Informal document No. **13**
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VEHICLES PROPELLED BY COMPRESSED NATURAL GAS (CNG)

Transmitted by the expert from ISO

At the 43rd session of GRPE (15-18 January 2002), the Chairman of ISO/TC22/SC25 reported on the progress of work on CNG standards. The Chairman is glad to provide GRPE with an updated status progress of the ISO work. In short, 21 out of 22 parts of ISO standards have been finalized and the remaining Standard - concerning the CNG connector - is at the final ballot stage.

More important, at the 43rd GRPE session, the SC25 Chairman informed on some discrepancies detected when comparing ECE Regulation No. 110 to the corresponding provisions of the ISO standards. The SC25 Chairman offered to provide GRPE with a list of those discrepancies. That statement was well received by the Group.

Consistently with the above, please find attached a first set of the detected discrepancies. The list is not exhaustive and only shows how ISO is developing its task.

According to the guidance of the GRPE Chairman and of the GRPE Working Party, ISO would progress in its work. ISO asks therefore to accept this contribution for evaluation at the 44th GRPE session.

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ISO STANDARDS CONCERNING NGV SYSTEM COMPONENTS

Updated on April 30, 2002

Name	ISO Reference	Status
CNG Fuelling Connectors to be integrated.	14469.4	DIS approved: French and US comments FDIS requested
CNG Fuelling Systems: Part 1 – Safety Requirements	15501-1	PUBLISHED on October 15, 2001
CNG Fuelling Systems: Part 2 – Test Methods	15501-2	PUBLISHED on June 1, 2001
CNG Fuel System Components: Part 1 – General requirement and definitions	15500-1	PUBLISHED on March 1, 2000 (DAM 1 requested on July 23,2001; inquiry started on October 11, 2001 and will end March 11, 2002)
CNG Fuel System Components: Part 2 – Performances and definitions	15500-2	PUBLISHED on February 15, 2001
CNG Fuel System Components: Part 3 – Check Valve	15500-3	PUBLISHED on January 15, 2001
CNG Fuel System Components: Part 4 – Manual Valve	15500-4	PUBLISHED on January 15, 2001
CNG Fuel System Components: Part 5 – Manual Cylinder Valve	15500-5	PUBLISHED on January 15, 2001
CNG Fuel System Components: Part 6 – Automatic Valve	15500-6	PUBLISHED on January 15, 2001
CNG Fuel System Components: Part 7 – Gas injector	15500-7	FDIS requested on August 3, 2001 (FDIS ballot started on February 21-2002: deadline is April 21, 2002- publication in progress: see e-mail Prog11 of April 24, 2002)
CNG Fuel System Components: Part 8 – Pressure indicator	15500-8	PUBLISHED on January 15, 2001
CNG Fuel System Components: Part 9 – Pressure Regulator	15500-9	PUBLISHED on January 15, 2001
CNG Fuel System Components: Part 10 – Gas Flow Adjuster	15500-10	PUBLISHED on January 15, 2001
CNG Fuel System Components: Part 11 – Gas / Air Mixer	15500-11	PUBLISHED on January 15, 2001
CNG Fuel System Components: Part 12 – Pressure Relief Valve	15500-12	PUBLISHED on January 15, 2001
CNG Fuel System Components: Part 13 – Pressure Relief Device	15500-13	PUBLISHED on April 15, 2001
CNG Fuel System Components: Part 14 – Excess Flow Valve	15500-14	PUBLISHED on March 15, 2002
CNG Fuel System Components: Part 15 – Gas Tight Housing and Ventilation	15500-15	PUBLISHED on January 15, 2001
CNG Fuel System Components: Part 16 – Rigid Fuel Line	15500-16	PUBLISHED on January 15, 2001
CNG Fuel System Components: Part 17 – Flexible Fuel Line	15500-17	PUBLISHED on January 15, 2001
CNG Fuel System Components: Part 18 – Filter	15500-18	PUBLISHED on January 15, 2001
CNG Fuel System Components: Part 19 – Fittings	15500-19	PUBLISHED on January 15, 2001

