



Compressed Natural Gas Storage System Components Cold Fill Test Procedure

1 Introduction

This test procedure has been approved by the Global Subsystem Leadership Team (GSSLT) pending verification of test conditions and instructions. Prior to using this procedure, conduct the tests described within this procedure to confirm that the results are attainable by state-of-the-art components available in the region of sale. Consult with the GSSLT Lead or System Bill of Material (BOM) Family Owner (BFO) prior to securing a test lab for verification.

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. The purpose of this test procedure is to demonstrate adherence to the leak tightness requirement of the specific Compressed Natural Gas (CNG) refueling component during vehicle fast fill conditions at extreme low ambient temperature conditions.

1.2 Applicability. This test procedure is applicable for all natural gas storage system components, sealing pressurized CNG against the ambient or to internal system areas with lower pressures, which are impacted by decreasing gas temperatures during expansion processes under fast fill conditions (e.g., fill valves, tank shut off valves, etc.)

1.3 Remarks. The CNG fuel subsystem shall accept fuel from a NGV 1 or UN R110 approved fill nozzle at ambient temperatures of -40 °C to 50 °C (-40 °F to 122 °F) with an initial container pressure of 0.5 MPa (73 psi) and a final container pressure of 24.8 MPa (3600 psi) compensated for ambient temperature of 21 °C (70 °F) with an average fast fill rate of at least 6.0 GGE per minute for North America and a final container pressure of 20 MPa compensated for ambient temperature of 15 °C with an average fast fill rate of at least 10 kg/minute for UN R110 regions.

A temperature drop of -40 °K could be expected in the first 20 s during a fast refueling with a 250 bar refueling target pressure.

This data was observed with a vehicle at a public refueling station which has a storage bank set pressure of 300 bar.

In the first 20 s, the low peak is reached and then the gas temperature rises again (due to the decreasing pressure difference and the heat of compression in the tank) assuming constant gas flow.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

ANSI NGV 1 ANSI NGV 3.1 UN R110.00

2.2 GM Standards/Specifications.

None

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3 Resources

3.1 Facilities.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment.

3.2.1 Climate Control.

3.2.1.1 A climate chamber capable of cooling down to a steady temperature of -40°C shall be used. It shall be approved to contain at least one (1) 120 dm^3 large CNG storage bundle with a working pressure of up to 300 bar. The setup shown in Figure 1 simulates a refueling station high pressure storage bank.

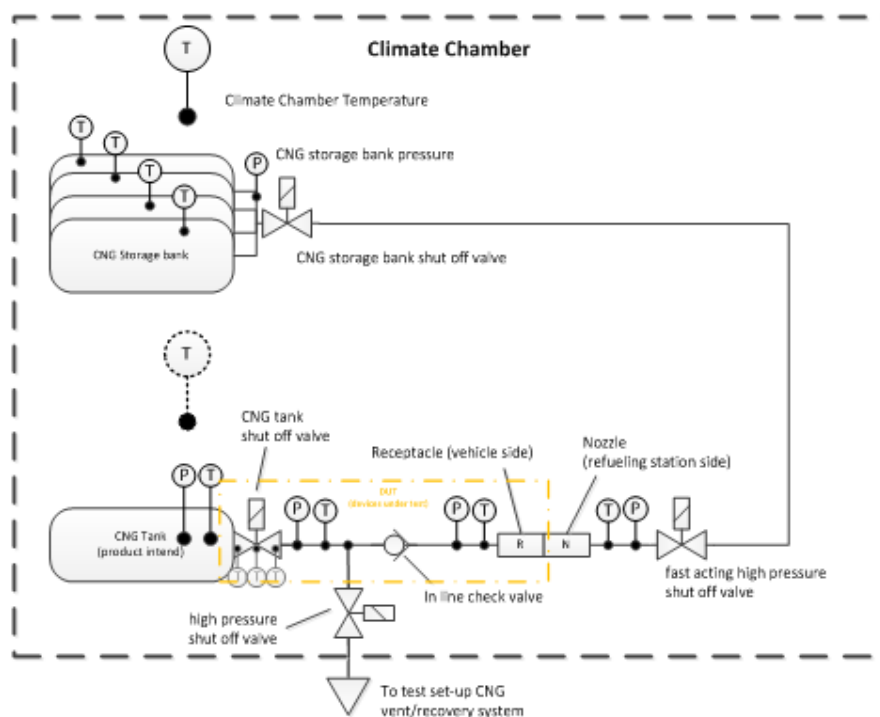


Figure 1: Single Climate Chamber Test

3.2.1.2 The chamber may include the Device(s) Under Test (DUT). The setup for the DUT contain a remotely controlled, fast acting, high pressure shut off valve in front of a NGV1 type nozzle coupled to a receptacle, a secondary inline check valve, as well as a tank shut off valve fitted to a CNG storage tank.

Note: This setup could also be put into a secondary climate chamber. The potential second chamber must also be capable of cooling to a steady temperature of -40°C . In any case, the climate chamber(s) shall be approved to operate with CNG filled test equipment.

3.2.2 Flow Control

3.2.2.1 The fast acting high pressure shut off valve shall be capable of opening against a 300 bar pressure delta in $< 1\text{ s}$.

3.2.2.2 The components under test shall be attached to a storage container with an internal water volume defined by the program specific documents. In the case of a multi tank system, the largest tank shall be chosen. If there is no specific volume disclosed before the start of the request, a default volume of 60 dm^3 shall be used.

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