



Apartment Heating Supply of Apartment Houses

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Abstract. This article describes the need to limit the height of apartment buildings at apartment heating.

1. Introduction

The developers have been given the task of building 120 million square meters of housing per year. In large cities, with the possibility of connecting to central heating networks, issues of heating and hot water are being addressed. But if there is a need to reduce the cost of square meter it is necessary to choose an apartment heating.

Issues of apartment heating are continuously discussed by the professional community. There is no consensus. The main disagreements arise around the following issues:

1. Limit the number of stories in a building for the use of gas stoves.
2. Limit the number of stories (and / or the number of apartments) for the use of gas boilers for heating and hot water supply.

On the first issue in the SNiPs of the USSR, there was a restriction on the use of gas stoves with a building height of up to nine stories. This requirement arose from the fire services in connection with a height limit for ladders to evacuate people in case of fire, since a house with gas stoves is a source of increased danger. Later, this restriction disappeared from the Code of Practice. Adoption of SP 402.1325800.2018 “Residential buildings. Rules for the design of gas consumption systems” returned the specified limitation, limiting the use of gas stoves in buildings up to 28 meters (i.e., up to nine stories). According to the authors, they had to withstand the strongest pressure of the opponents of this restriction and only the examination of the Ministry of Emergencies helped to defend the demand. But this requirement applies only to gas stoves, not including water heaters and boilers.

In 2017, the SP 282.1325800.2016 “Energy supply apartment of the buildings with the heat generation, working on gas fuel. Design rules and devices” was enacted [1–4]. The design rules for apartment-based heat supply systems on gas heat generators with a capacity of 50, 100 and more kW are set out. There are no restrictions on height and the number of apartments! One can see such decisions in many countries: Azerbaijan, Turkey, Italy, etc. But these are countries with milder climates, the power of heat generators is lower there and the outside temperature allows one to place the heat generator on the balcony in buildings up to 5 stories.

Proponents of this decision have their own arguments:

- the possibility of individual heat and hot water consumption metering system;
- decrease in reduce the cost of square meter of the housing, that is a matter of argument.

The problem of ensuring uninterrupted and safety operation is also very difficult. In addition to the appearance of 432 coaxial chimneys protruding on the facade or 24 vertical chimneys attached to the facade; 432 boilers requiring operation and maintenance (for example, for a four-door three-section 9-story building - 432 apartments) [5–8].

We decided to consider this issue from the point of view of ensuring the reliability of the operation of heat generators according to the gas pressure parameter in front of the boiler. Most of the heat generators used today for uninterrupted operation requires a minimum inlet pressure of 1200 Pa. Low pressure network up to 5000 Pa (actually in practice up to 3500 Pa decreasing in frosts). Next, we will carry out hydraulic calculations to determine the diameters of gas pipelines and pressure losses under various conditions.

The calculations are based on the methodology of SP 42-101-2003 “The general provision and construction gas distribution system from steel and polyethylene pipes”. The following options are considered:

- 1) number of stories of a typical building: 4, 9, 12, 16;
- 2) consumers: Gas four-burner stove / gas four-burner stove and gas boiler;
- 3) calculation method:
 - based on the allowable pressure loss of the home gas pipeline, the diameter in this case was taken according to the calculated value;
 - based on the experience of designing gas consumption systems, in this case the maximum permissible diameter at the access of the building was set (no more than 100 mm).

2. Methods.

The objects of study are several options for apartment houses: four-story, nine-story, twelve-story and sixteen-story buildings. In each building options two methods of gas distribution and gas consumption systems were used: the use of only a four-burner stove in the kitchen, and the joint use of a gas stove with heating and hot water systems, carried out by a double-circuit boiler. In this study, two principal methods of selecting diameters and calculating pressure losses are used.

1. The calculation is based on the allowable pressure loss in low pressure pipelines, thereby the diameter of the pipeline is not limiting.

2. The calculation is carried out based on the design experience; thereby the maximum allowable size of the gas pipeline is setting at the exit from the house.