DIS Draft International Standard
FDIS Final Draft International Standard

Column A gives an order number; columns B, C and D are marked as appropriate; column E contains the ISO text; column F indicates the ISO standard number, the part number, the clause(s) / sub-clause(s) / annex number; column G contains the R110 text; column H indicates the R110 clause(s) / sub-clause(s) number; column I is for comments.									
A		B	C	D	E	F	G	H	I
number	Title	Definition	Requirements	Test methods	Text ISO	Ref. in the ISO standard	Text R110	Ref in R110	comments
1	Check valve - leakage		X	X	The generic test method is described in ISO 15500-2. An additional test is given in part sub-clause 6.3. Test the check valve at the temperatures and pressure given in table 2.Test temperatures and pressure : -40°C 150 bar and 5 bar; 20°C 5 bar and 300 bar; 85°C to 120°C 10bar and 300 bar	15500-3 6.1 6.3	2. The test shall be performed at the following conditions: (i) at room temperature (ii) at the minimum operating temperature (iii) at the maximum operating temperature The maximum and minimum operating temperatures are given in annex 5O. 3. During this test the equipment under test (EUT) will be connected to a source of aerostatic pressure. An automatic valve and a pressure gauge having a pressure range of not less than 1. 5 times nor more than 2 times the test pressure are to be installed in the pressure supply piping. The pressure gauge is to be installed between the automatic valve and the sample under test. While under the applied test pressure, the sample should be submerged in water to detect leakage or any other equivalent test method (flow measurement or pressure drop). 4. The external leakage must be lower than the requirements stated in the annexes or if no requirements are mentioned the external leakage shall be lower than 15 cm 3 /hour. 5. High temperature test A CNG containing component shall not leak more than 15 cm 3 /hour with the outlet plugged when submitted to a gas pressure, at maximum operating temperature as indicated in annex 5O, equal to the maximum working pressure. The component shall be conditioned for at least 8 hours at this temperature. 6. Low temperature test A CNG containing component shall not leak more than 15 cm 3 /hour with the outlet plugged when submitted to a gas pressure, at the minimum operating temperature, equal to the maximum working pressure as declared by the manufacturer. The component shall be conditioned for at least 8 hours at this temperature.	Annex 5B	main point - rationale: ISO specify a low pressure test (5bar) which is necessary to check leaks and ensure safety. Furthermore the test duration could be more precisely define in R110. Ozone test may be not appropriate for these components
2	Check valve - excess torque resistance			X	The generic test method is described in ISO 15500-2	15500-3 6.1			

3	Check valve - bending moment			X	The generic test method is described in ISO 15500-2	15500-3 6.1			
4	Check valve - continued operation		X	X	The check valve shall be capable of withstanding 20 000 cycles of operation and 24 h of chatter flow when submitted to the following test procedure. A) connect the check valve to a test fixture and apply a 25 MPa (250 bar) pressure to the check valve's inlet, then vent pressure from its outet. Lower the pressure on the check valve's outlet side to between 0 and a maximum of 12,5 MPa (125 bar) prior to the next cycle. b) Following 20 000 cycles of operation, subject the check valve to 24 hours of chatter flow at a flow rate that causes the most chatter. After this test, the check valve shall comply with leakage test according to 6.3. Failure in any sense during the procedure shall constitute a failure of the check valve. All parts shall remain in position and function properly after this test.	15500-3 6.4	The check valve, being in the normal position of use specified by the manufacturer, is submitted to 20000 operations; then it is deactivated. The check valve shall remain leak-proof (external) at a pressure of 1,5 times the working pressure (MPa) (see annex 5B).	Annex 4A 3.2.3	
5	Check valve - Corrosion resistance		X		96h; The generic test method is described in ISO 15500-2	15500-3 6.1	144h;The generic test is described in annex 5E	Annex 4A 3.3	
6	Check valve - Oxygen ageing		X	X	The generic test method is described in ISO 15500-2	15500-3 6.1			
7	Check valve - Non metallic synthetic immersion			X	Tested with GNV; The generic test method is described in ISO 15500-2	15500-3 6.1	Tested with pentane; the generic test method is described in Annex 5D	Annex 4A 3.3	
8	Check valve - Vibration resistance				idem R110	15500-3 6.1	idem ISO		
9	Check valve - Brass material compatibility			X	The generic test method is described in ISO 15500-2. ISO does precise how long the test is (10 days)	15500-3 6.1	This test is part of the corrosion test described in Annex 5E (24 hours)	Annex 4A 3.3	Main point - ISO is evaluating whether 24 hours instead of 10 days are enough
10	Check valve - working temperature		X		shall conform to general temperatures requirements	15500-1 4.4	shall work in one of the two temperature ranges specified in annex 5O	Annex 4A 3.3	Main point - Temperature range are different between ISO and ECE. Components complying with the - 40°C to 120°C requirement are not

