Attachment 17

TECHNICAL STANDARD FOR FUEL LEAKAGE IN COLLISIONS, ETC.

1. Scope

This standard shall apply to the fuel tanks and fuel lines (gas containers, piping, and other devices on the hydrogen gas flow passage in the case of motor vehicles fueled by compressed hydrogen gas. Hereinafter the same.) of ordinary-sized motor vehicles exclusively for carriage of passengers, small-sized motor vehicles or mini-sized motor vehicles (except motor vehicles with a passenger capacity of 11 persons or more, motor vehicles with a gross vehicle weight of more than 2.8 tons, motor cycles with or without sidecars and mini-sized motor vehicles with caterpillar tracks and sleds).

2. Definitions

Those terms that appear in this technical standard have been defined as follows.

2–1 The “barrier” means a wall surface, against which a test vehicle is collided during frontal-impact tests.

2–2 The “impactor” means an impacting element which is collided against the rear-end of a test vehicle during rear-end impact tests.

3. Test procedure

3–1 Frontal-collision test

3–1–1 Test equipment

3–1–1–1 Barrier

The barrier shall be built of iron-reinforced concrete. Moreover, it shall be so constructed that it has sufficient weight and structure capable of withstanding the impacts caused by the test vehicle collision. The barrier face shall be 1.5 m or more in height and 3 m or more in width and right angle to the final approach path. In addition, the final approach path shall be flat and horizontal from the impacting surface of the barrier to a point about 5 m in front of the impacting surface.

Furthermore, the barrier frontal face shall be covered with about 20 mm-thick plywood board.

Moreover, it is permissible to install a steel sheet for the purpose of protecting the barrier or a load meter between the barrier and the plywood board.

3–1–2 Test vehicle conditions

3–1–2–1 The weight of the test vehicle shall be equivalent to or more than the vehicle weight. However, in the case of a motor vehicle equipped with spare tire and tools, etc., the test may be conducted with these accessories attached on the test vehicle.

3–1–2–2 As for those parts mounted on the test vehicle, it is permissible to use those other than genuine parts or to remove them, except for those parts with the possibility of interfering with the fuel tank and fuel line.

3–1–2–3 A fuel substitute liquid shall be used. This shall have such viscosity and specific gravity similar to those of the fuel used. In the case of motor vehicles fueled by compressed hydrogen gas, helium shall be used as substitute gas.

3–1–2–4 The fuel level of the fuel tank shall not be less than 90% of the rated fuel tank capacity. In the case of motor vehicles fueled by compressed hydrogen gas, the gas tank shall be filled with helium to 90% or more of the general-use pressure (referring to the general-use pressure in Paragraph 2–4 of Attachment 100 “Technical Standard for Fuel Systems of Motor Vehicles Fueled by Compressed Hydrogen Gas”).

3–1–2–5 It is permissible for systems other than the fuel tank and fuel lines to be empty.

3–1–2–6 In the case of motor vehicles fueled by compressed hydrogen gas, the main stop valve of the test vehicle and cutoff valves, etc. located in the downstream piping shall be kept open, immediately prior to the collision.

3–1–2–7 In the case of motor vehicles fueled by compressed hydrogen gas, without a system to close the main stop valve and other valves automatically at the time of the collision to shut off the fuel supply, the main stop valve and other valves shall be opened immediately if these valves are closed after the collision.

3–1–2–8 Motor vehicles fueled by compressed hydrogen gas, with a system

to close the main stop valve and other valves automatically at the time of the collision to shut off the fuel supply may be set in such a way that this system operates. In cases where the measurement of the pressure inside the gas container is interfered due to the fact that any valve is closed after the collision, it shall be opened when the pressure is measured, or a pressure sensor or a temperature sensor for the measurement shall be attached, as required.

3–1–3 Test procedure

The test vehicle shall be collided head-on against the frontal surface of the barrier at a speed of 50 ± 2 km/h. In this case, the lateral deviation between the median longitudinal plane of the test vehicle struck and the median plane of the barrier shall not exceed 300 mm. Also, measure the amount of fuel flowing out or dripping from various parts of the test vehicle to the outside. This measurement of the amount of fuel leakage shall be started as soon after the collision as possible and shall be performed for a period of 5 minutes. In the case of motor vehicles fueled by compressed hydrogen gas, the pressure and temperature of the gas shall be measured inside the gas container or at the upstream of the first pressure-reducing valve located downstream of the gas container, immediately before the collision and 60 minutes after the collision.

3–2 Rear-end collision test

3–2–1 Test equipment

3–2–1–1 Testing ground

The road surface on which the collision of the test vehicle and its movement take place shall be a dry, horizontal, flat paved road surface.

3–2–1–2 Impactor

The impactor shall be of steel and be of rigid construction. The impacting surface shall be flat. It shall measure at least at 800 mm in height and at least 2.5 m in width. Furthermore, its edges shall be rounded to a radius of 50 mm or less. In addition, its front face shall be covered with about 20 mm-thick plywood board. The ground clearance of the lower edge of the impacting surface shall be 175 ± 25 mm.

The impactor may either be secured to a carriage moving straight using the installation method prescribed in Paragraph 3–2–1–2–1 or be attached to a pendulum using the installation method prescribed in Paragraph 3–2–1–2–2.

3–2–1–2–1 Requirements for use of carriage

(1) The carriage shall have adequate rigidity and shall not be deformed by the impact.