A double-circuit boiler “Buderus Logamax U072-18” was selected due to the calculation of heat losses in the apartment of the building and due to the averaged calculation of the load on the hot water supply system.

3. Results and discussions.

The estimated costs for each section are determined by the sum of the nominal gas consumption by devices taking into account the coefficient of simultaneity of their work

$$Q_{p,i} = \sum_1^n k_s N_i, m^3/h. \quad (1)$$

where n is the number of appliances in the apartment;

k_s is a simultaneity coefficient, it is determined according to Table 5 of SP 42-01-2003;

Q_{nom} is the nominal gas consumption of appliances, m^3/h ;

N is the number of simultaneous operation of similar devices.

The nominal gas flow rate of the device is taken according to the passport data or technical characteristics of the devices:

- 1) for a four-burner stove:

$$Q_p^{21-20} = 1 \cdot 1.25 \cdot 1 = 1.25 m^3/h;$$

- 2) for a four-burner stove and a boiler:

$$Q_p^{20-19} = 1 \cdot 1.82 \cdot 1 + 1.25 = 3.07 m^3/h.$$

The selection of diameters is carried out from experience and the correspondence of the total pressure losses to the available pressure. In case of non-compliance, recounting and new selection of individual sections are carried out. We carry out the calculation for a steel gas pipeline of a low pressure network. Data is accepted according to SP 42.101.2003.

$$d_d = m^1 \sqrt{\frac{ABp_0 Q_0^m}{\Delta P_s}},$$

where d_d is a design diameter, cm;

A, B, m, m^1 are coefficients determined according to Tables 6 and 7 depending on the category of the network (pressure) and the material of the pipeline;

Q_0 is an estimated gas flow, m^3/h , under normal conditions;

ΔP_s is specific pressure loss (Pa/m – for low pressure networks, MPa/m – for medium and high pressure networks);

$$\Delta P_s = \frac{\Delta P_a}{1.1L},$$

ΔP_a is an acceptable pressure loss (Pa/m – for low pressure networks, MPa/m – for medium and high pressure networks);

L is a distance to the farthest point, m.

$$\Delta P_s = 600/(1.1\Delta L) \text{ Pa/m [for configuration with a stove];}$$

$$\Delta P_s = 1800/(1.1\Delta L) \text{ Pa/m [for configuration with a stove and a boiler].}$$

$$P_s = 600/170.14 = 3.21 \text{ Pa/m;}$$

$$d_d = 5 \sqrt{\frac{626 \cdot 0.022 \cdot 0.75 \cdot 1.25}{3.21}} = 1.374 \text{ cm} = 13.74 \text{ mm} \Rightarrow d_d = 1.37.$$

Then we make a selection of diameters for sections of the gas pipeline according to assortment.

The lengths of the plots are determined by the story-plan and by the scheme.

These values are given for calculation based on pressure loss. The diameter in this case was taken from the calculated values.