									for usual application in road vehicles.
11	Manual valve		X		There is no test related to the manual valve which is a component of the cylinder automatic valve, in R110, so it is impossible to make the comparison between ISO and R110.	15500-4			
12	Automatic valve - leakage		X	X	The generic test method is described in ISO 15500-2. An additional test is given in part 6 sub-clause 6.3. Test the automatic valve at the temperatures and pressure given in table 2.Test temperatures and pressures: -40°C 150 bar and 5 bar; 20°C 5 bar and 300 bar; 85°C to 120°C 10bar and 300 bar	15500-6 6.3	2. The test shall be performed at the following conditions: (i) at room temperature (ii) at the minimum operating temperature (iii) at the maximum operating temperature The maximum and minimum operating temperatures are given in annex 5O. 3. During this test the equipment under test (EUT) will be connected to a source of aerostatic pressure. An automatic valve and a pressure gauge having a pressure range of not less than 1. 5 times nor more than 2 times the test pressure are to be installed in the pressure supply piping. The pressure gauge is to be installed between the automatic valve and the sample under test. While under the applied test pressure, the sample should be submerged in water to detect leakage or any other equivalent test method (flow measurement or pressure drop). 4. The external leakage must be lower than the requirements stated in the annexes or if no requirements are mentioned the external leakage shall be lower than 15 cm 3 /hour. 5. High temperature test A CNG containing component shall not leak more than 15 cm 3 /hour with the outlet plugged when submitted to a gas pressure, at maximum operating temperature as indicated in annex 5O, equal to the maximum working pressure. The component shall be conditioned for at least 8 hours at this temperature. 6. Low temperature test A CNG containing component shall not leak more than 15 cm 3 /hour with the outlet plugged when submitted to a gas pressure, at the minimum operating temperature, equal to the maximum working pressure as declared by the manufacturer. The component shall be conditioned for at least 8 hours at this temperature.	Annex 4A 2.2.2	Main point - rationale: ISO specify a low pressure test (5bar) which is necessary to check leaks and ensure safety. Furthermore the test duration could be more precisely define in R110. Ozone test may be not necessary appropriate for these components