(2) The carriage shall not be restrained during the collision. Moreover, upon completion of the collision, the carriage shall no longer have any further propelling force. The carriage may be equipped with a braking device to prevent re-collision.

(3) The total mass of the carriage and impactor shall be 1,100 ± 20 kg.

3–2–1–2–2 Requirements for use of pendulum

(1) The pendulum and the attached section of the pendulum impactor shall have adequate rigidity and shall not be deformed by the impact.

(2) The distance between the centre of the impacting face and the axis of rotation of the pendulum shall be 5 m or more.

(3) The reduced mass "Mr" at the centre of percussion of the pendulum shall be 1,100 ± 20 kg.

"Mr" is calculated by the equation below.

$Mr = M \times L/A$

where:

M : Total mass of pendulum (kg)

L : Distance between the centre of percussion and the axis of rotation (m)

A : Distance between the centre of gravity and the axis of rotation (m)

(4) The pendulum shall be equipped with a braking device to prevent any secondary impact.

3–2–2 Speed measuring equipment

The speed measuring equipment used to measure the speed prescribed in Paragraph 3–2–3 shall be capable of measuring the speed of the impact with an accuracy of within one percent of the true value.

3–2–3 Test vehicle conditions

The same as with Paragraph 3–1–2.

3–2–4 Test procedure

With the test vehicle placed under the stationary state in the testing ground, the impactor shall be collided against the rear-end of the test vehicle horizontally and also in a direction parallel to the median longitudinal plane of the test vehicle at a speed of 50 ± 2 km/h. In this case, the lateral deviation between the median longitudinal plane of the test vehicle struck and the median plane of the impactor shall not exceed 300 mm. Also, measure the amount of fuel flowing out or dripping from various parts of the test vehicle to the outside. This measurement of the amount of fuel leakage shall be started as soon after the collision as possible and shall be performed for a duration of 5 minutes. In the case of motor vehicles fueled by compressed hydrogen gas, the pressure and temperature of the gas shall be measured inside the gas container or at the upstream of the first pressure-reducing valve located downstream of the gas container, immediately before the collision and 60 minutes after the collision.

4. Requirements

When subjected to the test prescribed in paragraphs 3–1 and 3–2 above, the amount of fuel flowing out or dripping from various parts of the test vehicle to the outside shall not exceed 30 g for the first one minute and also shall not exceed 150 g for a period of 5 minutes. In the case of motor vehicles fueled by compressed hydrogen gas, the rate of hydrogen gas leakage measured by the following procedure shall not exceed 131 NL per minute:

(1) The helium gas pressure inside the gas container or at the upstream of the first pressure-reducing valve located downstream of the gas container, immediately before the measured collision and 60 minutes after the collision, shall be converted to the pressure at 0 °C.

$$P_0' = P_0 \times [273 / (273 + T_0)]$$

where:

P_0' : Helium gas pressure converted to pressure at 0 °C immediately before collision is conducted (MPa abs)

P_0 : Measured helium gas pressure immediately before collision is conducted (MPa abs)

T_0 : Measured helium gas temperature immediately before collision is conducted (°C)

$P_{60}' = P_{60} \times [273 / (273 + T_{60})]$

where:

P_{60}' : Helium gas pressure converted to pressure at 0 °C 60 minutes after collision (MPa abs)

P_{60} : Measured helium gas pressure 60 minutes after collision (MPa abs)

T_{60} : Measured helium gas temperature 60 minutes after collision (°C)

(2) The gas density immediately before the collision is conducted and 60 minutes after the collision shall be calculated, respectively, using the pressure at 0 °C converted from the helium gas pressure inside the gas container or at the upstream of the first pressure-reducing valve located downstream of the gas container, immediately before the collision is conducted and 60 minutes after the collision, which have been obtained in Item (1).

$\rho_0 = -0.00621 \times (P_0')^2 + 1.72 \times P_0' + 0.100$

where:

ρ_0 : Helium gas density immediately before collision is conducted (kg/m^3)

$\rho_{60} = -0.00621 \times (P_{60}')^2 + 1.72 \times P_{60}' + 0.100$

where:

ρ_{60} : Helium gas density 60 minutes after collision (kg/m^3)

(3) The helium gas volume immediately before the collision is conducted and 60 minutes after the collision shall be calculated, respectively, using the gas density obtained in Item (2), provided that the internal volume shall be the internal volume of the gas container in cases where the

helium gas pressure has been measured inside the gas container; and the internal volume of the gas container down to the upstream of the first pressure-reducing valve located downstream of the gas container in cases where the helium gas pressure has been measured at the upstream of the first pressure-reducing valve located downstream of the gas container.

$Q_0 = \rho_0 \times V \times (22.4 / 4.00) \times 10^{-3}$

where:

Q_0 : Helium gas volume immediately before collision is conducted (m^3)

V : Internal volume (L)

$Q_{60} = \rho_{60} \times V \times (22.4 / 4.00) \times 10^{-3}$

where:

Q_{60} : Helium gas volume 60 minutes after collision (m^3)

V : Internal volume (L)

(4) The rate of helium gas leakage shall be calculated.

$\Delta Q = (Q_0 - Q_{60}) \times 10^3$

$RHe = \Delta Q / 60$

where:

ΔQ : Volume of helium gas leakage 60 minutes after collision (NL)

RHe : Rate of helium gas leakage (NL/min)

(5) The rate of helium gas leakage shall be converted to the rate of hydrogen gas leakage.

$RH = 1.33 \times RHe$

where:

RH : Rate of hydrogen gas leakage (NL/min)