

INDUSTRIAL GAS INSTALLATIONS FOR NATURAL GAS - SPECIFIC FEATURES AND TECHNICAL SURVEILLANCE**Sabev P.***Bachelor of Engineering**1574 Sofia, Bulgaria**128 "Geo Milev" Str.*<https://doi.org/10.5281/zenodo.13788507>**Abstract**

In the scientific article, a classification of the types of industrial gas installations for natural gas and their elements is made, and the main requirements for them are indicated. All the requirements of the current regulatory documents have been considered, both in terms of their technical condition and for the performance of their technical surveillance. An assessment was made of the relevance of the current regulatory requirements in relation to the currently used technologies, technical equipment and elements of industrial gas installations.

Possibilities for optimizing the processes of carrying out the technical supervision of industrial gas installations.

A new approach to the practical performance of supervised activities is presented, as a way to introduce unified methodologies and procedures for technical supervision of industrial gas installations for natural gas.

Keywords: Industrial gas installations, industrial gas installations for natural gas, technical surveillance of gas installations, technical surveillance, ordinance on Device and Safe Operation of transmission and distribution gas pipelines and of natural gas equipment, installations and appliances

1. Classification of types of industrial gas installations for natural gas

The industrial gas plant for natural gas is a set of elements, assemblies and units connected to each other with pipelines and intended for transportation, regulation and, in certain cases, measurement of the specified fluid. This type of gas installations is used to supply natural gas to consumers who are different in terms of quantity consumed, pressure level and method of use.

The industrial gas installation may include both an above-ground and an underground part.

Individual units representing components of the general installation should also be considered as a constituent part of the industrial gas installation, namely:

- gas pipelines between separate industrial buildings in one plant;
- internal gas pipelines in individual industrial buildings in one plant;
- gas regulating installations
- gas measuring installations;

According to the Ordinance on the device and safe operation of transmission and distribution gas pipelines and facilities, installations and appliances for natural gas, industrial gas installations are classified depending on the working pressure they use into the following types:

- installations with working pressure up to 0,01 MPa;
- installations with a working pressure of 0,01 MPa to 0,2 MPa;
- installations with a working pressure of 0,2 MPa to 0,5 MPa;
- installations with a working pressure of 0,5 MPa to 1,6 MPa;
- installations with working pressure above 1,6 MPa.

The classification indicated in the aforementioned Ordinance provides a guiding framework, which, in relation to modern realities and current needs, far from exhausting the possibilities for a more comprehensive

and applicable classification of industrial gas installations. In support of this statement, in addition to the way specified in the Ordinance, a classification of these installations could be carried out in relation to the way of using natural gas, in which case the industrial gas installations can be classified in the following way:

- Installations for supplying fan burners that burn the fuel in equipment with closed combustion chambers and used to heat water or air;
- Installations for supplying fan burners that burn the fuel in equipment with closed combustion chambers and used to heat only air;
- Installations for powering gas appliances burning the fuel in facilities with open combustion chambers;
- Installations for powering gas appliances used in the implementation of technological processes;
- Installations for powering gas appliances for cooling/freezing.

2. Elements of industrial gas installations for natural gas

The main elements of industrial gas installations are:

- pipes - made of metal and polyethylene;
- measuring devices - manometers, thermometers, etc.;
- regulating devices - pressure regulators;
- stabilizing devices - pressure stabilizers;
- filtering devices - filters for natural gas;
- connecting fittings - fittings, gas hoses, etc.;
- gas measuring devices - gas flow meters;
- safety equipment - safety-discharge valves;
- shut-off valves;
- gas appliances.

3. Requirements for the elements of industrial gas installations for natural gas

The construction of the schematic solution for placing the necessary elements and devices in the industrial gas installation is different for each specific

case. Determining the choice of the optimal solution is the satisfaction of the set conditions for operation and guaranteeing safety during work.

The pipes from which the above-ground and exposed parts of the industrial gas installation are built must be metal, and the connection between them should be by welding or brazing. It is possible to use other pipes specified for natural gas at a certain pressure and accompanied by the relevant certificates and declarations of conformity for this.