13	Automatic valve - leakage under low pressure		X		refer to comment 14	15500-6 6.3	R110 is more stringent than ISO. It specifies 15cm^3/h, ISO requiring 20 cm^3/h	Annex 4A 2.2.2	
14	Automatic valve - Excess torque resistance			X	The generic test method is described in ISO 15500-2	15500-6 6.1			
15	Automatic valve - bending moment			X	The generic test method is described in ISO 15500-2	15500-6 6.1			
16	Automatic valve - Continued operation			X	Test the automatic valve in accordance with the procedure for testing continued operation given in ISO 15500-2, for 50 000 cycles, but lower the downstream pressure of the test fixture to less than 0,5 MPa (5 bar), and perform the leakage test in accordance with 6.3 of this part of ISO 15500.	15500-6 6.3	The automatic valve, being in the normal position of use specified by the manufacturer, is submitted to 20 000 operations; then it is deactivated. The automatic valve shall remain leak-proof at a pressure of 1.5 times the working pressure (MPa) (see annex 5B)	Annex4 A 2.2.3	
17	Automatic valve - corrosion test		X		96h; The generic test method is described in ISO 15500-2	15500-6 6.1	144h;The generic test is described in annex 5E	Annex 4A 2.5	
18	Automatic valve - Oxygen ageing		X	X	The generic test method is described in ISO 15500-2	15500-6 6.1			
19	Automatic valve - Electrical over-voltage			X	The generic test method is described in ISO 15500-2	15500-6 6.1			Main point - the functionality of the component shall be guaranteed whichever the voltage is
20	Automatic valve - non-metallic synthetic immersion			X	Tested with GNV; The generic test method is described in ISO 15500-2	15500-6 6.1	Tested with pentane; the generic test method is described in Annex 5D	Annex 4A 2.5	
21	Automatic valve - vibration resistance				idem R110	15500-6 6.1	idem ISO		

22	Automatic valve - insulation resistance		X		The generic test method is described in ISO 15500-2. 6.5 of ISO 15500-6 insulation resistance: This test is designed to check for a potential failure of the insulation between the two-pin coil assembly and the automatic valve casing. Apply 1000V DC between one of the connector pins and the housing of the automatic valve for at least 2s. The minimum allowable resistance shall be 240kohm;	15500-6 6.5	The electrical system, if existing, shall be isolated from the body of the automatic valve. Isolation resistance shall be more than 10 Mohm.		
23	Automatic valve - minimum opening voltage		X		The minimum opening voltage at room temperature shall less or equal to 6V for a 12V system and less or equal to 16 for a 24V system	15500-6 6.6			Main point - the functionality of the component shall be guaranteed, whichever the voltage is
24	Pressure indicator - hydrostatic strength		X	X	Test the pressure indicator according to the procedure for testing hydrostatic strength in ISO 15500-2. The test pressure shall be 80 MPa (800 bar)	15500-8 6.2	2.2 The pressure and temperature sensors are classified in a class according to the scheme 1.1 in paragraph 2 of this regulation. 3.1.2 The class 0 part of the pressure and temperature sensors shall withstand a pressure up to 1.5 times the working pressure (MPA). 3.1.4 The class 1 and class 2 part of the pressure and temperature sensors shall withstand a pressure up to twice the working pressure. The class 3 part of the pressure and temperature sensors shall withstand a pressure up to twice the relief pressure of the pressure relief valve, on which it is subject.	Annex 4E 2.2, 3.1.2, 3.1.4, 3.1.5	