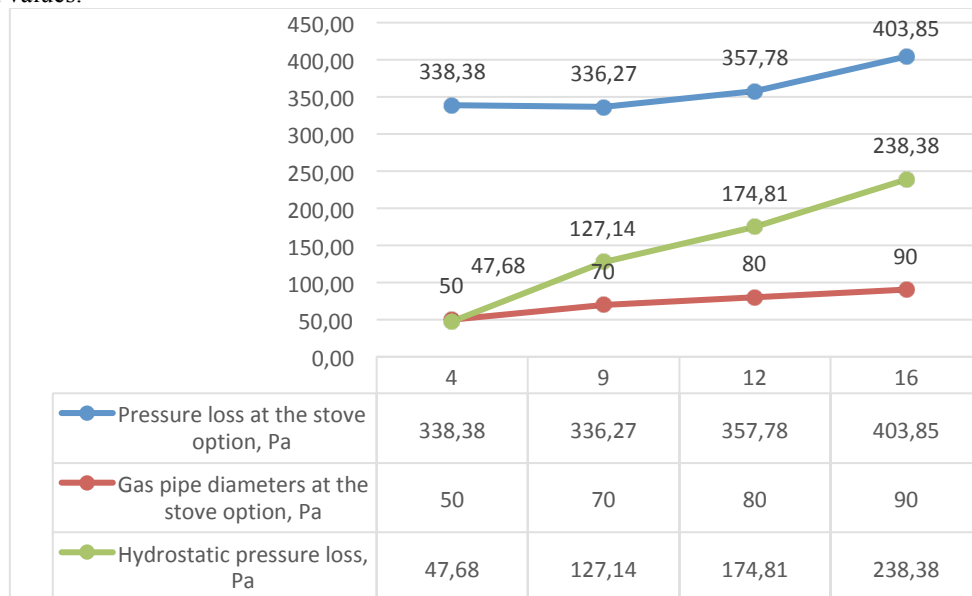


Figure 1. Graph of pressure loss depending on the diameter of the gas pipeline for a consumer-stove option
 Figures 1, 2 show graphs of the dependence of various options.

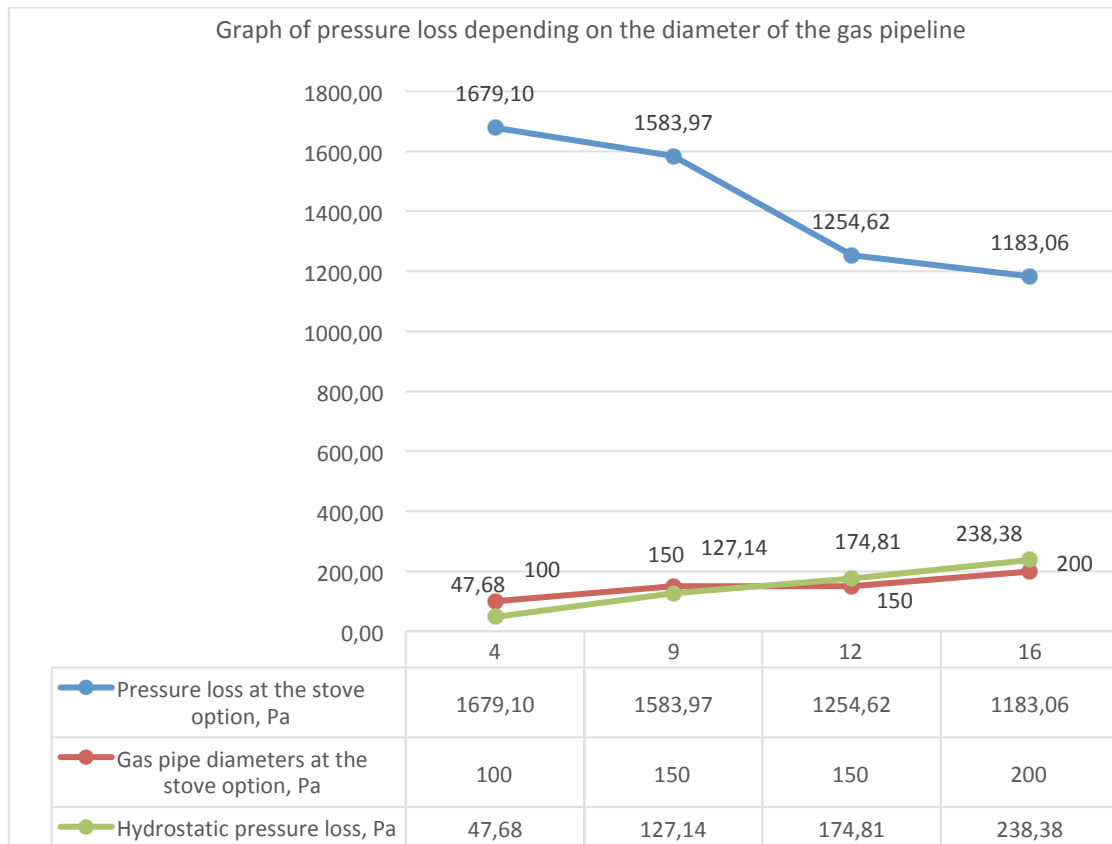


Figure 2. Graphs of the dependence for a consumer-stove-boiler option

Next, we give the values for determining diameters and pressure losses based on design experience. The diameters at the exit of the house were not accepted more than 100 mm. The curve for the consumer-stove option remained unchanged, therefore, we are considering consumption-stove-boiler option (Figure 3).