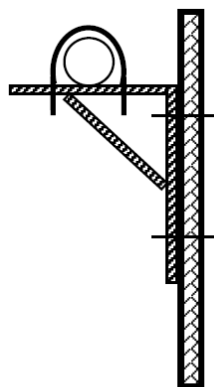


Figure 1. Suspension "cantilever"

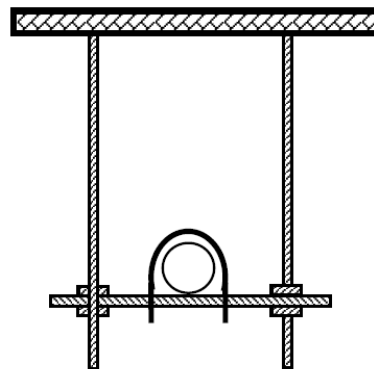


Figure 2. Suspension type "pendant"

In cases where a part of the industrial gas pipeline must be executed underground, high-density polyethylene pipes can be used in this section, and when the gas pipeline goes from underground to above ground, appropriate transitions of the "polyethylene-metal" type should be used, accompanied by a relevant certificate and declaration of conformity.

When constructing an underground gas pipeline with metal pipes, it must be protected from corrosion by anti-corrosion coating and active electrochemical protection (cathodic protection). The passage of gas

pipelines through foundations, walls and floors of buildings is carried out in a protective jacket, and the space between the protective jacket and the gas pipeline must be filled with an insulating and corrosion-resistant material. The protective casing is generally made of a sufficiently strong tube of gas- and corrosion-resistant material.

The remaining elements of the industrial gas installation are located in the gas regulation points (Figure 3).

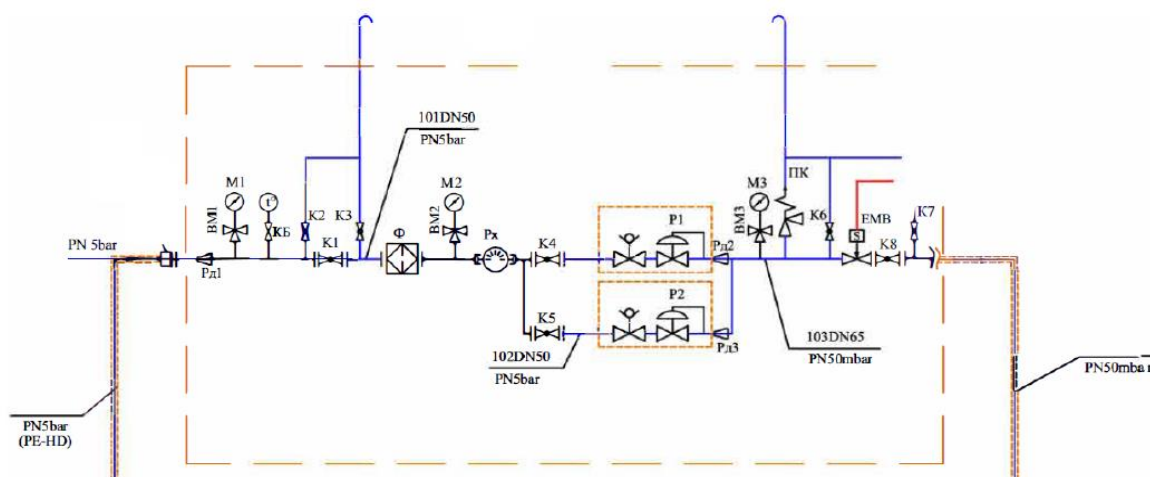


Figure 3

The gas regulator unit is a facility for changing the pressure of natural gas in order to satisfy the requirements of the consumer or consumers using natural gas to ensure normal operating conditions related to work and technological processes. In the general case, the change of this pressure is expressed in its lowering to reach the set input pressure levels of the end devices

(consumers). Industrial gas systems are usually supplied by the municipal distribution network, which maintains a pressure of 0.5 MPa. But in settlements where there is no distribution network or in those where there is, but the owner of the industrial enterprise wants to build his own site with the cylinder groups with compressed natural gas located on it, it is possible for the

industrial gas installation to be supplied before the gas regulation unit with pressure significantly higher than 0.5 MPa.