25	Pressure indicator - leakage			X	The generic test method is described in ISO 15500-2. An additional test is given in part 6 sub-clause 6.3. Test the pressure indicator at the temperatures and pressure given in table 2.Test temperatures and pressure : - 40°C 150 bar and 5 bar; 20°C 5 bar and 300 bar; 85°C to 120°C 10bar and 300 bar	15500-8 6.3	2. The test shall be performed at the following conditions: (i) at room temperature (ii) at the minimum operating temperature (iii) at the maximum operating temperature The maximum and minimum operating temperatures are given in annex 5O. 3. During this test the equipment under test (EUT) will be connected to a source of aerostatic pressure. An automatic valve and a pressure gauge having a pressure range of not less than 1. 5 times nor more than 2 times the test pressure are to be installed in the pressure supply piping. The pressure gauge is to be installed between the automatic valve and the sample under test. While under the applied test pressure, the sample should be submerged in water to detect leakage or any other equivalent test method (flow measurement or pressure drop). 4. The external leakage must be lower than the requirements stated in the annexes or if no requirements are mentioned the external leakage shall be lower than 15 cm 3 /hour. 5. High temperature test A CNG containing component shall not leak more than 15 cm 3 /hour with the outlet plugged when submitted to a gas pressure, at maximum operating temperature as indicated in annex 5O, equal to the maximum working pressure. The component shall be conditioned for at least 8 hours at this temperature. 6. Low temperature test A CNG containing component shall not leak more than 15 cm 3 /hour with the outlet plugged when submitted to a gas pressure, at the minimum operating temperature, equal to the maximum working pressure as declared by the manufacturer. The component shall be conditioned for at least 8 hours at this temperature.	Annex 4E 3.1.1, 3.1.3	
26	Pressure indicator - leakage under low pressure		X		refer to comment 28	15500-8 6.3	R110 is more stringent than ISO. It specifies 15cm^3/h, ISO requiring 20 cm^3/h	Annex 4E 3.1.1, 3.1.3	
27	Pressure indicator - Excess torque resistance			X	The generic test method is described in ISO 15500-2	15500-8 6.1			
28	Pressure indicator - bending moment			X	The generic test method is described in ISO 15500-2	15500-8 6.1			

29	Pressure indicator - continued operation			X	6.4.1 Test the pressure indicator in accordance with the procedure for testing continued operation given in ISO 15500-2, for 20 000 cycles; a cycle consists of pressurization to 20 MPa (200 bar), followed by depressurization to less than 1 MPa (10 bar). 6.4.2 Perform the leakage test in accordance with 6.3 of this part of ISO 15500.	15500-8 6.4			Main point - It is better to define a test method
30	Pressure indicator - corrosion resistance		X		96h; The generic test method is described in ISO 15500-2	15500-8 6.1	144h;The generic test is described in annex 5E	Annex 4E 2.2	
31	Pressure indicator - oxygen ageing		X	X	The generic test method is described in ISO 15500-2	15500-8 6.1			
32	Pressure indicator - electrical over voltage			X	The generic test method is described in ISO 15500-2	15500-8 6.1			
33	Pressure indicator - non-metallic synthetic immersion			X	Tested with GNV; The generic test method is described in ISO 15500-2	15500-8 6.1	Tested with pentane; the generic test method is described in Annex 5D	Annex 4E 2.1	
34	Pressure indicator - vibration resistance				idem R110	15500-8 6.1	idem ISO		
35	Pressure indicator - Brass material compatibility			X	The generic test method is described in ISO 15500-2. ISO does precise how long the test is	15500-8 6.1	This test is part of the corrosion test described in Annex 5E	Annex 4E 2.1	
36	Pressure indicator - insulation resistance		X		The generic test method is described in ISO 15500-2. 6.5 of ISO 15500-8 insulation resistance: This test is designed to check for a potential failure of the insulation between the two-pin coil assembly and the automatic valve casing. Apply 1000V DC between one of the connector pins and the housing of the automatic valve for at least 2s. The minimum allowable resistance shall be 240kohm;	15500-8 6.5	The electrical system, if existing, shall be isolated from the body of the automatic valve. Isolation resistance shall be ter than 10 Mohm.	Annex 4E 3.3	
37	Pressure indicator - minimum opening voltage		X		The minimum opening voltage at room temperature shall less or equal to 6V for a 12V system and less or equal to 16 for a 24V system	15500-8 6.6			

