

## QUALITY OF THE LNG DELIVERED AND OF THE GAS REDELIVERED

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## 1) QUALITY OF THE LNG DELIVERED

The qualitative characteristics of the LNG delivered by the Users shall be those identified by means of the analysis carried out at the Panigaglia Terminal using the methods, procedures and instruments for measuring quality in use at the Terminal itself.

The quality characteristics of the LNG delivered to the Delivery Point must comply with the quality specifications set out below.

### 1.1) Determining the Quality of the LNG Unloaded

The LNG quality is determined at the Terminal using its own instrumentation system. The procedure is based on determining the average composition of the LNG, obtained by means of:

- a) LNG sampling;
- b) Gas chromatographic analysis;
- c) Calculations based on the average composition of each LNG component (HHV, molar volume, molecular weight).

### 1.2) Quality Specifications at the Delivery Point

The LNG delivered by the User to the Panigaglia Terminal must meet the following specifications:

#### HHV components

Component	Acceptance values	Unit of measurement
Methane	(*)	
Ethane	(*)	
Propane	(*)	
Iso-butane	(*)	
Normal butane	(*)	
Hexanes and higher	(*)	
Nitrogen	(*)	
Oxygen	≤ 0.6	%mol
Carbon dioxide	≤ 2,5	%mol

(\*) Acceptance values for these components are inherently limited by the acceptability range of the Wobbe index

#### Trace compounds

Parameters	Acceptance values	Unit of measurement
Hydrogen sulphide	≤ 5	mg/Sm <sup>3</sup>
Mercaptan sulphur	≤ 6	mg/Sm <sup>3</sup>

Total sulphur	≤20	mg/Sm <sup>3</sup>
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Physical properties

Properties	Acceptance values	Unit of measurement
Gross Heating Value	38.18 ÷ 43.18 MJ/Sm <sup>3</sup>	MJ / Sm <sup>3</sup>
Wobbe Index	47.31 ÷ 52.13 MJ/Sm <sup>3</sup>	MJ / Sm <sup>3</sup>
Adjustment of the Wobbe Index <sup>(1)</sup>	52.13 ÷ 53.17 MJ/Sm <sup>3</sup>	MJ / Sm <sup>3</sup>
LNG Density	430 ÷ 470 kg/m <sup>3</sup>	kg/m <sup>3</sup>

(1) Interval of use of the adjustment systems present at the Terminal

Please refer to the specific procedure published on GNL Italia's website to address situations in which quality data for the LNG delivered by the User is unavailable.

### 1.3) Mixing of the LNG in the Tanks

The Parties agree that, taking into account the technical issues arising from mixing, in the Terminal's storage tanks, quantities of LNG with different densities, pursuant to the Notice of the Ministry of Industry, Commerce and Handicrafts of 11 February 1975 prot. 616026, if quantities of LNG are delivered to the Operator at the Delivery Point with densities that differ by over  $\pm 25$  kg/Sm<sup>3</sup> from the density of the Liquefied Natural Gas present in the Terminal's storage tanks at the time of unloading, the Operator is entitled to delay the unloading of such LNG quantities at the Terminal, except for the provisions of the "Receiving, storage and regasification of the LNG" chapter of this document.

If this circumstance arises, the Operator shall notify the User of the estimated delay that will be incurred at least 24 hours prior to the arrival date of the Carrier.

## 2) QUALITY AND PRESSURE OF THE GAS INJECTED INTO THE NETWORK

The qualitative characteristics of the gas injected into the Snam Rete Gas network are the result of the analyses carried out at the Panigaglia Terminal using the methods, procedures and instruments for measuring quality in use at the Terminal itself.

The regasified LNG injected into the network by GNL Italia shall meet the quality and pressure specifications for gas entering the Snam Rete Gas network – as specified in the Network Code – provided that the LNG delivered by the User complies with the specifications at the Delivery Point, as described above.

GNL Italia, owner of the transport capacity at the Entry Point to the National Network interconnected with the Terminal under Article 8(1) of Resolution No. 137/02, respects the quality specifications contained in the Network Code pursuant to the provisions of

Article 8(1) of Annex A of Resolution No. 185/05, which prohibits injecting off-specification gas into the National Network, or gas that meets specifications but contains quantities of elements not normally present in the natural gas that could harm the Users, so as to be able to redeliver the gas to Users at the Redelivery Point.

