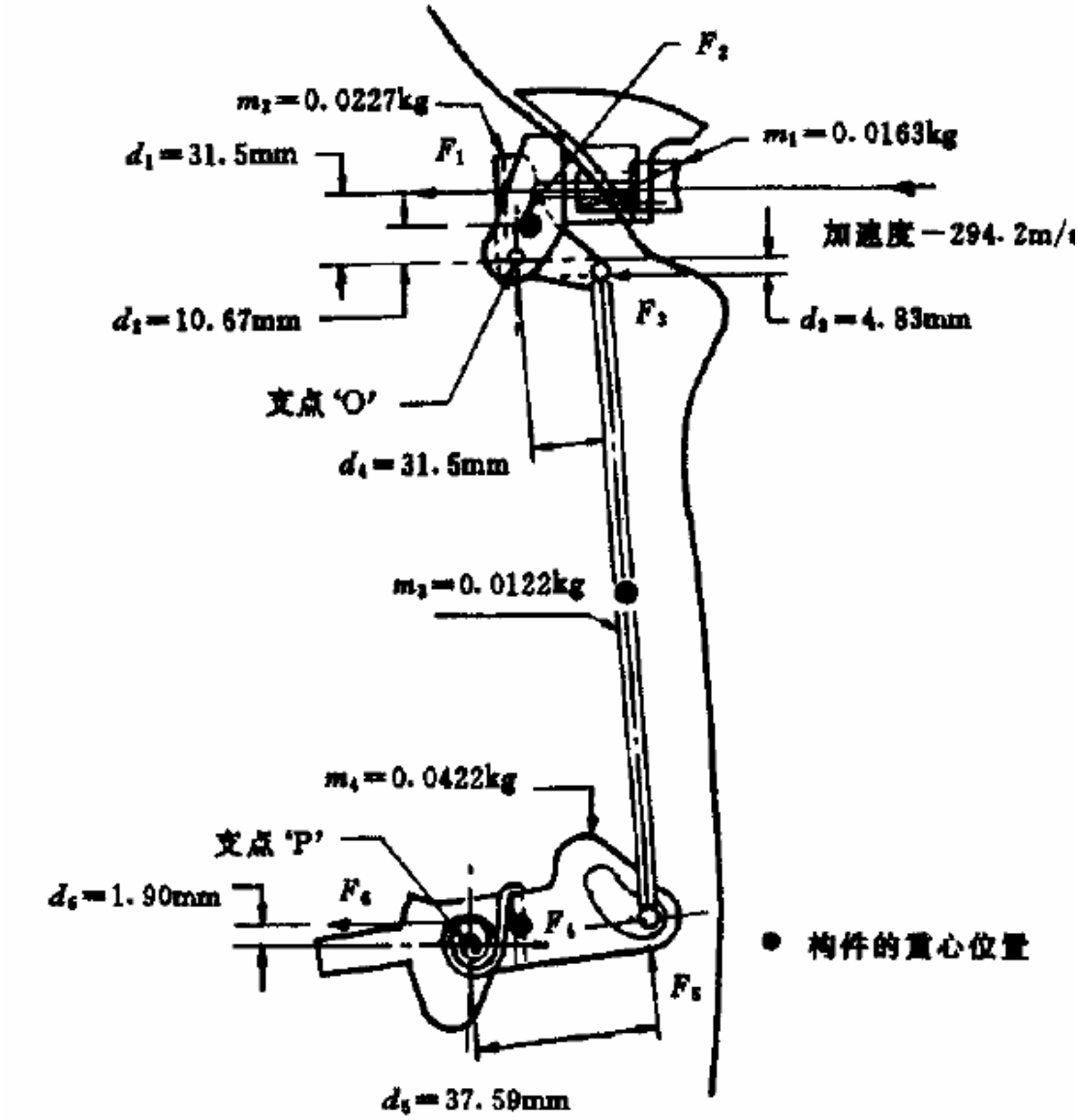
4.4 Sliding door test method

Use a rigid structure to apply a total force of 17780 N on all the joints of the door and members. The force should act outwards on the middle area of the polygon formed by the edges of the joints. This method can be tested in compliance with Clause 3.4 of this Standard.

4.5 Equivalent test method

An equivalent non-destructive test method can be adopted, provided that the results specified in Chapter 3 of this Standard can be obtained, either totally through substitution tests or by calculating the substitution test results. See Appendix A for a sample calculation. Prove the equivalence of the results if the methods used differ from those specified in the aforementioned Clauses 4.2 & 4.3.

Appendix A
(Informative)
Sample Calculation of Inertia Resistance



Given: Action of 294.2 m/s^2 (30g) deceleration on the door lock system, as shown in Figure A1.
Average elastic force of push-button spring, P=4.5 N;
Torque of pawl spring, T=0.45 N.m;
Deceleration: a = 30g = 30 × 9.80655 = 294.2 m/s^2
Mass (kg) m_1 = 0.0163 m^2 = 0.0227
m_3 = 0.0122 m_4 = 0.0422
Distance (mm): d_1 = 31.50 d_2 = 10.67
d_3 = 4.83 d_4 = 31.50
d_5 = 37.60 d_6 = 1.91

Calculation:

$F_1 = m_1 a - P = (0.0163 \times 294.2) - 4.5 = 0.30$ N

$F_2 = m_2a = 0.0227 \times 294.2 = 6.68$ N

$F_3 = m_3a/2 = (0.0122 \times 294.2)/2 = 1.80$ N

$\Sigma M_0 = F_1d_1 + F_2d_2 - F_3d_3 = 0.3 \times 31.5 + 6.68 \times 10.67 - 1.80 \times 4.83 = 72.04$ N.m

$F_5 = \Sigma M_0/d_4 = 72.04/31.05 = 2.29$ N

$F_6 = m_4a = 0.0422 \times 294.2 = 12.42$ N

$\Sigma M_p = T - (F_5d_5 + F_6d_6)/1000 = 0.45 - (2.30 \times 37.6 + 12.40 \times 1.91)/1000 = 0.34$ N.m

Conclusion: The calculation results show that the torque of the spring ΣM_p is greater than 0, indicating that the door locks can remain at full latching under the action of 294.2 m/s^2 (30g) deceleration.

Appendix B
(Informative)
Cross-Reference Between the Numbering of Chapters and Clauses
In this Section and that in ECE R11

Table B.1 provides cross-reference between the numbering of chapters and clauses in this section and that in ECE R11

Table B.1 Cross-Reference Between the Numbering of Chapters and Clauses in this Section and that in ECE R11

Numbering of Chapters and Clauses in This Section	Numbering of Chapters and Clauses ECE R11
3	5
3.1	5.1
3.2	5.2
3.3	5.3
3.4	5.4
4	Appendix
4.1	1
4.2	3
4.3	2
4.4	2.2.5
4.5	4