38	Pressure regulator - Hydrostatic strength			X	6.2.1Test the pressure regulator according to the procedure for testing hydrostatic strength in ISO 15500-2. 6.2.2Test the inlet of the first stage of the pressure regulator using a pressure of at least 100 MPa (1 000 bar).6.2.3 Test the inlet or inlets of the downstream stage or stages at four times the working pressure.6.2.4 Test the outlet chamber, port and all outlet fittings at four times the working pressure, or 0,4 MPa (4 bar), whichever is the greater.	15500-9 6.2	3.1 The part of the pressure regulator, which is in contact with the pressure of the container is regarded as Class 0. 3.1.2 The class 0 part of the pressure regulator shall withstand a pressure up to 1.5 times the working pressure (MPa). 3.1.4 The class 1 and class 2 part of the pressure regulator shall withstand a pressure up to twice the working pressure.3.1.5 The class 3 part of the pressure regulator shall withstand a pressure up to twice the relief pressure of the pressure relief valve, on which it is subject.	Annex 4D 3	
39	Pressure regulator - Leakage			X	The generic test method is described in ISO 15500-2. An additional test is given in part 9 sub-clause 6.3. Test the automatic valve at the temperatures and pressure given in table 2.Test temperatures, percentage and inlet pressure : -40°C 1% 150 bar and 5 bar; 20°C 1% 5 bar and 300 bar; 120°C 2%,3%...0,75 x working pressure, -40°C 2%,3%... 10 bar and 1,5 x working pressure, 20°C 2%, 3%... 10bar and 1,5 x working pressure, 120°C 2%, 3% ... 10 bar and 1,5 x working pressure	15500-9 6.3	3.1.1 The Class 0 pressure regulator shall be leak-proof (see annex 5B) at a pressure up to 1,5 times the working pressure (MPa) with the outlet(s) of the part closed off. 3.1.3 The Class 1 and Class 2 pressure regulator shall be leak-proof (see annex 5B) at a pressure up to twice the working pressure.	Annex 4D 3.1.1 and 3.1.3	
40	Pressure regulator - Excess torque resistance			X	The generic test method is described in ISO 15500-2	15500-9 6.1			
41	Pressure regulator - Bending moment			X	The generic test method is described in ISO 15500-2	15500-9 6.1			
42	Pressure regulator - Continued operation		X	X	The pressure regulator shall be able to withstand 50 000 cycles without any failure when tested according to the following procedure. Where the stages of pressure regulation are separate, the service pressure in a) to f) is considered to be the working pressure of the upstream stage. a) Recycle the regulator for 95% of the total number of cycles at room temperature and at the service pressure. Each cycle shall consist of flow until stable outlet pressure has been obtained, after which the gas flow shall be shut off by a downstream valve within 1 s, until the downstream loch-up pressure has stabilized. Stabilized outlet pressures are defined as set pressure +/- 15% for at least 5 s. The regulator shall comply with 6.3 at room temperature at	15500-9 6.4			Main point - it is better to define a test method

					intervals of 20%, 40%, 60%, 80% and 100% of room temperature cycles. b) Cycle the inlet pressure of the regulator for 1% of the total number of cycles at room temperature from 100% to 50% of the service pressure. The duration of each cycle shall be no less than 10 s. The regulator shall comply with 6.3 at room temperature at the completion of this test. c) Repeat the cycling procedure of a) at 120°C at the service pressure for 1% of the total number of cycles. d) Repeat the cycling procedure of b) at 120°C at the service pressure for 1% of the total number cycles. The regulator shall comply with 6.3 at 120°C at the completion of this test. e) Repeat the cycling procedure of a) at -40°C and 50% of service pressure for 1% of the total number of cycles. f) Repeat the cycling procedure of b) at -40°C and 50% of service pressure for 1% of the total number of cycles. The regulator shall comply with 6.3 at -40°C at the completion of this test. g) at the completion of the cycles, the lock-up pressure downstream of the regulator shall not exceed the lock-up pressure.				
43	Pressure regulator - Corrosion resistance		X		96h; The generic test method is described in ISO 15500-2	15500-9 6.1	144h;The generic test is described in annex 5E	Annex 4D 2.3	
44	Pressure regulator - Oxygen ageing			X	The generic test method is described in ISO 15500-2	15500-9 6.1			
45	Pressure regulator - electrical over voltage			X	The generic test method is described in ISO 15500-2	15500-9 6.1			
46	Pressure regulator - Non-metallic synthetic immersion			X	Tested with GNV; The generic test method is described in ISO 15500-2	15500-9 6.1	Tested with pentane; the generic test method is described in Annex 5D	Annex 4D 2	
47	Pressure regulator - Vibration resistance				idem R110, non applicable to engine-mounted pressure regulator	15500-9 6.1	idem ISO	Annex 4D 2	