The gas regulating units are installed with the following equipment:

- manual shut-off valve;
- filter - must be installed immediately after the manual shut-off valve in a way that provides easy access for cleaning;
- safety shut-off valve - is installed in front of the pressure regulator or is structurally built into it. In the case of a gas regulating unit with an inlet pressure of up to 0.01 MPa, installation of a shut-off valve is not required;
- pressure regulator to automatically reduce and maintain pressure after it;
- safety-discharge valve, which is installed after the regulator in the direction of gas flow, and the exhaust pipeline after the safety-discharge valve is sized with a nominal diameter of more than 15 mm, but not smaller than the diameter of the safety-discharge valve, and is led in the atmosphere of a safe place. It is important to note that it is inadmissible to combine exhaust gas pipelines with different gas pressures in them. These valves are subject to annual inspection and, if necessary, adjustment. They represent one of the most important elements guaranteeing the safety of the gas installation. According to the current regulation, these valves can be checked and adjusted by persons holding a permit for repair, conversion and maintenance of gas equipment and installations, but it is not clearly and precisely described what requirements the stand with which these persons should meet should be available to carry out the relevant inspection and/or adjustment of the relief valves. Clearly, there are opportunities here to improve outcomes and increase safety. To achieve this goal, a unified scheme of the test bench must be created, which is generally applicable and required for all persons performing this type of activity.
- exhaust valve, which is installed on the low pressure side of the gas and serves to purge and degas the installation. This faucet and the piping on which it is installed must have an internal diameter greater than 15 mm.

In the construction of an industrial gas installation, it is permissible to use detachable joints, but only in the places of installation of the fittings, control and measuring devices and gas devices. Only gaskets made of non-hardening materials can be used for threaded joints, and these joints can be used in the following cases:

- at a pressure of up to 0.01 MPa and a nominal diameter of up to 80 mm;
- at a pressure of up to 0.5 MPa and a nominal diameter of up to 50 mm.

For pipelines with a diameter greater than 42 mm, the use of mechanical joints is not allowed.

The shut-off valve for an industrial gas installation must provide the necessary conditions for operation and correspond to the pressure and temperature of the natural gas in the facility or installation. It can be made of steel, non-ferrous metals or alloys. Stop valve made of polyethylene is allowed only for polyethylene gas pipelines. Cast iron fittings can also be used, including

ductile iron, but only in places that are not subject to vibrations or other mechanical loads.

Depending on the pressure level before the gas regulating unit and what is required to be achieved after it, two main types of circuit solutions can be used:

- single-level (single-stage)
- two-level (two-stage)

The single-level scheme is convenient and applicable when we have a feeding village distribution network. In this case, a regulator is used to reduce the pressure, after which the necessary level is usually achieved to satisfy the parameters of the final consumer of natural gas. To further guarantee stability and smooth out the reduced pressure, a stabilizer can be used, which is installed immediately before the connection to the final consumer (burner, infrared gas heater, etc.). This scheme could be successfully applied in cases where the pressure needs to be reduced from the cylinder groups for compressed natural gas.

The two-stage scheme is applied in cases where power supply is used from a cylinder group storing compressed natural gas. Since the pressure of the gas in the bottle group is 20 MPa (200 bar), it should be reduced to 0.01 MPa (100 mbar) in order to be admitted to the inlet of the final consumer performing the relevant work function to achieve the specified industrial and technological process. Very often, when developing this type of scheme, a rather cumbersome technical solution is used, which involves the inclusion of two pressure regulators in order to reduce it to two stages:

- first lowering step – from 200 bar to 5 bar
- second lowering step – from 5 bar to 100 mbar.

On the face of it, this solution seems much more streamlined and leads to a smooth decrease in pressure. In fact, however, if an analysis is made of the behavior of a system using two regulation steps, respectively two regulators, it can be seen that the risk of the system entering a failure state increases. This condition is twice as likely to occur compared to the one-stage schematic solution. The only and important problem that needs to be solved with the two-stage depressurization is that at higher flow rates, the need for more energy-intensive preheating systems arises, because the risk of freezing of the pipeline increases when the consumption increases. Therefore, in the design and construction of industrial gas installations with natural gas flow rates required by the final or final consumers and exceeding 100 Hm³/h, a well-sized natural gas heating system should be provided.

Currently, the current regulatory framework does not sufficiently reflect the modern trends and achievements of technologies in gas installations for natural gas, although for the most part the regulations provide the basic parameters and regulations according to which the relevant activities are carried out. The large scope of the Ordinance, including even the regulation of technical supervision, leads to difficulties in the use by the persons guided in their activities by this regulatory document. In our opinion, it is necessary to change the philosophy when drawing up the ordinance related to these installations in order to be able to meet modern requirements. It must give clear and precise rules and adequate requirements for the device, installation, safe

operation, repair and reconstruction of gas equipment and installations and in the specific case of an industrial gas installation. With such a philosophy of building the regulatory framework, technical supervision should be separated into a separate regulation, thus creating a clear and correct documentary base that will be useful to all persons involved in its implementation in their daily activities.

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