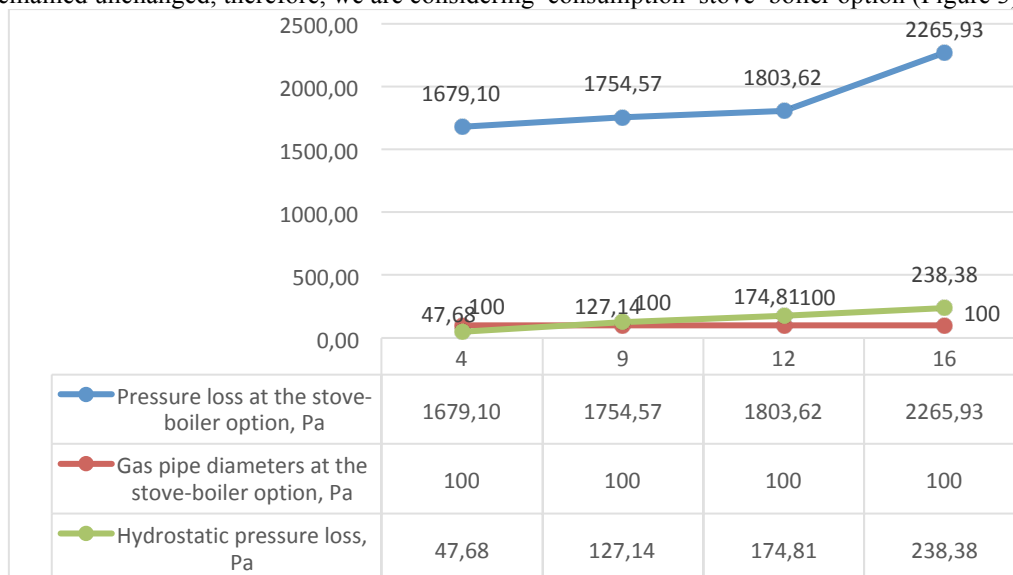


Figure 3. The graph of pressure loss while limiting the diameter of the pipeline, for the consumer-stove-boiler option

The obtained values are summarized in graphs (Figures 4, 5).