However, should any of the aforementioned scenarios occur, GNL Italia, in accordance with article 19(1) of Annex A of Resolution No. 185/05, must provide prompt written notice to Snam Rete Gas and to the User(s) concerned.

## 2.1) Overview

Checks on gas quality are performed according to the methods and frequencies indicated below. The quality of the natural gas injected into the network at the redelivery flange at the Panigaglia Terminal is continuously monitored by two "mono-stream" gas chromatographs connected to the SVC (Supervisory Computer System) of the measurement system, as well as by a third gas chromatograph with similar functionality that works with the other two using a "2 out of 3" logic, interrupting the supply if two instruments out of three report an off-specification condition (in relation to the Wobbe Index value) of the gas.

The three gas chromatographs mentioned above are installed in a special pressurized gas-quality control room along with other "multi-stream" gas chromatographs which are normally dedicated to the analysis of other gas flows coming from the process, but which can analyse the composition of the final gas if the instruments specifically intended for that purpose are all simultaneously unavailable.

Natural gas that has been vaporised from LNG is virtually free of sulphur compounds. This is the result of a combination of the following factors:

- 1) the process for liquefying natural gas is always preceded by a gas supply processing phase designed to remove all the components of the mixture which may solidify at typical liquefaction cryogenic temperatures (-162°C) from the natural gas stream (in particular H<sub>2</sub>O (dehydration) and CO<sub>2</sub> (decarbonation)), or at least reduce the concentration thereof to a level that does not determine precipitation phenomena or problems of fouling and clogging in subsequent processes. These compounds include branched and cyclic hydrocarbons and, if present in the gas field, hydrogen sulphide and other sulphur compounds;
- 2) the regasification process has no possible source of input of sulphur compounds.

As far as water and hydrocarbon dew points are concerned, the liquefied natural gas unloaded at the Panigaglia Terminal is well below the network limits as a result of the treatments carried out at the loading ports, briefly outlined in point 1).

In the light of the above, the sulphur compounds and water and hydrocarbon dew points are determined in discontinuous manner, and according to the procedures and frequency set out below.

The quality shall be determined on the basis of the chemical and physical characteristics described in the following paragraphs.

#### Molar composition

Chemical composition in % mol.

- Methane (C1)
- Ethane (C2)
- Propane (C3)
- Iso-Butane (i-C4)
- n-Butane (n-C4)
- Iso-Pentane (i-C5)
- n-pentane (n-C5)
- Hexanes and higher hydrocarbons (C6 +)
- Nitrogen (N2)
- Carbon dioxide (CO2)
- Helium (He)
- Oxygen (O2)

Sulphur compounds in mg/Sm<sup>3</sup>. The following compounds are determined:

- Hydrogen sulphide (H2S)
- Mercaptan sulphur (S-RSH)
- Total sulphur (S TOT)

#### Temperature

The temperature of the LNG delivered, expressed in degrees Celsius.

#### Relative density

The relative density of the gas-air ratio is defined as the ratio of gas and air densities at reference conditions (Rhos air = 1.22541 kg/Sm<sup>3</sup>).

#### Density

The Density (Rhos), expressed in Kg/Sm<sup>3</sup>, is calculated on the basis of chemical composition in accordance with standard ISO 6976.

#### Determination of the HHV

The Higher Heating Value (HHV), expressed in kJ/Sm<sup>3</sup> is calculated on the basis of chemical composition per the ISO 6976 standard (most recent version), considering the ideal values of the components specified in that standard (reference conditions: m<sup>3</sup> 15 °C, combustion 15 °C).

#### Wobbe Index

The Wobbe Index (WI) is expressed in kJ/Sm<sup>3</sup> and is calculated using the following formula:  $WI = HHV / \sqrt{rd}$ .

#### Water dew point

The dew point of water at delivery pressures of 70 bar, expressed in °C.

Hydrocarbon dew point

The dew point of hydrocarbons in the pressure range 1-70 bar, expressed in °C.

**2.2) Analysis methods**

The chemical and physical characteristics set out in section 2.1.1 are determined continuously by means of suitable measurement equipment installed in the measurement station, or discontinuously by means of gas sampling in a cylinder that is subsequently analysed in the laboratory.

In continuo

The Operator and Snam Rete Gas shall agree in advance on the type of equipment to be used for continuous analysis, the accessories required for its operation and the action plans for routine maintenance thereof.

