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اللائحة الفنية الخاصة بدليل التجهيزات والفحص والتشغيل للمركبات التي تعمل
بوقود الغاز الطبيعي المضغوط

Guideline for equipment, testing and operation of vehicles
propelled by Compressed Natural Gas.

دولة الامارات العربية المتحدة
UNITED ARAB EMIRATES

IEC:

تقديم

هيئة الامارات للمواصفات والمقاييس هي الهيئة المسؤولة عن أنشطة التقييس بالدولة ومن مهامها إعداد المواصفات القياسية و اللوائح الفنية الاماراتية بواسطة لجان فنية متخصصة تضم خبراء ومختصين من الجهات المعنية في الدولة. وقد قامت اللجنة الفنية الفرعية لمواصفات استخدام الغاز الطبيعي كوقود للمركبات وبعد الدراسة باقتراح التبني بالمصادقة للائحة المطبقة في الأوروبية:

رقم TUV 757 اللائحة الخاصة بدليل التجهيزات والفحص والتشغيل للمركبات التي تعمل بوقود الغاز الطبيعي المضغوط.

وأقرتها اللجنة الفنية للمواصفات لقطاع المنتجات الميكانيكية وهي موزعة لإبداء الرأي والملاحظات حولها قبل اعتمادها كلائحة فنية اماراتية

Foreword

Emirates Authority for Standardization & Metrology (ESMA) has a national responsibility for standardization activities in UAE. One of ESMA main functions is to issue Emirates Standards /Technical regulations through specialized technical committees.

ESMA sub committee for Standardization the project of using CNG as fuel for vehicles had recommended the adoption of the

Regulation used in European region:

TUV 575 "Guideline for equipment, testing and operation of vehicles propelled by Compressed Natural Gas"

ESMA/TC5" for standardization of Mechanical Products" had approved it.

This Regulation distributing for notes and recommendations.

Pressure Equipment Automotive-VdTUV 757

Guideline for equipment, testing and operation of vehicles propelled by Compressed Natural Gas

This guideline serves as a working document for legally approved technical experts. It contains all relevant provisions and instructions and is supplemented by interpretations and operating experiences summarized by the working party "pressure gases".

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1 Scope

This guideline applies to the equipment, testing and operation of motor vehicles that are fitted out in such a way that operation with Compressed Natural Gas (CNG) is possible. Compliance with this guideline means compliance with the Road Traffic Licensing Regulations.

2 Components of the compressed gas unit

The compressed gas unit is firmly connected with a motor vehicle as part of its equipment. It is filled through a pressure gauge. Compulsory components of a compressed gas unit (high pressure parts) are:

1. cylinder fixing
2. gas cylinder
3. gas cylinder shut-off-device
4. safety installations at the gas cylinder (flow limiter), protection against temperature- or pressure excess in case of fire
5. receptacle, disposal means
6. non-return valve between receptacle and gas cylinder
7. shut-off device between receptacle and cylinder/disposal facility, alternatively a second non-return valve
8. pressure regulator (high pressure)
9. rigid fuel lines (piping), flexible fuel lines (flexible tubing), joints
10. pressure- or level gauge in the vehicle driver's compartment
11. main shut-off device

Additional components of the compressed gas unit can be (if available):

1. gas tight housing for the valves
2. filter
3. auxiliary power consuming device (high pressure)
4. heat exchanger
5. pressure gauge

3 Basic requirements for ready-to-use compressed gas units

3.1 General requirements

Ready-to-use compressed gas units shall be designed to resist the loads to be likely at operation, they shall be leak-proof.

All components of the compressed gas unit shall be fixed in at least 100 mm distance of the exhaust system. If the distance between components of a compressed gas unit and the exhaust pipe is less than 200 mm, a deflector shall be added in between.

If leaks occur in CNG components, the emitting gas shall not (e.g. through air intake for heating or air conditioning) reach the driver- or the passenger compartment.

Compressed gas cylinders and/or components that may have leaks shall not be installed in the passenger compartment or any other closed spaces (including the boot). As far as this is technically impossible, those components shall be housed in a closed container (except the cylinder) or in a sufficiently leak proof housing with sufficient ventilation. Electric devices shall not be installed in the closed container or the leak proof housing as long as they are not explosion proof according to zone 1 of the ATEX 95 regulation. Electric wirings shall be inside cable shafts.