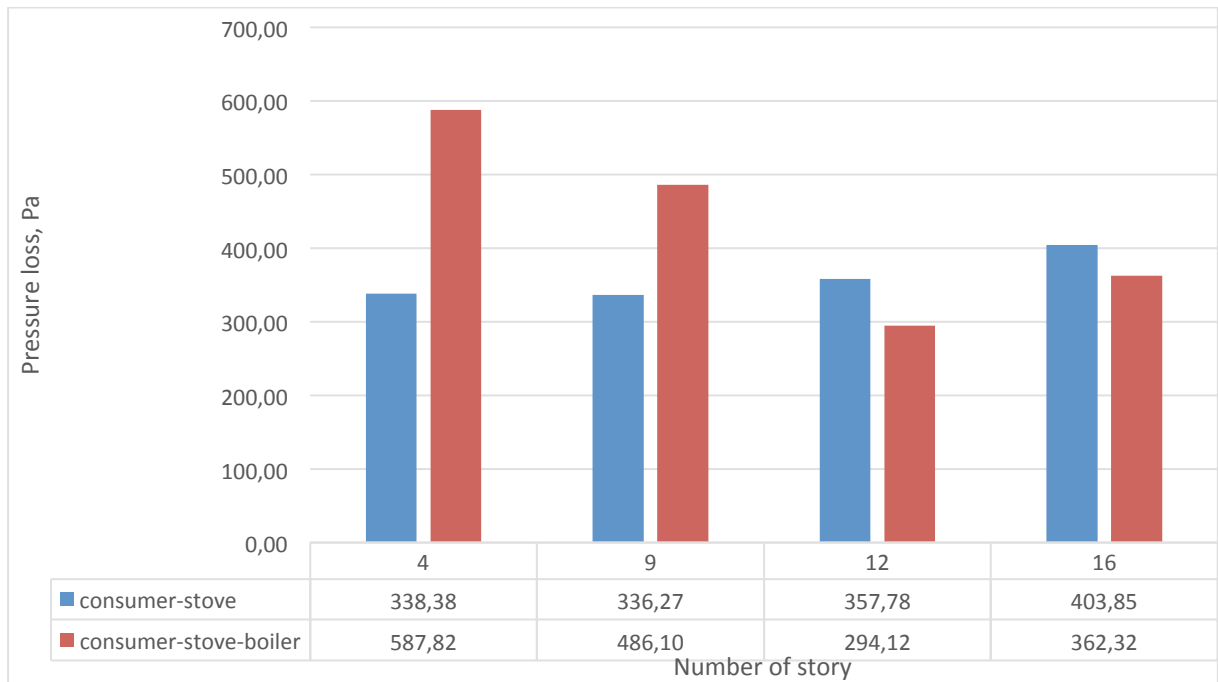


Figure 4. Schedule of pressure loss at the different number of stories in buildings taking into account allowable pressure loss



Figure 5. Schedule of pressure loss at the different number of stories in buildings taking into account design experience

Summary graphs of final diameters at the entrance to the house are given in Figures 6, 7.

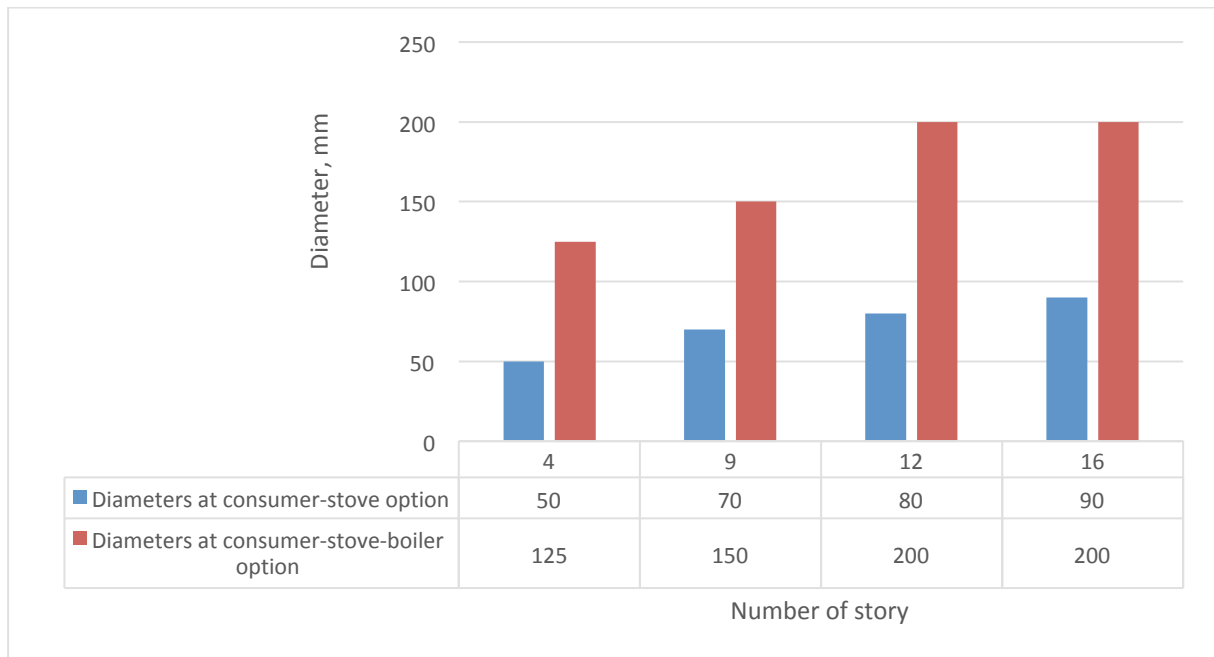


Figure 6. Diagram of diameters at the different number of stories in buildings taking into account allowable pressure loss