48	Pressure regulator - Brass material compatibility			X	The generic test method is described in ISO 15500-2. ISO does precise how long the test is	15500-9 6.1	This test is part of the corrosion test described in Annex 5E	Annex 4D 2.2	
49	Pressure regulator - insulation resistance		X		The generic test method is described in ISO 15500-2. 6.5 of ISO 15500-6 insulation resistance: This test is designed to check for a potential failure of the insulation between the two-pin coil assembly and the pressure regulator casing. Apply 1000V DC between one of the connector pins and the housing of the automatic valve for at least 2s. The minimum allowable resistance shall be 240kohm;	15500-9 6.5			
50	Pressure regulator - Minimum opening voltage		X		The minimum opening voltage at room temperature shall less or equal to 6V for a 12V system and less or equal to 16 for a 24V system	15500-9 6.6			
51	Pressure regulator - Pressure impulse		X		a) Subject the pressure regulator with its first stage valve rendered fully open to sudden application of its service pressure at its inlet. The pressure regulator shall retain or release the pressure without any permanent deformation. b) Record the lock-up pressure of the regulator.	15500-9 6.7			
52	Pressure regulator - Water jacket Freezing		X		a) Fill the regulator or water jacket, which normally contains an antifreeze solution, with water to normal capacity and expose it at -40°C for 24h; attach 1 m sections coolant hose to the coolant inlet and outlet of the regulator or water jacket. b) Following the freezing conditioning an external leakage test at room temperature according to 6.3. A separate sample may be used for this test.	15500-9 6.8			Main point - for safety we must prove the integrity of the component under extreme conditions
53	Pressure regulator - heat exchange medium		X				The material constituting the regulator which are in contact with the heat exchange medium of the regulator when operating, shall be compatible with that fluid.	Annex 4D 2.2	
54	Gas-flow adjuster - Hydrostatic strength		X	X	Test the gas flow adjuster according to the procedure for testing hydrostatic strength in ISO 15500-2, at four times the working pressure, or 0,6 MPa (6 bar), whichever is the greater.	15500-10 6.2	The gas flow adjuster of Class 2 shall withstand a pressure twice the working pressure.	Annex 4G 3.3.1	

55	Gas-flow adjuster - Leakage		X	X	The generic test method is described in ISO 15500-2. In 15500-10 6.3 : Test the gas-flow adjuster at the temperatures of - 40°C, 20°C and 120°C, at a pressure of 15 kPa (1,5 bar).	15500-10 6.1 6.3	The gas flow adjuster of Class 2 shall be free from leakage at a pressure twice the working pressure.	Annex 4G 3.3.1.1	
56	Gas-flow adjuster - Excess torque resistance			X	The generic test method is described in ISO 15500-2	15500-10 6.1			
57	Gas-flow adjuster - Bending moment			X	The generic test method is described in ISO 15500-2	15500-10 6.1			
58	Gas-flow adjuster - Continued operation			X	If it is intended that the gas-flow adjuster be adjusted at the time of installation or service, no continued operation test is required. However, if the gas-flow adjuster be adjusted repeatedly during engine operation, then it shall undergo 100 000 cycles from minimum to the maximum flow. At the completion of this test, the gas-flow adjuster shall comply with 6.3 at room temperature.	15500-10 6.3			
59	Gas-flow adjuster - Corrosion resistance		X		96h; The generic test method is described in ISO 15500-2	15500-10 6.1	144h;The generic test is described in annex 5E	Annex 4G 3.2	
60	Gas-flow adjuster - Oxygen ageing			X	The generic test method is described in ISO 15500-2	15500-10 6.1			
61	Gas-flow adjuster - Electrical over voltage			X	The generic test method is described in ISO 15500-2	15500-10 6.1			
62	Gas-flow adjuster - Non-metallic synthetic immersion			X	Tested with GNV; The generic test method is described in ISO 15500-2	15500-10 6.1	Tested with pentane; the generic test method is described in Annex 5D	Annex 4G 3. 2	
63	Gas-flow adjuster - Vibration resistance				idem R110	15500-10 6.1	idem ISO	Annex 4G 3.2	
64	Gas-flow adjuster - Insulation resistance			X	This test id designed to check for potential failure of the insulation between the two pin-coil assembly and the gas flow adjuster casing.	15500-10 6.5			