Torsions of the vehicle frame or the body shall not have a damaging effect on the components of the compressed gas unit or fixings. The clampings shall not be sharp-edged. To isolate the compressed gas unit components and the fastenings or supports corrosion-proof intermediate bearings shall be used.

All components shall be protected against mechanical damage. If necessary, bumpers, a stoneguard underbody compound and/or a protection against use as step (e.g. near doors) should be attached.

3.2 Fixings of the compressed gas unit

At least two supports per cylinder shall be used as fixings, and it should be designed in a way that they can withstand—with filled cylinder—the acceleration given in the ECE R110.

Fastening of the compressed gas unit with steel cables is not allowed.

3.3 Gas cylinders

The gas cylinders shall be approved in compliance with ECE R 110.

Changes at gas cylinders shall only be made by the manufacturer. Before a change is made a legally approved technical expert shall be consulted. The cylinders shall be tested again by a legally approved technical expert after a change has been made.

The cylinder and the components of the compressed gas unit shall be mounted at the vehicle in such a way that they are protected against mechanical and other (e.g. corrosive) damages.

In case of the fastening of cylinders close to the vehicle bottom, the cylinders and other parts of the compressed gas unit shall not be the lowest point of the floor group.

Gas cylinders shall not be installed in the engine compartment.

3.4 Gas tight housing

The valves of cylinders installed in the interior of the car (boot included) shall be inside a gas tight housing, sufficiently gas tight to the interior of the car, permeable to warmth and sufficiently ventilated to the outside, so that the response of the valves remains unaffected.

3.5 Gas cylinder shut-off-device

The cylinder shut-off-device shall be approved in compliance with ECE R 110.

3.6 Gas cylinder safety devices

3.6.1 Safety devices against temperature excess in case of a fire

Safety devices can be: pressure relief devices (temperature activated) and, if need be, a pressure relief devices/burst discs (temperature activated) AND a pressure relief valve (pressure activated). The safety devices shall be of approved design according to the ECE R110.

Pressure relief devices (temperature activated) shall be equipped with solder that guarantee a sufficient pressure relief at not less than $100 \pm 5^\circ \text{C}$ (not less than $125 + 5^\circ \text{C}$ with an all-steel container).

The combination of pressure relief devices and pressure relief devices/burst discs is only permitted if it is ensured that after the flow temperature of the solder is reached the response of the pressure relief device/burst disc is guaranteed at a lower interior pressure of the container (0,1x test pressure of the cylinder \pm 5 bar). No burst discs with the inherent danger of changing the burst pressure (e.g. copper and its alloys) shall be used for pressure relief devices/burst discs.

The safety devices shall be fully operable even with closed gas cylinder shut-off devices.

The venting means of safety devices shall be dimensioned, arranged and fixed in such a way that a safe discharge of the gas is ensured. If venting pipes are available, they shall be protected against dirt and water inflow and installed as far away as possible from ignition sources in the vehicle. They shall not be directed at gas cylinders or vehicle components.

3.6.2 Flow limiter

The flow limiter controller shall ensure that in case of a pipe burst the emitting gas volume flow rate will be limited to 0,1x of the maximum gas volume flow rate possible.

The flow limiter shall be approved in compliance with ECE R 110.

3.7 Receptacle

The receptacle shall be approved in compliance with ECE R 110.

The receptacles' design shall guarantee that only pressure gas permissible for the cylinder and with the permissible filling pressure can be filled in, and that it cannot flow back. This last requirement is met if two independently operating non-return valves according to no. 3.8 are provided, or if one non-return valve is replaced by a shut down valve according to no. 3.14.

The receptacle shall not be installed in the driver's compartment. It shall be installed in a sufficiently ventilated room.

3.8 Non-return valve between receptacle and gas cylinder

Non-return valves shall be approved in compliance with ECE R 110.

3.9 Disposal means

The disposal means behind the cylinder shut-off-device is used for the disposal of gas in the piping and shall be designed for the 1,5x test pressure of the gas cylinder. Basically natural gas shall not reach the atmosphere. Therefore the compressed gas unit should be equipped with an adequate disposal means if disposal via the engine is not possible.

3.10 Main shut-off device

The main shut-off device shall be approved in compliance with ECE R 110.