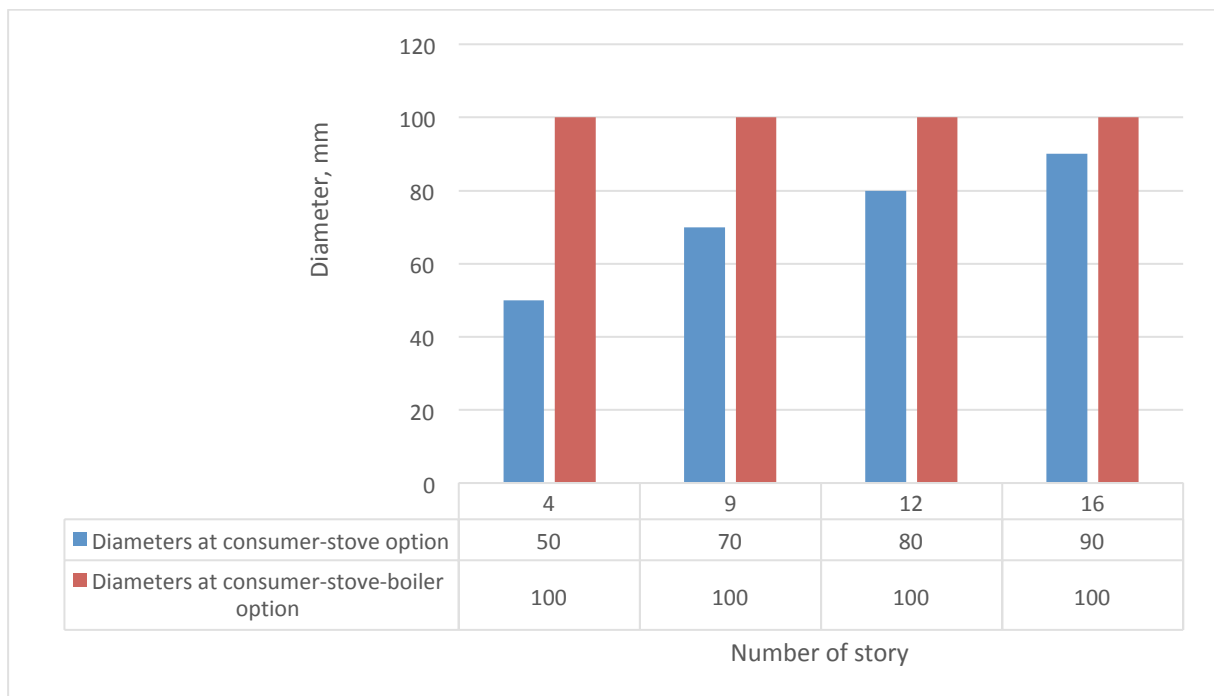


Figure 7. Diagram of diameters at the different number of stories in buildings taking into account design experience

4. Conclusions.

From the above results, the following conclusions can be drawn:

1. To ensure the uninterrupted operation of the heat generator, installation of gas risers with a diameter of 200 mm is required.
2. Uninterrupted operation of the heat generator cannot be guaranteed at smaller diameters.

3. With a diameter of 200 mm, there will be three or more cubic meters of gas in one riser, which in case of fire will create a large explosion and fire hazard.

There is also another option for supplying medium-pressure gas pipelines to each building and placing main distribution pipes at the gas inlet to the building. This decision contradicts the safety intra-quarter gas distribution networks of low pressure from hydraulic fracturing adopted in the USSR and used in Russia.

Many specialists discussed the issue of using apartment heating. They agree that it is necessary to limit the use of apartment heating for multi-apartment buildings. It can be used for private housing, townhouses and residential three- and four-stories buildings. In other cases, to ensure reliable and safe operation, it is necessary to design roof, annexed, and intra-boiler rooms for heating and hot water supply.

References

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- [2] SP 282.1325800.2016 “Energy supply apartment of the buildings with the heat generation, working on gas fuel. Design rules and devices” (Moscow)
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