APPROVED
By order No 1-67 of the
director general of AB Amber
Grid of 30 December 2014

METHODOLOGY FOR DETERMINING THE FIXED GAS QUALITY PARAMETER VALUES APPLIED FOR CONVERSION (RECALCULATION) OF MEASURED VOLUMES OF GAS

1. This methodology was developed in accordance with the following regulations and standard reference documents:
   - *Natural gas quality requirements* approved by order No 1-194 of the Minister of Energy of the Republic of Lithuania of 4 October 2013;
   - *Description of natural gas metering procedure*, approved by order No 1-245 of 27 December 2013 of the Minister of Energy of the Republic of Lithuania (version of order No 1-255 of the Minister of Energy of the Republic of Lithuania of 14 October 2014);
   - LST EN ISO 12213-3 "Natural gas. Calculation of compression factor. Part 3. Calculation using physical properties";
   - LST EN 12405-1:2005+A2:2011 "Gas meters. Conversion devices. Part 1. Volume conversion";
   - LST EN ISO 13443:2005 "Natural gas. Standard reference conditions (ISO 13443:1996, including Corrigendum 1:1997*).

   The methodology implements the requirements of paragraph 61, part 2 of the *Description of natural gas metering procedure*. It is applicable in measuring the volume of gas in no more than 6 bar excess gas pressure.
2. In accordance with the provisions of *Description of natural gas metering procedure* the fixed values of gas density (ρ), relative density (d), nitrogen (N_2), carbon dioxide (CO_2) and the upper calorific value (H_s) may be used for conversion (recalculation) of measured natural gas volume under operating conditions to the volume under standard reference conditions, when gas measurement systems are installed in no more than 6 bar excess gas pressure. These parameters can be used in the calculation of the gas compressibility factors Z_n and Z, converting the gas volume to the standard reference conditions, according to the following formula:

$$V_n = V \times \frac{P}{P_n} \times \frac{t_n + 273.15}{t + 273.15} \times \frac{Z_n}{Z} \qquad (1)$$

Where:

V_n -- volume of gas under standard reference conditions;

V – gas volume measured with a gas meter under operating conditions;

P –operating gas pressure (absolute);

P_n –standard reference gas pressure (absolute); (1.01325 bar);

t_n – standard reference temperature (0^oC);

t – gas temperature;
Z_n – gas compressibility factor under standard reference conditions, where $t_n = 0^oC$, o P_n = 1.01325 bar;
Z – gas compressibility factor under operating conditions.

Gas compressibility factor is the is the ratio of the molar volume of a gas to the molar volume of an ideal gas at the same temperature and pressure calculated in accordance with the equation of the ideal gas:

$$P \times V_m = R \times T \quad (2)$$

Where:
P – the pressure of the gas;
V_m – the volume of one mole of the gas;
R – the ideal gas constant;
T – temperature of gas.

Real gas does not follow the equition of the ideal gas. In case of real gas, this equation must be adjusted as follows:

$$P \times V_m = Z(T, P) \times R \times T \quad (3)$$

Where:
Z(T, P) – variable, referred to as the gas compressibility factor.

The gas compressibility factors Z_n and Z are calculated in electronic gas volume collectors or flow computers automatically, according to the requirements of the standard LST EN ISO 12213-3.

3. In order to reduce the gas volume conversion error within the limit of tolerance (0.3%), when measuring gas volume in no more than 6 bar excess gas pressure conditions, it is necessary to enter the values of the gas density (ρ) or relative density (d), nitrogen (N_2), carbon dioxide (CO_2) and the upper calorific value (H_s), as close as possible to their real values at the time of measurement. For this purpose:

   - The natural gas transmission system of AB Amber Grid is divided into two zones – **Vilnius** and **Panevėžys** – considering that gas will be more often supplied to the Panevėžys zone via Klaipėda liquefied natural gas terminal (LNGT) and gas will be more often supplied to Vilnius zone from Russia, via the Kotlovka border gas metering station (GMS);

   - Zone boundaries are determined to maximize the likelihood that the gas quality parameters will change little in them;

   - Following the zoning principle described above, and in accordance with the localisation of gas analyzers (chromatographs) in the gas transmission system specified in the *Description of natural gas metering procedure*, the following gas analyzers are attributed to the zones:

- Vilnius zone – flow gas chromatographs installed in Vilnius, Elektrėnai, Jonava, Kaunas-1 regulation and metering stations (R&M S) and Šakiai GMS;

- Panevėžys zone – flow gas chromatographs installed in Panevėžys–2, Šiauliai, Rietavas (R&M S) and Klaipėda GMS.

- In accordance with the *Description of natural gas metering procedure*, the (R&M S) and GMS assigned to respective gas analyzers and zones are listed in the table below:

Regulation and metering stations (R&M S)	**Zone**
Alytus, Anykščiai, A. Paneriai-1, A. Paneriai-2, Baltoji Vokė, Batniava, Birštonas, Butrimonys, Elektrėnai, Girininkai, Grigiškės, Jašiūnai, Jonava, Kaišiadorys, Kaunas-1, Kaunas-2, Kėdainiai, Lekėčiai, Maišiagala, Marijampolė, Nemenčinė, Pabradė, Praviena, Prienai, Raguva, Rudamina, Šakiai, Šalčininkai, Širvintos, Švenčionėliai, Taujėnai, Ukmergė, Utena, Vandžiogala, Vievis, Vilkaviškis, Villon, Vilnius, Visaginas, Zapyškis, Žiežmariai	Vilnius
Alksnupiai, Biržai, Daugėlai, Gargždai, Gegužinė, Jurbarkas, Klaipėda-1 Klaipėda-2, Kretinga, Kužiai, Mažeikiai, Miežiškiai, , Naujoji Akmenė, Pajiešmeniai, Pakruojis, Palanga, Panevėžys -1, Panevėžys-2, Šiauliai, Papilė, Pasvalys, Piniava, Plungė, Radviliškis, Rietavas, Telšiai.	Panevėžys

- The gas quality parameter values for each zone are determined as the annual average of relevant parameters measured by flow gas chromatographs installed in that zone. For the first quarter of 2015, the parameter values are determined as the average data in December 2014. For the II, III and IV quarters of 2015, the parameter values are determined as the average data of the first quarter of 2015.

4. Every year, the gas quality parameters received form the chromatographs and approved by AB Amber Grid are published on the Internet website of AB Amber Grid for each zone, according to the table below:

Fixed gas quality parameter values
Vilnius / Panevėžys zone

No	Parameter	Marking	Value	Measurement unit
1	Nitrogen	N_2		% mole
2	Carbon dioxide	CO_2		% mole
3	Upper calorific value*	HS		kWh/m^3
4	Gas density	ρ		kg/m^3
5	Relative gas density	d		-

Comments: **Gas calorific values are specified at combustion temperature of +25 °C, measurement temperature 0 °C and pressure of 101.325 bar.*

5. Gas volume correctors or flow computers installed at the (R&M S) or GMS of the relevant zone are normally configured at the time of its metrological verification and, if necessary, more often, using the data published on the Internet website of AB Amber Grid for the relevant zone.