The main shut-off device shall be closed dead when the ignition switch is switched off. The gas supply to the engine shall only be released if either the starter is operated or an engine speed signal is present.

The gas supply to auxiliary power consuming devices (e.g. auxiliary heating) is allowed independently from the position of the ignition switch while the engine is not running. The gas supply shall only be released during the intended use of the auxiliary power consuming device (safety pilot at auxiliary heating).

This function shall be tested by a legally approved technical expert for road traffic before start-up of the vehicle.

3.11 Filter

Filters shall be made of a material resistant to the test pressure of the cylinder at its test temperature. Approval according to ECE R110 is mandatory.

3.12 Pressure regulator

Casings for pressure regulators shall be made of a material resistant to the test pressure of the cylinder at its test temperature and approved in compliance with ECE R 110.

The downstream side, the area before the inlet to the suction unit of the engine, shall be protected against unallowed pressure increase above fixed value due to a failure of the pressure regulator in open position by means of a safety device. The assembly of the pressure regulator to the vehicle shall be firm and vibration-damped respectively.

3.13 Rigid fuel lines (piping), flexible fuel lines and joints

Rigid fuel lines (piping), flexible fuel lines and joints shall be approved in compliance with ECE R 110.

Piping shall be connected by means of detachable units. Screw joints are allowed if the applicability has been proven by a quality verification and pressure testing by the manufacturer.

Piping made of aluminium and aluminium alloys shall not be used in a compressed gas unit.

Piping shall be installed in such a way (preferably along the frame) that no damaging self-induced vibrations (e.g. resonance with engine vibrations) and no friction areas—especially at holes—occur. The distance between two fixings should be not more than 1000 mm. Bend radii of the piping shall be adapted to the material and the dimension of the pipe.

Flexible fuel lines and joints shall be designed and tested for the 1,5x the test pressure of the gas cylinder. For non-metallic materials a verification of suitability for the use with the respective compressed gas shall be available.

3.14 Shut-off devices between cylinder/disposal means and receptacle

The shut-off devices shall be approved in compliance with ECE R 110. The shut-off device before the disposal means shall be sealed in the “closed” position or secured against accidental opening with an anti-twist protection that can only be loosened with a tool.

3.15 Pressure- or level gauge in the vehicle driver’s compartment

In the driver’s compartment (instrument panel) a pressure- or level gauge shall be installed that displays the pressure- or filling level in the gas cylinders. The pressure- or level gauge may consist of a sensor-controlled electric display (visual signal) on the vehicles’ instrument panel or an acoustic signal that alerts the driver to the fact that only a residual volume is left in the cylinder.

3.16 Compressed gas unit in the low pressure part

Parts of the compressed gas unit in the area of low pressure (ca. 10 bar) shall be approved in accordance with the ECE R110.

3.17 Auxiliary power consuming devices

Existing auxiliary power consuming devices shall be included in the tests of the compressed gas installation. Housings of auxiliary power consuming devices that are loaded with the operating pressure of the gas cylinder shall be made of a material resistant to the test pressure of the cylinder at the test temperature of the cylinder.

3.18 Heat exchanger

Casings of heat exchangers that are loaded with the operating pressure of the cylinder shall be made of a material resistant to the test pressure of the cylinder at its test temperature and designed for the highest allowed operating pressure. Highest operating pressure is the overpressure of the filling allotted to the temperature of 85° C.

The installation of the heat exchanger shall be firm and vibration-damped respectively.

4 Inspection of the compressed pressure installation

4.1 Installation as a whole

The legally approved technical expert has to certify before start-up of the compressed gas unit that all requirements are met according to no. 3, and has to perform a leak test. The leak test shall be made with gas contained in the gas cylinder or an inert gas at an overpressure of 0,1 bar above the minimum pressure of the installation (that is dependent on the system) and at the service pressure of the gas cylinder. The installation is leak-proof if the leak rate does not exceed $10^{-2} - 10^{-4}$ mbar 1/s or emitting gas bubbles can not be detected when using leak test spray. In case of series production the leak test may be performed by a factory-authorized inspector in consultation with the legally approved technical expert. The factory-authorized inspector shall have a special training according to the present VdTUV 757 guideline and the ECE R110.

