



Compressed Natural Gas (CNG) Oil Separator Component Technical Specification (CTS)

1 Introduction

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. This document provides the standard technical requirements for the Compressed Natural Gas (CNG) oil separator:

1.2 Applicability. This standard applies to both Bi-fuel and Dedicated CNG vehicles. The oil separator shall be designed to package downstream of the pressure regulator and to operate on the low-pressure side of the CNG fuel system.

2 References

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

2.1 External Standards/Specifications.

DIN 40050	NGV 3.1	UN R110
ISO 16750-4	SAE J1344	

2.2 GM Standards/Specifications.

GMW3059	GMW14234	GMW14665	GMW15862
GMW3116	GMW14264	GMW14872	GMW16331
GMW3172	GMW14386	GMW15272	GMW16807
GMW14089	GMW14573	GMW15570	GMW17759

2.3 Additional References.

- CG5505: Compressed Natural Gas (CNG) Oil Separator Statement of Requirements (SOR) Appendix G3 Validation Cross Reference Index (VCRI)
- Global Supplier Quality Manual (GM1927)
- GM Part Number 9986467

3 Requirements

3.1 System/Subsystem/Component/Part Definition. The oil separator receives fuel from the pressure regulator at fuel rail working pressure. Its main function is to remove and collect compressor oil in CNG fuel due to contamination at CNG refueling stations. The oil collected shall be drained at every second engine oil change interval at minimum. The targeted fuel rail inlet pressure may vary on demand in a defined pressure range to support the necessary fuel mass flow according to CNG fuel injection requirements.

3.1.1 Appearance. The oil separator appearance shall blend in to the surrounding vehicle structure in the place where mounted. For detailed information, refer to the program specific documents.

3.1.2 Content.

3.1.2.1 Physical Content. The CNG oil separator shall consist of the following physical content:

- Inlet to receive fuel from the pressure regulator.

- Mechanism to remove the compressor oil from CNG fuel. This mechanism can be cyclone separation, coalescing filtration or a combination of both.
- Storage to collect and trap the compressor oil.
- Outlet to deliver fuel to the fuel rail.
- Mounting system to secure the oil separator to the supporting bracket.

3.1.2.2 Functional Content. The CNG oil separator shall:

- remove the compressor oil in the CNG fuel upstream of the CNG fuel rail.
- collect and trap the compressor oil to prevent the oil re-entering the CNG fuel.
- have sufficient storage capacity for the oil collected to meet appropriate engine oil change interval.
- have design provision to drain the oil collected at the appropriate service interval.
- be equipped with a mounting provision for oil separator fixation to vehicle.
- manage all generated noise below target level.
- not induce excessive flow restriction for CNG fuel flow.

3.1.3 Ambient Environment. See applicable requirements stated GMW17759.

3.1.4 Interfaces.

3.1.4.1 CNG Fuel Inlet/Outlet Connections. Provision is required for ferrule style connection between the oil separator and fuel line or adaptor. The connection shall be designed to accept the CNG fuel pipe size chosen by the program. Common pipe sizes are 6 mm, 8 mm, or 3/8" in diameter. See program specific requirements for pipe sizing, connection design details, and adaptor requirements.

3.1.4.2 Structural Mounting Connections. Provision is required to secure the oil separator to the vehicle. Minimum two (2) fixation points are required to accept M6x1x15 screws for oil separator attachment.

3.1.4.3 Compressor Oil Sump Connections. Provision is required to allow drainage of the compressor oil accumulated inside the oil separator during vehicle operation.

3.1.5 Usage Definition. The oil separator shall support and meet vehicle usage for design life of 15 years. The oil separator shall not degrade in performance when subjected to the total duty cycles (no < 75 000 key cycles) in the expected lifetime per vehicle marketing region. See additional duty cycle requirements in program specific document if the vehicle is equipped with engine start/stop function.

3.2 Product Characteristics.

3.2.1 Performance Requirements. The oil separator shall meet all the applicable legal standards and certified to common industry standards of the region of sale. All requirements apply to the conditions specified in 3.1.3 thru 3.1.5, except where noted otherwise. Special vehicle, operational, or ambient conditions may be identified in the performance requirements paragraphs.