The gas sample to be analysed shall be sampled by means of a suitable probe installed at a representative point of the delivered gas line, along the centreline of the pipeline or at a point at least one third into the diameter of the upper or lower route.

Discontinuous

Instantaneous sampling shall be carried out at the frequencies set out in accordance with ISO method 10715/97 or GPA 2166. At the time of sampling, the report must be prepared and the results of the laboratory determinations must be reported in the Quality Certificate.

Analysis of Hydrogen Sulphide

The Panigaglia Terminal has a H<sub>2</sub>S analysis instrument that continuously monitors the final gas.

Sulphur compounds (total sulphur and mercaptan sulphur)

The sulphur compounds, identified in paragraph 2.1.1 shall be determined discontinuously by laboratory analyses, according to the ASTM D5504 method or another method agreed between the Parties or between the Network Manager and the Operator.

This determination shall be made each time the continuous analysis produced by the H<sub>2</sub>S analyser gives concentration values that are greater than 1 mg/Sm<sup>3</sup>, or at least once a year.

**2.3) Quality specifications at the Network Insertion Point**

The regasified LNG injected into the network by the Operator meets the quality specifications for insertion of gas into the National Network, as specified in the Network Code.

HHV components:

Component	Acceptance values	Unit of measurement
Methane	(*)	
Ethane	(*)	
Propane	(*)	
Iso-butane	(*)	
Normal butane	(*)	
Hexanes and higher	(*)	
Nitrogen	(*)	
Oxygen	≤ 0.6	%mol
Carbon dioxide	≤ 2,5	%mol

(\*) Acceptance values for these components are inherently limited by the acceptability range of the Wobbe index

Trace compounds

Parameters	Acceptance values	Unit of measurement
Hydrogen sulphide	≤ 5	mg/Sm <sup>3</sup>
Mercaptan sulphur(*)	≤ 6	mg/Sm <sup>3</sup>
Total sulphur(*)	≤ 20	mg/Sm <sup>3</sup>

(\*) Excluding sulfur from odorizer

Physical properties

Properties	Acceptance values	Unit of measurement	Conditions
Gross Heating Value	34.95 ÷ 45.28	MJ / Sm <sup>3</sup>	
Wobbe Index	47.31 ÷ 52.33	MJ / Sm <sup>3</sup>	
Relative density	0.555 ÷ 0.7		
Water dew point	≤ -5	°C	At a relative pressure of 7000 kPa
Hydrocarbon dew point	≤ 0	°C	In the relative pressure range of 100 to 7000 kPa
Max temperature	< 50	°C	
Min temperature	> 3	°C	

### 3) CHECKS TO DETERMINE THE QUALITY OF THE LNG DELIVERED

Normally every 3 days, GNL Italia must check the calibration of the gas chromatographs used to analyse the quality of the LNG unloaded from the LNG Carriers.

Should the User request further checks of the entire system to determine the quality parameters of the LNG delivered, GNL Italia shall implement such requests for additional checks.

#### 4) CHECKS TO DETERMINE THE QUALITY OF THE GAS INJECTED INTO THE NETWORK

##### 4.1) Instrument checks

All of the measurement equipment must be periodically calibrated and checked to ensure correct measurement within the maximum specified accuracy limits.

If an error that exceeds the allowed limits is identified while performing such checks and calibrations, all necessary actions shall be taken to eliminate the error.

If it is not possible to restore proper operation of the equipment, it must be replaced.

The results of the checks and calibration must be reported in specific reports, dated and signed by the tester and by representatives of Snam Rete Gas and of the Operator. Periodic calibration must also be performed on any equipment that is temporarily out of service.

The samples and cylinders used for calibration must be certified by SIT (Italian Calibration Service) accredited laboratories.

##### 4.2) Automatic checks on the consistency of the data processed by the SVC

The variable data measured by field instruments and the processed data must be continuously checked by the SVC (Supervisory Computer System).

The SVC compares the density values produced by the two gas chromatographs, and compares them to the data obtained from the reference hydrometer.

If the difference between the densities measured by the two gas chromatographs and between these values and that of the reference hydrometer exceeds acceptable limits, an asterisk is added next to the density value "Gas Quality Daily Report" for which the exception was identified.

If such limits are exceeded – with regard to pressure, temperature and flow rate – the SVC will indicate an anomaly and report it on the alarms printer. If the anomaly does not affect the determination of the volume, no report will be noted on the daily quantity report; an asterisk will be printed next to the parameter if it exceeds the limit.