In case of compressed gas units of natural gas vehicles made in series production with a model certificate of the legally approved technical expert, individual test steps may be conducted by trained employees/factory-authorized inspector of the manufacturer. Manner and extent shall be laid down in the model certificate. A contract shall be concluded with the manufacturer concerning the inspection. An attestation about the tests according to the model certificate shall be signed by the factory-authorized expert. He shall report to the legally approved technical expert.

4.2 Inspection result, Certificate

The legally approved technical expert issues a certificate in which the underlying operating conditions and the installation parts are listed. Alongside this certificate a list of the manufacturer shall be available in which the documents of the installation parts (e.g. construction plan with list of components, design approvals, ...) are specified. These certificates shall be deposited with the manufacturer, parameterised with running code numbers and if need be perforated (e.g. TU8XXXX). The code number shall be stated in the vehicle registration document by the legally approved technical expert for road traffic. At the recurrent inspections and the inspections within the scope of changes and/or maintenance respectively the certificates shall be available for the legally approved technical expert.

5 Assembly

The assembly of the compressed gas unit shall only be carried out by trained personnel. The assembly shall be conducted following the manufacturer's specifications (like repair manual, operating instructions, quality regulations etc.) Only approved components and materials may be used.

6 Operation of compressed gas units in road vehicles

6.1 Intake from several cylinders

Gas may be taken from several cylinders simultaneously during operation of the compressed gas unit if the gas supply to the engine can be interrupted immediately in a hazardous situation by means of a shut-off device in the main line or separate shut-off devices between the cylinders.

6.2 Operating manual

Every vehicle with a compressed gas unit shall be provided with an operating manual.

6.3 Maintenance

The maintenance shall be conducted following the manufacturer's specifications by specially trained personnel of the manufacturer. An inspection book for the compressed gas unit shall be kept.

7 Inspections after changes and repair

7.1 Inspection after changes

If changes are made at a compressed gas unit, i.e. replacement of components according to no. 2, the legally approved technical expert verifies if the compressed gas unit complies with this guideline. Changes have to be documented and if applicable, added to the vehicle registration document.

7.2 Inspection after repair

If damages occur on components of the compressed gas unit by extraneous causes so that the proper operation is not possible any more according to this guideline in observance of no. 9.1, the legally approved technical expert shall be heard before repair, to specify manner and extent of the inspection. In case of series production the leak test may be conducted by a factory-authorized inspector in consultation with the legally approved technical expert.

8 Recurrent inspections

Recurrent inspections shall be conducted according to the time limit stated in the road traffic licensing regulation. A period of 3-2-2-... is recommended for virgin (0 mileage) cars, and 2-2-2-... for converted or used cars.

The approved technical expert issues a certificate of the inspection which shall be shown at recurrent inspections and the inspections within the scope of changes and/or maintenance respectively. The certificates shall be available for the legally approved technical expert.

9 Inspection of the vehicle

In preparation for the inspection of the vehicle in compliance with the road traffic licensing regulation through the legally approved technical expert or inspector for road traffic the applicant shall provide the following documents:

- a certificate of the legally approved technical expert stating that the whole compressed gas unit meets the requirements of this guideline.
- a report of the institution responsible for the exhaust gas analysis stating that the respective regulations of the road traffic licensing regulation are observed
- a attestation of the workshop stating that the installation has been installed and adjusted according to the instructions of the certificate in compliance with no. 2
- an operating manual for the driver.

The inspection includes:

The assembly of the installation according to this guideline and the manufacturer's specifications, and in case of subsequent conversions the regulation of the converted vehicle data

The registration document shall include

- the propulsion type "high pressure gas, CNG"
- code number of the certificate of the legally approved technical expert about the inspection of a compressed gas unit
- manufacturer and type of the pressure regulator
- manufacturer and type of the gas-air-mixer
- change of the registration document (emission standard)

In case of additional retrofitting of CNG-installations in vehicles (bivalent vehicles) the following changes in the registration document are mandatory:

- vehicle- and construction type, in the cases where the exhaust emission characteristics are changed through the retrofitting.
- dead weight through the addition of the CNG-installation. For heavy goods vehicles "cargo" shall be altered
- alternatively high pressure gas, CNG
- Cylinder....content
- Pressure controller... (give manufacturer and type)
- Gas-air-mixer... (give manufacturer and type)
- Certificate of the legally approved technical expert