3.2.1.1 Compressor Oil Removal Efficiency. The oil separator shall have compressor oil removal efficiency > 85% by weight at the fuel rail working pressure range and mass flow rate, as defined by the program. A reasonable assumption is 100 ppm of compressor oil contamination in CNG fuel. The oil separator shall be able to deliver CNG fuel with < 15 PPM of oil contamination to the fuel rail downstream.

Use 3.2.1.1.1 to 3.2.1.1.5 to evaluate compressor oil removal efficiency.

3.2.1.1.1 Measure the weight of oil separator before testing.

3.2.1.1.2 Condition oil separator, compressor oil and related test setup in the flow stream to 80 °C.

3.2.1.1.3 Introduce air to oil separator inlet at 5 bar pressure level and use a control valve downstream of the oil separator to regulate air mass flow rate. The inlet and outlet of the oil separator should be connected to piping no shorter than 300 mm in length in order to prevent any flow interruption during the test. See Figure 1 for test set up illustration.

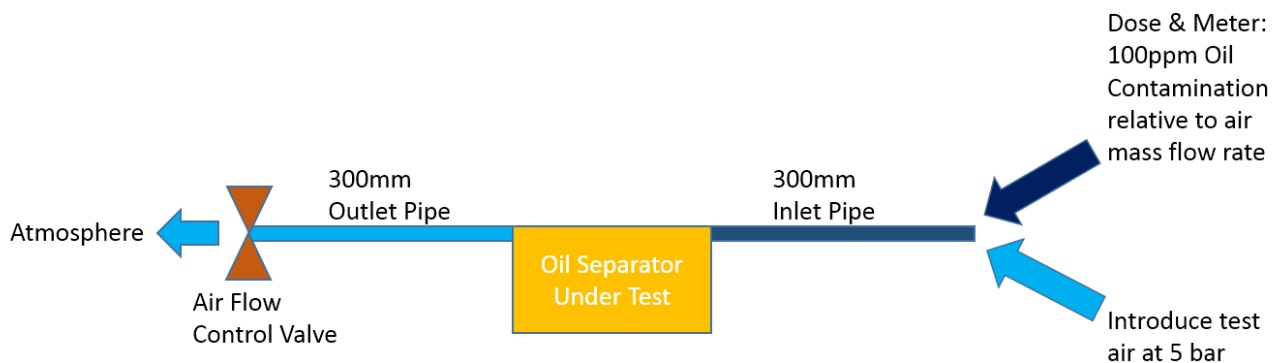


Figure 1: Oil Separator Efficiency Test Illustration

3.2.1.1.4 Dose and meter the compressor oil at 100 ppm into air stream upstream of the oil separator continuously; and run the test at 80 °C. Measure the weight of oil separator post testing for each test run.

3.2.1.1.5 Complete the test matrix in Table 1 and compute oil removal efficiency for each test run to demonstrate oil removal efficiency > 85% for all mass flow rates.

Table 1: Oil Removal Efficiency Test Matrix

Air Mass Flow Rate (kg/h)	Test Time (h)
2	30
10	6
30	2
50	1
70 only for truck application	1

3.2.1.2 Maximum Fuel Mass Flow. At the gas temperature 80 °C, the oil separator shall be able to provide a mass flow as follows within the fuel rail operating pressure range.

- For Car applications: 50 kg/h, or as directed by program specific requirement.
- For Truck applications: 70 kg/h, or as directed by program specific requirement.

3.2.1.3 Maximum Fuel Flow Restriction. The oil separator shall not have fuel flow restrictions > 1% of maximum fuel rail operating pressure at the mass flow rates stated in 3.2.1.2.

3.2.1.4 Compressor Oil Storage Capacity. The compressor oil storage capacity within the oil separator shall be sufficiently large to support compressor oil drainage at every second engine oil change interval.

- For Car application: 54 ml capacity required or as directed by program specific requirement.
- For Truck application: 108 ml capacity required or as directed by program specific requirement.

3.2.1.5 Compressor Oil Drainage. No unique tool is required to drain the compressor oil. Oil drainage shall be performed in the vehicle without disconnecting the oil separate from the CNG fuel line at its inlet and outlet or dismounting the oil separator from its structural attachment in vehicle.

3.2.1.6 External Leakage Tightness (100% Methane, 0 °C).

- Over total service life: 5×10^{-5} mbar $\times$ l/s.