65	Gas-flow adjuster - Minimum opening voltage			X	The minimum opening voltage at room temperature shall less or equal to 6V for a 12V system and less or equal to 16 for a 24V system	15500-10 6.6			
66	Gas-flow adjuster - Temperature		X		shall conform to general temperatures requirements	15500-1 4.4	shall work in one of the two temperature ranges specified in annex 5O	Annex 4G 3.3.2	
67	Gas/air mixer - Hydrostatic strength		X	X	Test the gas/air mixer according to the procedure for testing hydrostatic strength in ISO 15500-2, at four times the working pressure, in bar absolute, recommended by its manufacturer	15500-11 6.2	The gas/air mixer of Class 2 shall withstand a pressure twice the working pressure.	Annex 4G 2.3.1	
68	Gas/air mixer - Leakage		X	X	The generic test method is described in ISO 15500-2. In 15500-11 6.3 : Test the gas-flow adjuster at the temperatures of - 40°C, 20°C and 120°C, at a pressure of 3 kPa (0,3 bar).	15500-11 6.1 6.3	The gas/air mixer of Class 2 shall be free from leakage at a pressure twice the working pressure.	Annex 4G 2.3.1.1	
69	Gas/air mixer - Continued operation			X	If the gas/air mixer's components move repeatedly during engine operation, then it shall undergo 100 000 cycles from minimum to the maximum flow. At the completion of this test, the gas/air mixer shall comply with 6.3 at room temperature.	15500-11 6.3			
70	Gas/air mixer - Corrosion resistance		X		96h; The generic test method is described in ISO 15500-2. Additional requirements in15500-11 6.5: If materials or designs susceptible to corrosion are used in the component then the corrosion resistance test as given in ISO 15500-2 shall be performed.	15500-11 6.1	144h;The generic test is described in annex 5E	Annex 4G 2.2	
71	Gas/air mixer			X	The generic test method is described in ISO 15500-2	15500-11 6.1			
72	Gas/air mixer - Non -metallic synthetic immersion			X	Tested with GNV; The generic test method is described in ISO 15500-2	15500-11 6.1	Tested with pentane; the generic test method is described in Annex 5D	Annex 4G 2. 2	
73	Gas/air mixer - Vibration resistance				idem R110	15500-11 6.1	idem ISO	Annex 4G 2.2	
74	Gas/air mixer - Brass material compatibility			X	The generic test method is described in ISO 15500-2. ISO does precise how long the test is	15500-11 6.1	This test is part of the corrosion test described in Annex 5E	Annex 4G 2.2	
75	Gas/air mixer - electric insulation		X				Electrical operated components containing CNG shall comply with the following: They shall have a separate ground connection; The electrical system of the component shall be isolated from the body	Annex 4G 2.4	

76	Fixation requirements		X		Mounting of the cylinder : upward vertical acceleration (4,5 g for heavy duty vehicles and buses...) -	15501-1 4.4.3			Safety issue
77	Receptacle profile		X		Profile is defined	14469			to ensure the compatibility and the safety of the operation
78	Minimum receptacle clearance		X		Minimum clearance is defined	15501-1 4.2.4			to ensure the compatibility and the safety of the operation